Fraunhofer

Energy-Using Product Group Analysis - Lot 5

Machine tools and related machinery

Task 2 Report – Economic and Market Analysis

Sustainable Industrial Policy - Building on the Ecodesign Directive - Energy-using Product Group Analysis/2

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Executive Summary – Task 2

The machine tools market is subject to huge fluctuations, depending on economic cycles. Due to the long lifetime the stock (installed base) of machine tools shows much less fluctuation than the sales figures. PRODCOM figures were subject to an extensive plausibility check and revisions accordingly with the support of associations CECIMO (and member associations), EPTA and EWA in particular. Whereas EuroStat states a production volume of nearly 600.000 metal working machine tools for 2009, our plausibility check unveils, that a figure of **216.000 metal working machine tools** falling under the definition provided in task 1 is a much more likely figure. Similarly for wood working machinery instead of 3.4 million units sold production as stated by EuroStat for wood working machine tools a more reasonable figure according to the plausibility check by Fraunhofer is **130.000 units,** sold production in 2009 for larger machinery, which overlaps with a market of **220.000 light stationary wood working tools** (sales within EU 27). The market of **welding, soldering, and brazing equipment** covers roughly **1.400.000 units** sold EU production, falling under the definition provided above.

A stock model for the major market segments covered by the definition of “machine tools” set up by Fraunhofer and cross-checked by industry representatives indicates that currently in the EU 27 there are in operation

- 3,5 million metal working machine tools, thereof 750.000 CNC machine tools
- 5,8 million wood working machine tools, thereof 1,4 million larger stationary machinery
- 7,1 million units of welding, soldering and brazing equipment, thereof 1,5 million stationary units

Due to the long lifetime of the stationary machine tools the stock remains very stable for wood working machine tools and no major changes are to be expected regarding the installed base in the mid-term future. The metal working machine tools market sees an ongoing shift from non-CNC machine tools to CNC: In 2025 a total stock of 2.8 million metal working machine tools is forecasted, thereof 800.000 CNC machine tools with an increasing complexity and functionality.

The Life Cycle Cost model for machine tools is subject to the broad variety of machine tools and the fact, that many more factors than only purchase price, consumables and spare parts play a role. Actually, running costs over the lifetime in almost all cases

seem to be higher than initial investment, costs for electricity and (where applicable) consumables are very relevant, but even more maintenance costs.

Reflecting the regions where machine tools are most prominently used, size of companies using them and regional electricity costs, roughly the “typical” electricity price for use of metal working machine tools is 0,11 Euro/kWh, for wood working machine tools 0,14 Euro/kWh, but which a broad spread across EU-27.

Total sales volume for EU-27 for mineral oil based non-water miscible and water miscible cooling lubricants was roughly 800 million Euros in 2008, indicating the high economic relevancy of coolants.

The value of tools, work holders and spare parts in total for EU 27 production in 2008 was 7,6 billion Euros, compared to a sales volume (sold production) of 26,4 billion Euros for machine tools in the same year.

2 Task 2 – Economic and Market Analysis

The objective of task 2 is the assessment of trade and sales volumes for machine tools within the EU-27. A clear picture of the product stock available on the EU market should be provided and its growth and replacement rate be forecasted. Insight in the latest market trends so as to indicate the place of possible ecodesign measures in the context of the market structures and ongoing trends in product design should be given. A practical data set of prices and rates to be used in a Life Cycle Cost (LCC) calculation should be provided.

The economic analysis is structured according to the distinctions made in Task 1:

- Metal working machine tools,
- Wood working machine tools,
- Welding, soldering and brazing equipment, and
- Other machine tools.

For "related machinery" no dedicated analysis is provided in this task, as potentially a large variety from numerous sub-sectors falls under "related machinery". As a robust market analysis for all kind of industrial equipment is not feasible due to time and resource constraints, the effects of later findings on "related machinery" will be estimated on a case-by-case basis where relevant.

2.1 Generic economic data

2.1.1 Metal working machine tools

The machine tools market is an explicitly cyclical market, making any predictions for future developments a challenge. Figure 2-1 depicts the the machine tool production in the 15 CECIMO member countries[1] since 1980, showing a downturn nearly every ten years. Due to the economic crisis a sharp decline in production volume by 30% is stated for 2009. From the 2009 figures different scenarios are possible:

- Taking the 2009 figures into account, the average annual growth rate since 1980 is 1,4% per year. A conservative scenario is to extrapolate now from the

[1] Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Italy, The Netherlands, Portugal, Spain, Sweden, Switzerland, Turkey, UK

low 2009 level with a further growth rate of 1,4%. This scenario reflects a situation of a long term impact of the economic crisis on the European production industry and a shift of production to low cost countries.

- Excluding the 2009 crisis from the statistics results in a 3,0% average annual growth rate for the years 1980-2008. A possible scenario therefore is to extrapolate from the 2009 level with such a 3,0% annual growth rate now for the coming years until 2025. This scenario reflects a situation, where the economic crisis has got a long term impact, but coming from a low level the EU sees steady economic growth.
- An optimistic scenario is as follows: The machine tools market sees a rapid recovery from the current status – and as machine tools orders increase significantly again since 4th quarter 2009[2] this is not too unlikely to happen -, reaching the 2008 level again in 2012, followed by a 3, 0% average annual growth rates for the years thereafter, just as it was in the years 1980-2008. This scenario is based on the assumption that the European industry can compete with other regions on the globe and due to cutting edge technology remaining in Europe the economic industrial growth is stable in the EU.

Depending on which scenario is applied (and taking an extrapolation with average growth rates as a basis does not reflect the economic cycles at all), the production volume reached by 2020 might be 22.4 billion, 28.7 billion or even 36.1 billion Euros, i.e. with a spread of a factor of 1.5.

[2] CECIMO Statistical Toolbox - Updated: November 2010

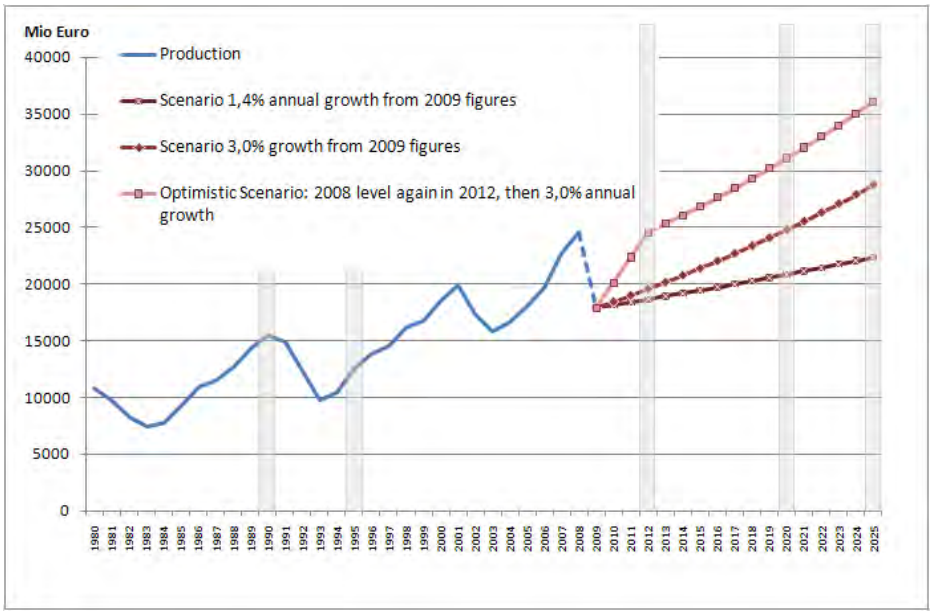

Figure 2-1: Machine tool production in CECIMO countries – totals 1980 - 2025[3]

This model with stable growth rates is a simplified one, due to the inherent dynamics of the machine tools industry: There is a phenomenon called "investment accelerator effect" which in particular is relevant for this industry, just as described by Kouvelis et al.[4]: “For machine tools, there is a fairly stable demand for replacement units, but when durable goods producers invest in anticipation of even a small surge in their demand, this often shows itself as a huge increase in the orders placed with machine tool manufacturers. For example, a plant may use 100 machine tools and replace 5% of them in a typical year. If this firm anticipates a 5% increase in sales, it may plan to buy 10 machine tools this period; 5 new and 5 replacements. Thus, a 5% surge in expected sales at one level becomes a 100% surge for the supplier. This is particularly problematic for machine tools because this pattern is correlated across the entire customer base.” This effect results in a high level of uncertainty for any prediction of future machine tools market developments. Same applies for the scenarios provided above.

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3 Years 1980-2008 based on CECIMO: Last trends in the European Machine Tool industry, http://www.cecimo.eu/index.php/machine-tools/dataastatistics/latesttrend.html, accessed December 17, 2010; 2009: EuroStat data for EU-27, scenarios 2009-2025: own assumptions by Fraunhofer

4 Kouvelis, P.; Chambers, C.; Wang, H.; Supply Chain Management Research and Production and Operations Management: Review, Trends, and Opportunities; Production and Operations Management, October 1, 2006

It should be noted, that the statistics and scenarios on machine tools production outlined above refer to the *economic value* of the market. As there is a trend towards highly integrated, high value machine tools the economic growth does not mean necessarily a growths in terms of units.

The World Machine Tool Output & Consumption Survey by Gardner Publications, Inc.[5] (see Table 2-1) shows global market shares of EU countries in terms of production of machine tools per country: Largest producer in 2010 was Japan, with a slightly higher production than Germany, followed by China, Italy being next. This ranking is confirmed when looking at cutting machine tools only (physicochemical processes, machining centres, lathes, grinding and polishing machines). Considering metals forming machine tools (e.g. presses and benches) Italy is the world market leader, followed by China, Germany, and Japan.

Table 2-1: Production of machine tools in US-$ per country (2010)

		2010 (est.)			2009 (rev.)	change in	change in
	Country	$-Millions	% Cut	% Form	% Form	local currency	U.S. dollars
1.	China, Peoples Rep.	19,980.0	73%	27%	15,300.0	$	31%
2.	Japan	11,841.7	89%	11%	7,007.0	59%	69%
3.	Germany	9,749.9	70%	30%	10,800.1	-5,00%	-10%
4.	Italy	5,166.4	53%	47%	5,242.2	3%	-1%
5.	Korea, Rep. of	4,498.0	69%	31%	2,758.0	$	63%
6.	Taiwan	3,803.3	77%	23%	2,266.4	60%	68%
7.	Switzerland	2,185.4	84%	16%	2,164.5	-3%	1%
8.	United States	2,026.2	72%	28%	2,218.9	$	-9%
9.	Austria	908.9	64%	36%	897.4	6%	1%
10.	Spain	812.0	66%	34%	1,035.9	-18%	-22%
11.	Brazil	714.2	81%	19%	714.2	$	0%
12.	Turkey	555.0	26%	74%	441.3	26%	26%
13.	India	525.0	86%	14%	278.0	89%	89%
14.	France	503.4	70%	30%	557.6	-5%	-10%
15.	Czech Republic	475.6[6]			602.1		
16.	United Kingdom	471.0	72%	28%	438.4	9%	7%
17.	Canada	459.6	62%	38%	434.0	6%	6%
18.	The Netherlands	369.6	20%	80%	369.9	5%	0%
19.	Belgium	316.6	10%	90%	368.5	-10%	-14%
20.	Poland	295.4			326.8		
21.	Sweden	249.7	44%	56%	233.3	1%	7%
22.	Russia	239.7	59%	41%	229.3	0%	5%

[5] Gardner Publications, Inc.: 2010 World Machine Tool Output & Consumption Survey, http://www.gardnerweb.com/consump/survey.html, accessed: November 7, 2011; market shares calculated based on Gardner data

[6] Data by CECIMO

23.	Finland	151.0	10%	90%	153.0	4%	-1%
24.	Mexico	132.5	52%	48%	132.5	$	0%
25.	Australia	129.9	96%	4%	32.0	$	306%
26.	Denmark	76.8	40%	60%	80.6	0%	-5%
27.	Portugal	49.0	8%	92%	62.6	-18%	-22%
28.	Romania	34.7	71%	29%	36.4	0%	-5%
29.	Argentina	33.3	43%	57%	26.7	$	25%
	Total	66,753.9			55,207.6		21%

These market statistics indicate the importance of the European machine tool industry and specifically of Germany and Italy as main machine tool producing, but also using countries: Table 2-2 lists the consumption of metal working machine tools in the various countries, the EU-27 market being slightly larger than China[7].

Table 2-2: Consumption of machine tools in US-$ per country (2010)

	Country	US-$-Millions
1.	China, Peoples Rep.	27,280.0
2.	Germany	5,033.9
3.	Japan	4,445.3
4.	Korea, Rep. of	4,264.0
5.	Italy	2768,7
6.	United States	2,752.3
7.	India	1,740.0
8.	Taiwan	1,505.5
9.	Brazil	1,488.3
10.	Russia	1,246.0
11.	Mexico	1,012.6
12.	Turkey	834.0
13.	Switzerland	824.3
14.	Canada	783.2
15.	France	680.9
16.	Poland	545.8
17.	Spain	494.1
18.	Austria	487.9
19.	United Kingdom	401.5
20.	Netherlands	314.0
21.	Belgium	266.3
22.	Sweden	254.1
23.	Australia	250.8
24.	Romania	204.1
25.	Czech Republic	196.1
26.	Argentina	141.1
27.	Finland	98.0
28.	Portugal	96.7
29.	Denmark	82.1

[7] Gardner Publications, Inc.: 2010 World Machine Tool Output & Consumption Survey, http://www.gardnerweb.com/consump/survey.html, accessed: November 07, 2011

Looking at the production and consumption data for metal processing machine tools for the years 2001-2008 confirms the long-term dominating role of Germany and Italy in Europe for both, production and consumption of machine tools: Production in Germany and Italy since 2002 has been stable at nearly exactly 75% (+/- 1%) of the countries listed, share of consumption of these two countries ranges between 60 and 65% (see Figure 2-2). Germany consumes 41% of all metal working machine tools in the EU 27 (according to 2008 economic figures, Table 2-2).

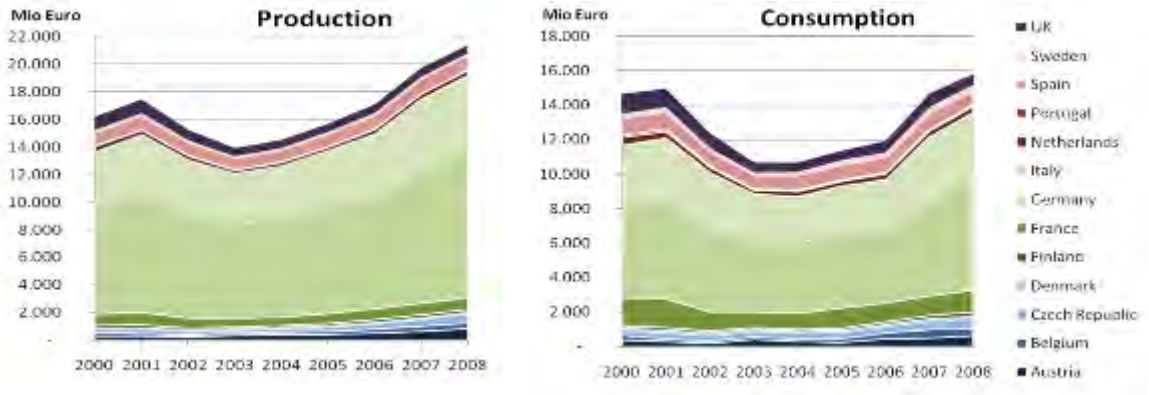

Figure 2-2: Machine tool production and consumption in CECIMO countries – per country 2000 - 2008[8]

Table 2-3: Update data for 2008 to 2011 by CECIMO

	2008	2009	2010	2011
Production (million EUR)	24425	16867	16638	21161
Apparent consumption (million EUR)	17798	10283	9719	n.a.

For the purpose of this study it is essential to provide market data in terms of units, not only economic values. The only publicly available database for such a market study is EuroStat. Fraunhofer analysed the EuroStat/PRODCOM data material in detail and applies a methodological approach to verify and consolidate EuroStat data. The methodology in detail is described in Annex I – Stock model methodology.

The revised PRODCOM 2009 production data for metal working machine tools is provided in Table 2-4. Those machine tools categories marked in red are dominated by CNC machine tools.

8 based on C ECIMO: Last trends in the European Machine Tool industry, http://www.cecimo.eu/index.php/machine-tools/dataastatistics/latesttrend.html, accessed March 11, 2010

Whereas EuroStat states a production volume of nearly 600.000 units for 2009, our plausibility check unveils, that a figure of 220.000 machine tools falling under the definition provided in task 1 is a much more likely figure.

For the UK, SKM Enviros cross-checked the plausibility-checked EU-27 sales figures against estimates for the UK, based on data provided by the Manufacturing Technologies Association (MTA). Total sales in the UK in 2009 according to these figures comprised 8.059 units, which corresponds to 3.5% of all EU-27 sales. SKM Enviros concluded: “In other industrial product areas, such as non-domestic electric motors, the UK market has traditionally been gauged at around 10% of the EU market; an equivalent comparison would suggest that the MTA estimation might be slightly low (or the Preparatory Study data is slightly high).”[9] This indicates that in turn our EU-27 figures still might be slightly overestimated.

[9] SKM Enviros: Estimating the Energy Saving Potential from Small Motors and Machine Tools, Report on Machine Tools Research & Modelling, 11 July 2011, p.15

Table 2-4: EU-27 Production of machine tools under PRODCOM 28.41 (2009, based on PRODCOM, plausibility checked by Fraunhofer)

PRODCOM Code 28.41...	Description	Volume (units) EU27 according to EuroStat	FRAUNHOFER Plausibility Check	Re-calculation rule	re-calculated EU27 Volume	re-calculated Value in THOUSANDS	re-calculated unit value	Re-calculation rule for a 2nd sub-category, where needed	re-calculated EU27 Volume (2nd catego-ry)	re-calculated Value in THOUSANDS (2nd catego-ry)	re-calculated unit value (2nd category)	TOTALS re-calculated EU27 Volume	TOTALS re-calculated Value in THOUSANDS	TOTALS re-calculated unit value
.1110	Machine-tools for working any material by removal of material, operated by laser or other light or photon beam processes	5,963	market intelligence indicates a higher unit value for typical industrial units	recalculat-ed with unit value 400 k Euro	1,178	471.180,789	400.000					1,178	471.180,789	400.000
.1130	Machine-tools for working any material by removal of material, operated by ultrasonic processes (excluding machines for the manufac-ture of semiconductor devices or of electronic integrated circuits)	0,637	seems to be plausible	no recalc.	0,637	31.004,422	48.673					0,637	31.004,422	48.673
.1150	Machine tools for working any material by removal of material, operated by electro-discharge processes	0,517	seems to be plausible	no recalc.	0,517	85.381,022	165.147					0,517	85.381,022	165.147
.1170	Machine-tools for working any material by removal of material, operated by electro-chemical, electron-beam, ionic-beam or plasma arc processes	2,946	seems to be plausible	no recalc.	2,946	113.375,640	38.485					2,946	113.375,640	38.485
.1180	Machine tools for working any material by removal of material, operated by ultrasonic processes, for the manufacture of semiconductor devices or of electronic integrated circuits	18,161	EU27 unit value of 1.600 Euro not plausible, but no country specific data accessible	rough estimate with 100.000 Euro unit value based on EU27 totals value	0,297	29.669,829	100.000					0,297	29.669,829	100.000
.1220	Horizontal machining centres for working metal	40,000	GER, F, I: 95% market share; remaining 5% market share not substantiated with unit volume	GER; F, I:	2,034	977.119,846	480.286					2,034	977.119,846	480.286
.1240	Vertical machining centres for working metal (including combined horizontal and vertical machining centres)	3,943	seems to be plausible	no recalc.	3,943	875.968,867	222.158					3,943	875.968,867	222.158
.1250	Unit construction machines (single station) for working metal	1,647	I (with major share in terms of units) @ 10.000 Euro unit value, others (including GER) > 100.000 Euro	I:	1,133	12.964,000	11.442	EU27 w/o I:	0,514	62.269,839	121.148	1,647	75.233,839	45.679
.1270	Multi-station transfer machines for working metal	1,550	seems to be plausible	no recalc.	1,550	771.951,499	498.033					1,550	771.951,499	498.033
.2123	Numerically controlled horizontal lathes, turning	20,000	EU27 unit value of 9.000 Euro	EU27	0,511	178.876,606	350.000					0,511	178.876,606	350.000

	centres, for removing metal		is not plausible; corrected GER data provided by VDW with unit value of 354.000 Euro	totals value divided by 350.000 Euro assumed unit value											
.2127	Numerically controlled horizontal lathes, automatic lathes, for removing metal (excluding turning centres)	2,525	seems to be plausible	no recalc.	2,525	432.386,856	171.242					2,525	432.386,856	171.242
.2129	Numerically controlled horizontal lathes, for removing metal (excluding turning centres, automatic lathes)	1,879	seems to be plausible	no recalc.	1,879	413.042,333	219.820					1,879	413.042,333	219.820
.2140	Non-numerically controlled horizontal lathes, for removing metal	5,990	seems to be plausible	no recalc.	5,990	143.325,496	23.927					5,990	143.325,496	23.927
.2160	Lathes, including turning centres, for removing metal (excluding horizontal lathes)	2,026	seems to be plausible	no recalc.	2,026	765.408,664	377.793					2,026	765.408,664	377.793
.2213	Numerically controlled drilling machines for working metal (excluding way-type unit head machines)	0,560	seems to be plausible	no recalc.	0,560	103.850,627	185.448					0,560	103.850,627	185.448
.2217	Numerically controlled knee-type milling machines for working metal (excluding boring-milling machines)	0,385	seems to be plausible despite a mis-match of EU27 unit value and median	no recalc.	0,385	84.980,847	220.729					0,385	84.980,847	220.729
.2223	Numerically controlled tool-milling machines for working metal (excluding boring-milling machines, knee-type machines)	22,021	value for GER corrected	no recalc.	2,538	475.751,005	187.451					2,538	475.751,005	187.451
.2225	Numerically controlled milling machines for working metal (including plano-milling machines) (excluding boring-milling machines, knee-type, tool-milling machines)	1,321	seems to be plausible, large variance, but all in the range of several 100.000 Euros unit value	no recalc.	1,321	518.450,002	392.468					1,321	518.450,002	392.468
.2233	Way-type unit heads for working metal by drilling, boring, milling, threading or tapping	9,760	Considered components											
.2235	Non-numerically controlled drilling machines for working metal (excluding way-type unit head machines)	9,720	unit values for most countries @ 2.000 - 7.000 Euro; industrial use questionable	no recalc.	9,720	44.770,133	4.606					9,720	44.770,133	4.606
.2240	Numerically controlled boring and boring-milling machines for working metal (excluding drilling machines)	0,778	seems to be plausible	no recalc.	0,778	488.636,573	628.068					0,778	488.636,573	628.068
.2260	Non-numerically controlled boring and boring-milling machines for working metal (excluding drilling machines)	0,338	units not disclosed for most important countries, but due to overall small number of units and high unit value it is unlikely, that a significant share of non-industrial equipment is covered	no recalc.	0,338	37.080,380	109.705					0,338	37.080,380	109.705
.2270	Non-numerically controlled milling machines for working metal (excluding boring-milling machines)	12,965	unit value I: 1.800 Euro; all others > 7.000 Euro	EU27 w/o I	4,716	53.029,715	11.245					4,716	53.029,715	11.245
.2280	Threading or tapping machines for working metal (excluding drilling machines)	16,349	unit value < 1.000 Euro	not relevant	-							-	-	0
.2305	Numerically controlled flat-surface grinding machines for working metal, in which the positioning in any one axis can be set up to a	1,061	UK unit value 30.000 Euro; GER, I: 175.000 and 290.000 Euro	UK:	0,432	13.153,523	30.448	EU27 w/o UK:	0,629	115.353,923	183.393	1,061	128.507,446	121.119

	minimum accuracy of 0.01mm													
.2315	Numerically controlled cylindrical surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	1,158	seems to be plausible	no recalc.	1,158	595.037,772	513.850					1,158	595.037,772	513.850
.2325	Other numerically controlled grinding machines in which the positioning in any one axis can be set up to accuracy >0.01mm	0,314	seems to be plausible	no recalc.	0,314	118.324,257	376.829					0,314	118.324,257	376.829
.2335	Non-numerically controlled flat-surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	3,220	ES unit value < 1.000 Euro	EU27 w/o ES	0,311	16.112,288	51.808					0,311	16.112,288	51.808
.2345	Non-numerically controlled cylindrical surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	0,600	only 40% of unit volume disclosed (uncertainty about the rest), but seems to be plausible general	no recalc.	0,600	34.840,718	58.068					0,600	34.840,718	58.068
.2355	Grinding machines for working metal; any one axis can be set to an accuracy >=0.01mm excluding flat-surface grinding machines, cylindrical surface grinding machines	4,200	GER, I 90% market share; UK: low unit values (3.800 Euro)	GER, I:	2,384	61.606,596	25.842					2,384	61.606,596	25.842
.2365	Numerically controlled sharpening (tool or cutter grinding) machines for working metal	4,704	unit value DK 3.900 Euro; GER: 35.000 Euro unit value @ 70% market share	EU27 w/o DK	2,699	105.905,985	39.239					2,699	105.905,985	39.239
.2375	Non-numerically controlled sharpening (tool or cutter grinding) machines for working metal	24,000	GER 60% market share @ 5.000 Euro unit value; I, UK 25% market share; large number of units not substantiated (obvious overestimate by EuroStat, or large number of parts/non-industrial equip-ment); even for GER, I, UK industrial use questionable	GER, I, UK:	5,243	25.892,492	4.938					5,243	25.892,492	4.938
.2385	Honing or lapping machines for working metal	12,999	market split GER, I 50:50, but unit value in GER: 500.000, I: 6.500 Euro (industrial use questionable)	GER:	0,213	106.708,612	500.979	I:	12,608	82.865,000	6.572	12,821	189.573,612	14.786
.2395	Machines for deburring or polishing metal (excluding gear finishing machines)	60,000	GER, ES, I are all far above median and EU27 unit value, but 90% market share; obvious-ly overestimates by EuroStat	GER, ES, I:	4,165	184.819,452	44.374					4,165	184.819,452	44.374
.2410	Broaching machines for working metal	6,000	GER close to 85% market share, but at rather high unit value compared to others; 99% of sold units not substantiated with disclosed data, most likely overestimate by EuroStat	GER:	0,067	29.364,057	438.270					0,067	29.364,057	438.270
.2430	Gear cutting, gear grinding or gear finishing machines, for working metals, metal carbides or cermets (excluding planing, slotting and broach-ing machines)	30,000	GER close to 95% market share, units provided by VDW	GER, I:	1,057	648.123,960	613.173					1,057	648.123,960	613.173
.2470	Sawing or cutting-off machines for working metal	45,000	unit value: I < 5.000 Euro, A ca.	CZ, DK,	6,043	202.163,497	33.454					6,043	202.163,497	33.454

			380.000 Euro; GER data provided by VDW	GER, A, P, FIN:										
.2490	Planing, shaping or slotting machines and other machine-tools working by removing metal or cermets, n.e.c.	0,657	market dominated by GER, F (both with high unit values) and I (unit value = median; signifi-cant unit volumes); "n.e.c." category = high level of uncertainty	GER, F:	0,083	29.166,659	353.287	I:	0,548	5.849,000	10.673	0,631	35.015,659	55.531
.3120	Numerically controlled bending, folding, straight-ening or flattening machines for working flat metal products (including presses)	6,146	huge differences regarding unit values, even among countries with large market share; 50% of unit volume not disclosed on country level; severe uncertain-ty, but EU27 unit value is plausible	no recalc.	6,146	740.826,950	120.538					6,146	740.826,950	120.538
.3140	Numerically controlled bending, folding, straight-ening or flattening machines for working metal (including presses) (excluding those for working flat metal products)	5,579	seems to be plausible	no recalc.	5,579	265.297,649	47.553					5,579	265.297,649	47.553
.3160	Non-numerically controlled bending, folding, straightening or flattening machines for working flat metal products (including presses)	12,000	GER, ES, I, FIN: 85% market share @ unit values 18.000 - 53.000 Euro; F, PL with relevant unit volumes, but unit value 4.000 Euro	GER, ES, I, FIN, BUL, CZ, DK, P:	5,676	203.540,780	35.860					5,676	203.540,780	35.860
.3180	Non-numerically controlled bending, folding, straightening or flattening machines for working metal (including presses) (excluding those for working flat metal products)	14,617	GER, I: market share 70% @ unit values 15-20.000 Euros, other countries: unit values < 5.000 Euro; UK: high unit value @ 320.000 Euro (but only 20 units)	GER, I, P, FIN:	4,827	78.041,565	16.168					4,827	78.041,565	16.168
.3220	Numerically controlled shearing machines for working metal (including presses) (excluding combined punching and shearing machines)	1,979	ES: unit value 850.000 Euro (40% market share); GER, I: 75.000/70.000 Euro unit value (50% market share)	ES:	0,084	71.698,091	853.549	EU27 w/o ES	1,895	113.316,383	59.798	1,979	185.014,474	93.489
.3240	Numerically controlled punching or notching machines for working metal (including presses, combined punching and shearing machines)	2,371	P: unit value 700 Euro; ES, SWE: rather low 30.000 Euro (NC!), others with unit values > 160.000 Euro	ES, SWE:	0,699	19.643,926	28.103	EU27 w/o ES, SWE, P	1,398	383.812,706	274.544	2,097	403.456,632	192.397
.3260	Non-numerically controlled shearing machines for working metal (including presses) (excluding combined punching and shearing machines)	11,589	PL: large unit volume @ unit value 250,- Euro	EU27 w/o PL:	10,457	234.296,871	22.406					10,457	234.296,871	22.406
.3280	Non-numerically controlled punching or notching machines for working metal (including presses, combined punching and shearing machines)	11,618	GER, ES, I: 90% market share, unit values 2.800 - 4.200 Euro; non-industrial use	not relevant	-							-	-	0
.3310	Numerically controlled forging or die-stamping machines and hammers for working metal (including presses)	1,971	GER 65% market share (with only 47 units); units for other relevant countries not disclosed	GER:	0,047	170.182,721	3.620.909	EU27 w/o GER; based on median value	0,295	93.915,002	318.063	0,342	264.097,723	771.602
.3320	Non-numerically controlled forging or die-stamping machines and hammers for working metal (including presses)	5,200	GER, I: 93% market share @ large unit values (320.000 / 620.000 Euro); others: few 1.000 Euro unit values	GER, I:	0,290	121.685,302	419.604					0,290	121.685,302	419.604

.3350	Hydraulic presses for working metal	11,156	GER, (F), I, SWE: 95% market share @ unit values 150.000 - 300.000 Euro; ES: large unit volume @ 5.000 Euro unit value	GER, F, I, SWE:	2,506	520.343,538	207.611					2,506	520.343,538	207.611
.3360	Non-hydraulic presses for working metal	42,000	GER, I close to 90% market share @ unit values 14.000-17.000 Euro	GER, I:	24,131	393.611,839	16.311					24,131	393.611,839	16.311
.3410	Draw-benches for bars, tubes, profiles, wire or the like of metal, sintered metal carbides or cermets	0,759	seems to be plausible	no recalc.	0,759	152.152,137	200.464					0,759	152.152,137	200.464
.3430	Thread rolling machines for working metal, sintered metal carbides or cermets	0,228	seems to be plausible	no recalc.	0,228	18.900,000	82.895					0,228	18.900,000	82.895
.3450	Machines for working wire (excluding draw-benches, thread rolling machines)	20,000	GER, I: market share 90% @ unit values 41.000 - 65.000 Euro;	GER, I:	6,734	330.734,905	49.114					6,734	330.734,905	49.114
.3470	Riveting machines, swaging machines and spinning lathes for working metal, machines for manufacturing flexible tubes of spiral metal strip and electro-magnetic pulse metal forming machines, and other machine tools for working metal without removing metal	75,843	D, I 75% market share @ 10.000 Euro unit value; DK large unit volume @ low unit values; other countries comparable to GER, I; uncer-tainty: F 10% market share, but no unit volume	EU27 w/o DK	57,865	605.502,272	10.464					57,865	605.502,272	10.464
.4030	Parts and accessories for metal cutting machine tools (excluding tool holders and self-opening dieheads, work holders, dividing heads and other special attachments for machine-tools)													
	Totals 28.41	**598,950**										**216,206**	**14.063.265,418**	**65.046**

2.1.2 Wood working machine tools

The market of **wood working machinery** saw a major drop in sales figures in 2009: VDMA states for the German market a 42% decrease in turnover for 2009 compared to 2008[10]. However, from quarter to quarter, most significantly in the 4th quarter there was a tendency towards a recovery of the market, so a further drop is unlikely. Actually, manufacturers expect for 2010 a growth rate of 10 to 15% compared to the low 2009 level. It is worthwhile noticing, that the 2009 drop in revenue was less dramatic on the domestic market (Germany in this case), as major customers are crafts enterprises, which are less affected by the global crisis, partly even benefit from infrastructure investment programmes.

Table 2-5 lists the verified 2009 PRODCOM production figures for wood working machine tools anticipated to fall under the definition outlined in Task 1. For details of the methodology see 3 Annex I – Stock model methodology. The approach followed here was discussed with VDMA and EPTA, but figures as such were not verified by VDMA and ACIMALL.

10 Press release: VDMA Holzbearbeitungsmaschinen: Umsatzeinbruch von 42 Prozent, Frankfurt am Main, February 17, 2010

Table 2-5: EU-27 Production of machine tools under PRODCOM 28.49 (2009, based on PRODCOM, plausibility checked by Fraunhofer, wood working only)

PRODCOM Code 28.49...	Description	Volume (units) EU27 according to EuroStat	FRAUNHOFER Plausibility Check	Re-calculation rule	re-calculated EU27 Volume	re-calculated Value in THOUSANDS	re-calculated unit value	Re-calculation rule for a 2nd sub-category, where needed	re-calculated EU27 Volume (2nd catego-ry)	re-calculated Value in THOUSANDS (2nd catego-ry)	re-calculated unit value (2nd category)	TOTALS re-calculated EU27 Volume	TOTALS re-calculated Value in THOUSANDS	TOTALS re-calculated unit value
.1210	Multi-purpose machines where the workpiece is manually transferred between operations, for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	15,438	GER, ES, I, A: 90% market share; but at large variation of unit prices (A: 10.000, ES: 82.000); others with lower unit values	GER, ES, I, A:	5,270	90.791,003	17.228					5,270	90.791,003	17.228
.1220	Multi-purpose machines where the workpiece is automatically transferred between operations for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	9,858	unit value for all market dominating countries @ 38.000 - 160.000 Euro	no recalc.	9,858	484.977,240	49.196					9,858	484.977,240	49.196
.1233	Band saws for working wood, cork, bone and hard rubber, hard plastics or similar hard materials	2.000,000	figure not substantiated by figures of individual countries: GER, ES, F, I, P with 80% market share @ 4.000+ Euro unit value (I only slightly above 4.000); no unit volume for PL (10% market share)	GER, ES, F, I, P:	7,858	62.525,401	7.957					7,858	62.525,401	7.957
.1235	Circular saws for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	39,677	ES, F, A, FIN unit values @ 20.000-160.000 Euro (25% market share); D + I @ < 6.000 Euro unit value (70% market share)	ES, F, A, FIN:	0,852	54.420,268	63.847					0,852	54.420,268	63.847
.1237	Sawing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials (excluding band saws, circular saws)	300,000	GER close to 40% market share, but no unit volume (confiden-tial) for 2009; 2008 unit value GER: 1850 Euro (GER 2009 volume recalculated with 1850 Euro); I, A, FIN, SWE comprise another 50% market share with plausible volume. 300.000 units by far over-estimated	I, A, FIN, SWE	3,532	70.300,928	19.904	GER:	26,051	48.193,566	1.850	29,583	118.494,494	4.006
.1250	Planing, milling or moulding (by cutting) ma-chines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	39,889	GER, ES, P unit values > 20.000 Euro (60% market share); I (+ PL) < 3.000 Euro (25% market share) - considered non-industrial use; FIN 7% market share with 21 units @ 1,7 mio each	GER, ES, P	3,568	168.041,369	47.097					3,568	168.041,369	47.097
.1263	Grinding, sanding or polishing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	784,566	GER, I: 90% market share, but huge difference in unit value (9.000 vs. 55.000 Euro); DK @ unit value of 75 Euro	GER	5,490	49.157,049	8.954	I:	0,885	48.509,000	54.812	6,375	97.666,049	15.320

.1265	Bending or assembling machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	2,319	GER + I + ES 70% market share @ 19.000 - 26.000 Euro unit value; FIN 15% market share with 6 units @ 1,5 mio Euro each	GER, ES, I:	2,194	51.400,465	23.428					2,194	51.400,465	23.428
.1267	Drilling or morticing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	10,548	includes countries with unit values down to few 1.000 Euros; GER, I: 90% market share at unit values 19.000 and 9.000 Euro. Figures are plausible, but covers most likely also some non-industrial equipment	no recalc.	10,548	126.004,066	11.946					10,548	126.004,066	11.946
.1275	Splitting, slicing or paring machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	16,448	GER, I, FIN cover 95% market share with unit values of 19.000 down to 6.600 Euros; figures are plausible, but cover also likely non-industrial equipment	no recalc.	16,448	218.972,083	13.313					16,448	218.972,083	13.313
.1279	Machine tools for working wood, cork, bone, hard rubber, hard plastics or similar hard materials, n.e.c.	200,000	nearly 90% of the market share covered by GER, ES, F, I (I = 60%), A, PL, FIN, but large spread: I @ 6.600 Euro unit value, FIN @ 260.000 Euro; most units to be assessed as close to non-industrial use	GER, ES, F, I , A, PL, FIN:	31,330	288.817,730	9.219					31,330	288.817,730	9.219
.1287	Presses for the manufacture of particle board or fibre building board of wood or other ligneous materials, and other machines with individual functions for treating wood or cork	17,149	DK irrelevant at unit values of 1.600 Euro; others frequently in the 40.000 Euro range; D @ 500.000 Euro, FIN @ 1.500.000 Euro;	GER, FIN:	1,209	605.691,250	500.985	EU27 w/o DK, GER, FIN:	5,747	185.073,900	32.204	6,956	790.765,150	113.681
	Totals 28.49 wood working	**3.435,892**										**130,840**	**2.552.875,318**	**19.511**

Instead of 3.4 million units sold production as stated by EuroStat for wood working machine tools under 28.49 a more reasonable figure according to the plausibility check by Fraunhofer is **130,000 units** sold production in 2009[11]. The categories saws and planing equipment, for which the recalculated number of industrial units is 42,000 there is an overlap with so-called light stationary wood working tools, which are at a rather low unit value of up to 1,000 Euro:

Light Stationary Wood working Tools

EPTA, the European Power Tools Association, provided market insights for light stationary wood working tools: This sub-sector accounts for approximately € 135 million sales and 220,000 units per annum. The products fall broadly into three categories as listed in Table 2-6.

Table 2-6: EU sales of light stationary wood working tools (source EPTA)

	Table and Radial Arm Saws	Band Saws	Planer Thicknessers
EU sales value	**€ 80 million**	**€ 30 million**	**€ 25 million**
EU sales volume	**110,000 units**	**80,000 units**	**30,000 units**
Calculated unit value	**730 Euros**	**375 Euros**	**833 Euros**

Only 30% of sales in this sector are attributable to EPTA members. There are an unknown number of small independent suppliers, mostly Asian.

This market segment, according to EPTA, can be differentiated from heavier wood working stationary products by three factors:

- Duty – Light Stationary products are typically used intermittently and are almost always manually fed. Heavier duty machines are typically used continuously and are usually automatically fed.
- Motor power – Light Stationary products use induction motors rated mainly between 750 and 3000 watts input power. Heavier duty products are powered by motors usually in excess of 3000 watts.

[11] Given the fact, that the wood working market sees a much higher share of low cost units e.g. for DIY-ers, there is a higher uncertainty regarding the number of units used by professionals, than for the metal working machine tools market.

- Cutting capacity – Light Stationary table and radial arm saws have maximum blade diameters of 350 mm. Light stationary bandsaws have a maximum cutting height / passage width of 280 x 440 mm. Light stationary planer thicknessers have a maximum passage height / width of 180 x 307 whereas heavier duty products have capacities in excess of that.

Typically, because they are light duty, these tools do not have feed systems, hydraulic units or cooling lubricant facilities.

The life cycle of these products is relatively long. It is estimated that **50% of these products will be used longer than 25 years** because they are used intermittently – which would result roughly in an installed stock of 5 million units in EU-27. According to EPTA and their members the majority of users use the products no more than once per day.

Consequently, there were roughly between 90,000 and 130,000 larger, industrial type units produced in EU-27, and 70,000 (30% of EU-27 sales) of light stationary wood working tools.

2.1.3 Welding, soldering and brazing equipment

Table 2-7 lists the verified 2009 PRODCOM production figures for welding, soldering and brazing equipment anticipated to fall under the definition outlined in Task 1. For details of the methodology see 3 Annex I – Stock model methodology. The figures and classifications were discussed with representatives of EWA. The column "plausibility check" also lists further explanations regarding the likely allocation of equipment to a given category. For example, "fully or partly automatic electric machines" is a category to which typically equipment is reported, which is equipped with an automatic welding wire feed, but not highly complex full-automatic welding machines[12]. Those machinery categories, which – after revision – covers mainly CNC machinery is marked in red. Two categories cover equipment in the below 1,000 Euro unit value range, which is smaller transportable equipment. Misallocation of components and parts in this category might have happened, but overall order of magnitude seems to be plausible according to industry experts.

[12] As the data has to be reported individually by manufacturers to the national statistics authorities a judgement by manufacturers and the association to which categories they report which type of equipment is the best indication available to facilitate the interpretation of the data – although naming of PRODCOM codes might be misleading in some cases.

Table 2-7: EU-27 Production of welding, soldering and brazing equipment (2009, based on PRODCOM, plausibility checked by Fraunhofer)

PRODCOM Code	Description	Volume (units) EU27 according to EuroStat	FRAUNHOFER Plausibility Check	Re-calculation rule	re-calculated EU27 Volume	re-calculated Value in THOUSANDS	re-calculated unit value
27903118	Electric brazing or soldering machines and apparatus (excluding soldering irons and guns)	2,713	seems to be plausible, likely to be electronics soldering machines etc., covering solder pots to flow solder machines	no recalculation	**2,713**	**71.483,300**	**26.348**
27903145	Electric machines and apparatus for resistance welding of metal	224,563	volume is not plausible; CZ, GER, ES, SWE, UK: 75% market share at minimum 5000 Euro unit value	CZ, GER, ES, SWE, UK:	**43,656**	**558.596,000**	**12.795**
27903154	Fully or partly automatic electric machines for arc welding of metals (including plasma arc)	277,321	seems to be plausible: transportable equipment for manual welding with automatic feed of welding wire; GER 25% market share @ 20.000 Euro unit value, all others in the 500 - 2.000 Euro range	no recalculation	**277,321**	**329.375,815**	**1.188**
27903163	Other for manual welding with coated electrodes	630,299	seems to be plausible: transportable equipment for manual welding, low unit values < 400 Euro	no recalculation	**630,299**	**136.152,471**	**216**
27903172	Other shielded arc welding	326,963	seems to be plausible: transportable equipment for manual welding, low unit value 700 Euro	no recalculation	**326,963**	**194.935,172**	**596**
27903181	Machines and apparatus for welding or spraying of metals, n.e.c.	17,367	seems to be plausible, covers automatic machinery, i.e. mostly stationary welding units; UK with 5% market share at low 2.500 Euro unit value, others in the 10.000 Euro range	no recalculation	**17,367**	**163.760,510**	**9.429**
27903190	Machines and apparatus for resistance welding of plastics	1.111,507	number and category questionable, not covered by "welding" sector, presumably packaging machines to seal plastic packages; some large units for the automotive sector might be covered here as well; I 35% market share (< 2.000 Euro unit value), F 10% market share(13 Euro unit value - laminating devices?), GER 50% market share (10.000 Euro unit value)	EU-27 w/o F:	**47,323**	**123.569,842**	**2.611**
27903199	Machines and apparatus for welding (excluding for resistance welding of plastics, for arc and plasma arc welding, for treating metals)	41,999	GER, UK, DK 85% market share	GER, UK, DK:	**8,911**	**222.451,139**	**24.964**
28297090	Machinery and apparatus for soldering, brazing, welding or surface tempering (excluding hand-held blow pipes and electric machines and apparatus)	672,909	covers inter alia industrial cutting equipment, but number of units is way too high for this; I, FIN with unit values below 100 Euro, F at 1.000 Euro, GER+UK 70% market share	GER, UK:	4,727	136.797,305	28.940
Totals		**3.305,641**			**1359,280**	**1.937.121,554**	

The figures above include soldering equipment, which can be considered industrial ovens (e.g. reflow soldering ovens for printed circuit board assembly), which fall under the scope of Product Group Study Lot 4 - Industrial and Laboratory Furnaces and Ovens[13].

2.1.4 Other machine tools

It is not possible to provide a comprehensive verification of all kinds of other machine tools. Therefore the following figures are restricted to the important sub-segment of stone and ceramics working machine tools. Table 2-8 lists the verified 2009 PRODCOM production figures. For details of the methodology see 3 Annex I – Stock model methodology.

The plausibility check unveiled, that the EuroStat figures are much higher than the actual plausible number of stone and ceramics working machine tools for professional use, parts and components and non-energy related tools excluded. In total the production volume in the EU-27 in 2009 was close to 60,000 units (instead of 430,000 units as listed by EuroStat).

For grinding and polishing machines a distinction of the German, Italian, Spanish and UK market, reporting rather high-value machinery with an average unit value of 85,000 Euros and France and Portugal reporting unit values slightly below 10,000 Euros is provided.

[13] See http://www.eco-furnace.org/

Table 2-8: EU-27 Production of stone and ceramics working machine tools (2009, based on PRODCOM, plausibility checked by Fraunhofer)

PRODCOM Code 28.49...	Description	Volume (units) EU27 according to EuroStat	FRAUNHOFER Plausibility Check	Re-calculation rule	re-calculated EU27 Volume	re-calculated Value in THOUSANDS	re-calculated unit value	Re-calculation rule for a 2nd sub-category, where needed	re-calculated EU27 Volume (2nd catego-ry)	re-calculated Value in THOUSANDS (2nd catego-ry)	re-calculated unit value (2nd category)	TOTALS re-calculated EU27 Volume	TOTALS re-calculated Value in THOUSANDS	TOTALS re-calculated unit value
.1130	Sawing machines for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold working glass	143,531	EU27 unit value below 2.000 Euro, GER: below 600 Euro; I: 8.500 Euro at 60% market share	EU27 w/o GER	30,344	203.942,051	6.721					30,344	203.942,051	6.721
.1150	Grinding or polishing machines for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold working glass	9,948	GER, I: unit values 90.000 Euro (65% market share); F unit value 9.000 Euro (25% market share); others < 1.000 Euro unit value	GER, I, ES, UK:	2,022	172.682,451	85.402	F, P:	6,720	61.390,391	9.135	8,742	234.072,842	26.776
.1170	Machine-tools for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold working glass (excluding sawing machines, grinding or polishing machines)	276,626	ES unit value 150 Euro; GER @ 25.000 Euro; I @ 35.000 Euro; GER + I > 85% market share	GER, I:	20,054	612.630,883	30.549					20,054	612.630,883	30.549
Totals		**430,105**										**59,140**	**1.050.645,776**	**17.765**

2.1.5 Summary

The production figures from the Eurostat PRODCOM statistics, which underwent a plausibility check by Fraunhofer, were discussed with market experts at the industry associations and with market leaders for some segments, and were subject to revision based on the findings are summarised in the table below.

Grand totals of the EU 27 production market of machine tools according to these figures is 19.6 billion Euros, and 1. 77 million units (but largely dominated by welding equipment).

Table 2-9: EU-27 Production of machine tools – Summary (2009, based on PRODCOM, plausibility checked by Fraunhofer)

Category	Initial PRODCOM production figures (units, 2009)	**TOTALS re-calculated EU27 Production Volume**	**TOTALS re-calculated Value in Euro**	**TOTALS re-calculated unit value**
Metal working machine tools	**598.950**	**216.206**	**14.063.265.418**	**65.046**
Wood working machine tools	**3.435.892**	**130.840**	**2.552.875.318**	**19.511**
Light stationary woodworking tools	**n.a.**	**70.000**	**n.a.**	**< 1.000**
Welding, soldering and brazing equipment	**3.305.641**	**1.359.280**	**1.937.121.554**	
Stone and ceramics working machine tools	**430.105**	**59.140**	**1.050.645.776**	**17.765**
Totals (w/o light stationary wood working machine tools)	**7.770.588**	**1.765.466**	**19.603.908.066**	

2.2 Market and stock data

2.2.1 Base Data for the Stock Model

2.2.1.1 Metal working machine tools

As there are no dedicated statistics available regarding the installed stock of machine tools, such figures have to be derived from sales figures with qualified assumptions. Average technical and economic product life is one of these key parameters:

The large Japanese machine tool manufacturer Mori Seiki Co. estimates an average lifetime of **15 years** for machine tools[14].

According to a VDMA index, average lifetime of **NC-controlled machine tools** is **9.5 years**, average lifetime of **non-NC controlled machine tools 18.6 years**[15].

An indication about age of machine tools being still in use or at least considered usable is the market for used machine tools. An evaluation of more than 3,400 machine tools offered mid-March 2010 at one of the leading internet platforms MM Maschinenmarkt Börse online unveils the broad age spread of machine tools offered for reuse: Actually reuse starts right from day zero. These very early reuse cases obviously stem from companies cancelling orders or facing bankruptcy after having ordered machinery. The huge fluctuations in the design year[16] of offered machine tools reflects nearly exactly the economic cycles: If in a certain year less machine tools have been manufactured, rather logically a lower number of machine tools from that respective year is offered now as used machinery. The design year with most used machine tools traded is 1989, indicating that a machine tools' lifetime of more than 20 years is not uncommon at all. There is a remarkable number of machine tools build in the 1960s and 1970s still offered on this trade platform.

This platform is particularly popular for metal working machine tools.

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[14] See Interview with Dr. Rüdiger Kapitza, CEO Gildemeister AG, and Dr. Masahiko Mori,CEO Mori Seiki Co., Ltd., in: Die Zukunft der Werkzeugmaschinen-Industrie, Produktion Nr. 24, 2007

[15] VDMA-Kennzahlen Fertigung und Montage 2006

[16] For clarification of terminology: "design year" refers to the year when an individual machine tool is produced, not the year when the layout of a certain model series of machine tools was designed for the first time

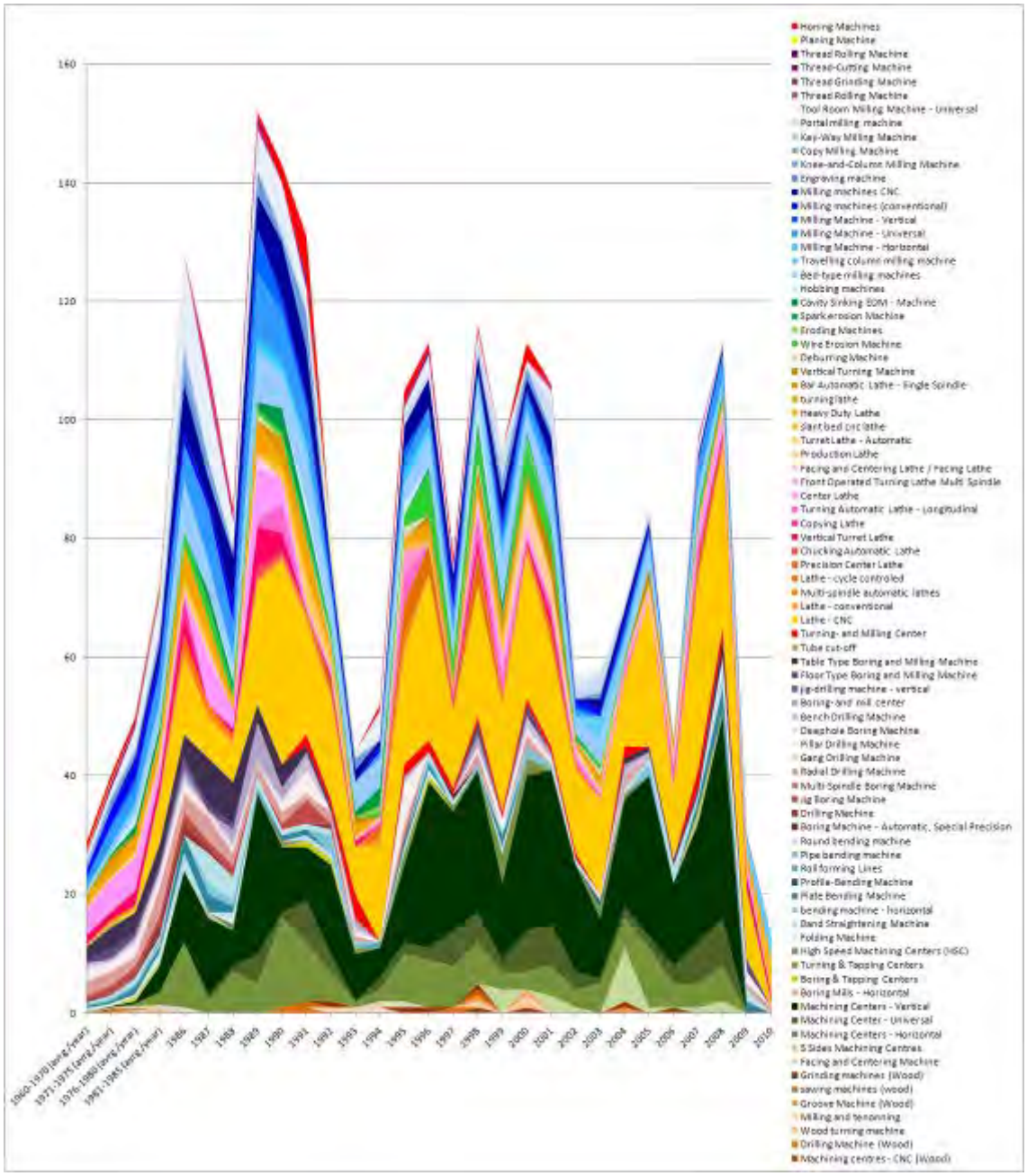

Figure 2-3: Year of Design of Second Hand Machine Tools – Absolute Numbers (as of March 2010)

Looking at those machine tools traded at MM Maschinenmarkt Börse online, which bear in the category name a reference to numerical controlled or machining centre gives an indication about the age of numerical controlled machine tools specifically.

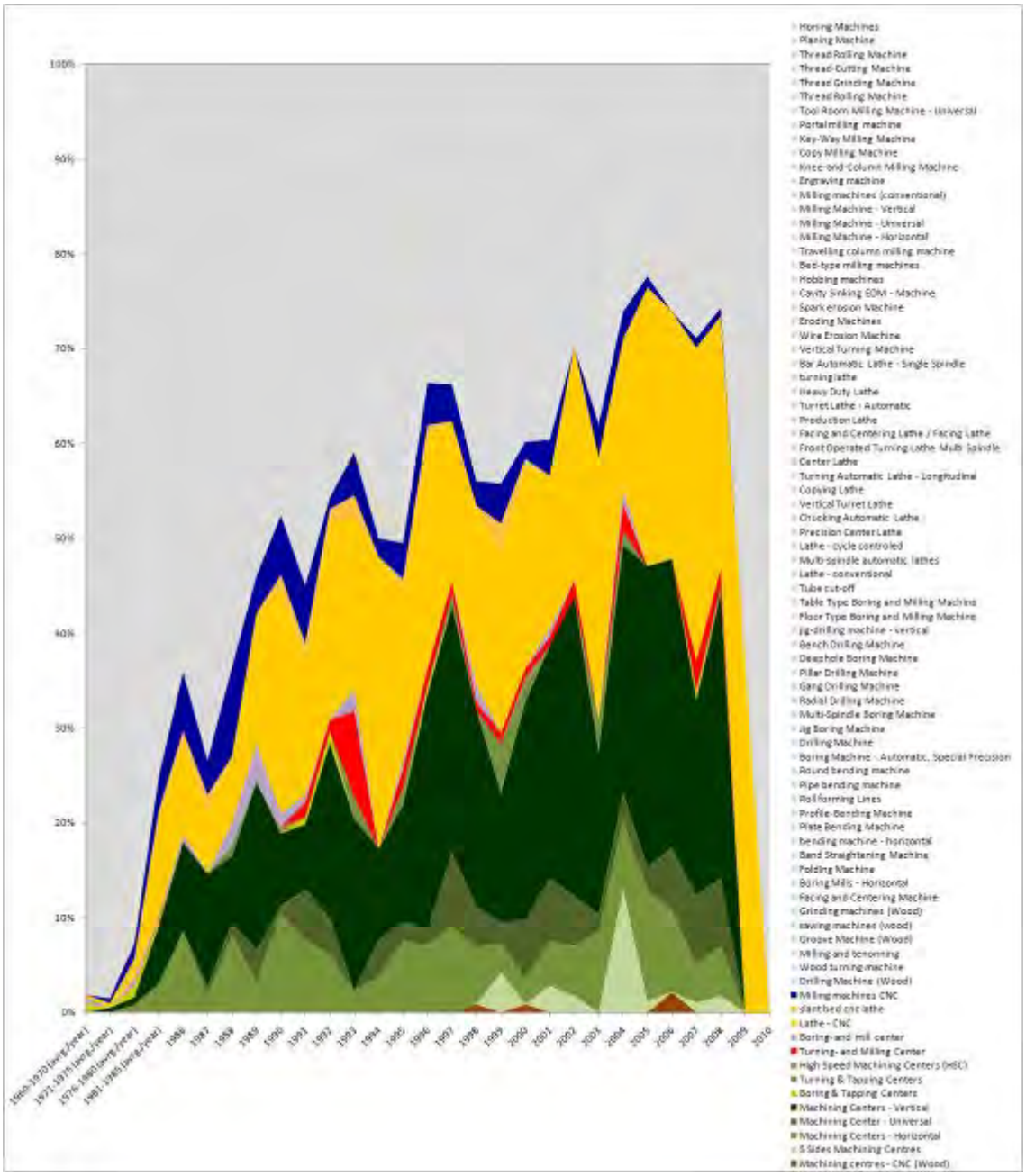

Figure 2-4: Year of Design of Second Hand Machine Tools – Percentage – numerical-controlled and machining centres highlighted[17]

[17] Not that the distinction of NC / non-NC is not that clear in the statistics and categories of this second hand platform as it seems to be in this graphical illustration; there are NC-controlled machine tools also included occasionally in the greyed categories

In Figure 2-4 all categories are greyed out, which do not bear CNC or machining centre in the category name: It is confirmed, that as a tendency, numerical-controlled machine tools traded as second hand machinery have a higher representation in the reuse market of younger machines. The figure of 9.5 years average lifetime of NC-controlled machine tools stated by VDMA (see above) nevertheless is likely to underestimate the real lifetime when looking at the second hand statistics provided below. On the other hand it should be not ed, that the market share of new machine tools shifted from non-numerical controlled machine tools to CNC machine tools anyway, so the statistics of second hand machinery provided in the figure below might rather be a reflection of the market situation of the given year of design (more non-NC controlled machine tools available from earlier years, more NC-controlled machinery available from more recent years).

Table 2-10 lists the average age of machine tools traded at MM Maschinenmarkt Börse online. Only categories with more than 40 units offered as of March 2010 (and stating a year of design) are listed. At minimum the average age of machine tools showing up on this platform is 11 years in case of universal machining centres, and at maximum in the range of 30 years for table type boring and milling machines, centre lathes, and conventional milling machines.

Table 2-10: Average Age of Machine Tools offered as Second Hand Equipment

	Units offered (Totals)	Avrg. age (years)
Machining Centres - Horizontal	149	15
Machining Centre - Universal	77	11
Machining Centres - Vertical	422	12
Round bending machine	42	20
Radial Drilling Machine	89	29
Pillar Drilling Machine	63	29
Table Type Boring and Milling Machine	111	30
Lathe - CNC	475	13
Vertical Turret Lathe	73	28
Centre Lathe	158	31
turning lathe	83	25
Wire Erosion Machine	42	14
Bed-type milling machines	132	20
Milling Machine - Universal	140	24
Milling machines (conventional)	67	30
Milling machines CNC	97	19

	Units offered (Totals)	Avrg. age (years)
Knee-and-Column Milling Machine	41	25
Tool Room Milling Machine - Universal	129	25
Honing Machines	48	29

According to a recent survey by VDW[18] the age of machine tools at end-of-life is **frequently above 25 years** (43% of the replies), the remaining machine tools reach their end-of-life mostly between 16 and 20 years of age, some already at 10 to 15 years (see Task 3.3 for more details).

An inquiry among market experts through CECIMO at their member associations lead to experts' estimates regarding average lifetimes of metal working machine tools. Estimates were made by experts from Italy and France, the German data on average age was taken with the assumption, that the lifetime is roughly twice the average age of the machine tools found in operation.

Table 2-11: Estimates of Average Lifetime of Metal Working Machine Tools

PRODCOM	Description	Average lifetime (years)			
		Italy	France	Germany	average
		Estimate	Estimate	VDMA, 2006	
28411110	Machine-tools for working any material by removal of material, operated by laser or other light or photon beam processes	10	17	9,5	**12**
28411130	Machine-tools for working any material by removal of material, operated by ultrasonic processes (excluding machines for the manufacture of semiconductor devices or of electronic integrated circuits)		17	18,6	**18**
28411150	Machine tools for working any material by removal of material, operated by electro-discharge processes	14	17	9,5	**14**
28411170	Machine-tools for working any material by removal of material, operated by electro-chemical, electron-beam, ionic-beam or plasma arc processes		17	18,6	**18**
28411180	Machine tools for working any material by removal of material, operated by ultrasonic processes, for the manufacture of semiconductor devices or of electronic integrated circuits		17	18,6	**18**
28411220	Horizontal machining centres for working metal	8	17	9,5	**12**

18 Verein Deutscher Werkzeugmaschinenfabriken e.V.: Art und Umfang von Retrofit-/Refurbishing-Maßnahmen (R/R) an Werkzeugmaschinen, survey, February 2010

28411240	Vertical machining centres for working metal (including combined horizontal and vertical machining centres)	12	17	9,5	**13**
28411250	Unit construction machines (single station) for working metal		17	18,6	**18**
28411270	Multi-station transfer machines for working metal	8	17	9,5	**12**
28412123	Numerically controlled horizontal lathes, turning centres, for removing metal	10	17	9,5	**12**
28412127	Numerically controlled horizontal lathes, automatic lathes, for removing metal (excluding turning centres)	8	17	9,5	**12**
28412129	Numerically controlled horizontal lathes, for removing metal (excluding turning centres, automatic lathes)	10	17	9,5	**12**
28412140	Non-numerically controlled horizontal lathes, for removing metal		17	18,6	**18**
28412160	Lathes, including turning centres, for removing metal (excluding horizontal lathes)	30	17	9,5	**19**
28412213	Numerically controlled drilling machines for working metal (excluding way-type unit head machines)	20	17	9,5	**16**
28412217	Numerically controlled knee-type milling machines for working metal (excluding boring-milling machines)	15	17	9,5	**14**
28412223	Numerically controlled tool-milling machines for working metal (excluding boring-milling machines, knee-type machines)	12	17	9,5	**13**
28412225	Numerically controlled milling machines for working metal (including plano-milling machines) (excluding boring-milling machines, knee-type, tool-milling machines)	15	17	9,5	**14**
28412233	Way-type unit heads for working metal by drilling, boring, milling, threading or tapping				**n.a.**
28412235	Non-numerically controlled drilling machines for working metal (excluding way-type unit head machines)		17	18,6	**18**
28412240	Numerically controlled boring and boring-milling machines for working metal (excluding drilling machines)	20	17	9,5	**16**
28412260	Non-numerically controlled boring and boring-milling machines for working metal (excluding drilling machines)		17	18,6	**18**
28412270	Non-numerically controlled milling machines for working metal (excluding boring-milling machines)		17	18,6	**18**
28412280	Threading or tapping machines for working metal (excluding drilling machines)		17	18,6	**18**
28412305	Numerically controlled flat-surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	8	17	9,5	**12**
28412315	Numerically controlled cylindrical surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	8	17	9,5	**12**

28412325	Other numerically controlled grinding machines in which the positioning in any one axis can be set up to accuracy >0.01mm	12	17	9,5	**13**
28412335	Non-numerically controlled flat-surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm		17	18,6	**18**
28412345	Non-numerically controlled cylindrical surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm		17	18,6	**18**
28412355	Grinding machines for working metal; any one axis can be set to an accuracy >=0.01mm excluding flat-surface grinding machines, cylindrical surface grinding machines		17	18,6	**18**
28412365	Numerically controlled sharpening (tool or cutter grinding) machines for working metal	6	17	9,5	**11**
28412375	Non-numerically controlled sharpening (tool or cutter grinding) machines for working metal		17	18,6	**18**
28412385	Honing or lapping machines for working metal	5	17	18,6	**14**
28412395	Machines for deburring or polishing metal (excluding gear finishing machines)		17	18,6	**18**
28412410	Broaching machines for working metal		17	18,6	**18**
28412430	Gear cutting, gear grinding or gear finishing machines, for working metals, metal carbides or cermets (excluding planing, slotting and broaching machines)	10	17	9,5	**12**
28412470	Sawing or cutting-off machines for working metal		17	18,6	**18**
28412490	Planing, shaping or slotting machines and other machine-tools working by removing metal or cermets, n.e.c.		17	18,6	**18**
28413120	Numerically controlled bending, folding, straightening or flattening machines for working flat metal products (including presses)	15	17	9,5	**14**
28413140	Numerically controlled bending, folding, straightening or flattening machines for working metal (including presses) (excluding those for working flat metal products)	12	17	9,5	**13**
28413160	Non-numerically controlled bending, folding, straightening or flattening machines for working flat metal products (including presses)		17	18,6	**18**
28413180	Non-numerically controlled bending, folding, straightening or flattening machines for working metal (including presses) (excluding those for working flat metal products)		17	18,6	**18**
28413220	Numerically controlled shearing machines for working metal (including presses) (excluding combined punching and shearing machines)	12	17	9,5	**13**
28413240	Numerically controlled punching or notching machines for working metal (including presses, combined punching and shearing machines)	12	17	9,5	**13**
28413260	Non-numerically controlled shearing machines for working metal (including presses) (excluding combined punching and shearing machines)		17	18,6	**18**

28413280	Non-numerically controlled punching or notching machines for working metal (including presses, combined punching and shearing machines)		17	18,6	**18**
28413310	Numerically controlled forging or die-stamping machines and hammers for working metal (including presses)	30	17	9,5	**19**
28413320	Non-numerically controlled forging or die-stamping machines and hammers for working metal (including presses)		17	18,6	**18**
28413350	Hydraulic presses for working metal	25	17	9,5	**17**
28413360	Non-hydraulic presses for working metal	25	17	18,6	**20**
28413410	Draw-benches for bars, tubes, profiles, wire or the like of metal, sintered metal carbides or cermets				**15**
28413430	Thread rolling machines for working metal, sintered metal carbides or cermets				**15**
28413450	Machines for working wire (excluding draw-benches, thread rolling machines)				**15**
28413470	Riveting machines, swaging machines and spinning lathes for working metal, machines for manufacturing flexible tubes of spiral metal strip and electro-magnetic pulse metal forming machines, and other machine tools for working metal without removing metal				**15**

The huge spread in estimated and calculated lifetimes indicates that machine lifetime (and thus the stock calculated on this basis) is subject to a high level of uncertainty.

2.2.1.2 Wood working machine tools

There is no lifetime data available for wood working machine tools. Taking the stated lifetime for other larger machinery of indicatively 15 - 25 years as an approximation, and noticing the EPTA statement that 50% of light stationary products will be used longer than 25 years it is considered appropriate to **calculate with roughly 20 years lifetime** for wood working machinery, but this is subject to a high level of uncertainty.

2.2.1.3 Welding, soldering and brazing equipment

As there is no robust statistic the average lifetime of welding, soldering and brazing equipment was estimated by an industry expert[19], and confirmed at an EWA association meeting.

[19] P. Couderc, Air Liquide

Table 2-12: Estimates of Average Lifetime of Welding, Soldering and Brazing Equipment

PRODCOM	Description	Average lifetime (years)
27903118	Electric brazing or soldering machines and apparatus (excluding soldering irons and guns)	**20**
27903145	Electric machines and apparatus for resistance welding of metal	**15**
27903154	Fully or partly automatic electric machines for arc welding of metals (including plasma arc)	**7**
27903163	Other for manual welding with coated electrodes	**5**
27903172	Other shielded arc welding	**5**
27903181	Machines and apparatus for welding or spraying of metals, n.e.c.	**20**
27903190	Machines and apparatus for resistance welding of plastics	**20**
27903199	Machines and apparatus for welding (excluding for resistance welding of plastics, for arc and plasma arc welding, for treating metals)	**20**
28297090	Machinery and apparatus for soldering, brazing, welding or surface tempering (excluding hand-held blow pipes and electric machines and apparatus)	**20**

The low cost units in particular are estimated to be at a rather short lifetime of 5 years, whereas the larger production equipment, being high value investment goods are typically used much longer, indicatively 20 years.

2.2.1.4 Other machine tools

For the large variety of other machine tools and application fields no robust figures regarding average lifetime can be stated. The only statement that can be made, is that the lifetime as for other investment goods is in the range of several years to few decades. For the segment of stone and ceramics working machine tools similar lifetimes as for metal and wood working can be anticipated in the range of 10-25 years. Estimates below will be based on 20 years lifetime.

2.2.2 Installed base (EU-27 stock)

2.2.2.1 Metal working machine tools

Actually, it has to be noticed that average machine tool lifetime changes with the economic cycle and does not keep stable over time. However, these dynamics in detail are not known.

Having said this, the stock model for metal working machine tool product categories (NACE codes) is as listed in the table below for 1995 as Kyoto reference year and 2009 as most recent year, for which Eurostat data is available[20].

[20] as of early 2010

Table 2-13: Metal working machine tools - Installed stock 1995 and 2009

PRODCOM	Description	1995	2009
28411110	Machine-tools for working any material by removal of material, operated by laser or other light or photon beam processes	4.818	18.978
28411130	Machine-tools for working any material by removal of material, operated by ultrasonic processes (excluding machines for the manufacture of semiconductor devices or of electronic integrated circuits)	3312	8762
28411150	Machine tools for working any material by removal of material, operated by electro-discharge processes	22964	33246
28411170	Machine-tools for working any material by removal of material, operated by electro-chemical, electron-beam, ionic-beam or plasma arc processes	64263	114266
28411220	Horizontal machining centres for working metal	17137	33965
28411240	Vertical machining centres for working metal (including combined horizontal and vertical machining centres)	34986	99614
28411250	Unit construction machines (single station) for working metal	13862	40955
28411270	Multi-station transfer machines for working metal	11949	22828
28412123	Numerically controlled horizontal lathes, turning centres, for removing metal	15104	34214
28412127	Numerically controlled horizontal lathes, automatic lathes, for removing metal (excluding turning centres)	18451	38005
28412129	Numerically controlled horizontal lathes, for removing metal (excluding turning centres, automatic lathes)	27577	44347
28412140	Non-numerically controlled horizontal lathes, for removing metal	148116	100104
28412160	Lathes, including turning centres, for removing metal (excluding horizontal lathes)	21708	53745
28412213	Numerically controlled drilling machines for working metal (excluding way-type unit head machines)	17673	34743
28412217	Numerically controlled knee-type milling machines for working metal (excluding boring-milling machines)	4891	6859
28412223	Numerically controlled tool-milling machines for working metal (excluding boring-milling machines, knee-type machines)	12886	36197
28412225	Numerically controlled milling machines for working metal (including plano-milling machines) (excluding boring-milling machines, knee-type, tool-milling machines)	11030	23858
28412235	Non-numerically controlled drilling machines for working metal (excluding way-type unit head machines)	408178	320900
28412240	Numerically controlled boring and boring-milling machines for working metal (excluding drilling machines)	8420	23136
28412260	Non-numerically controlled boring and boring-milling machines for working metal (excluding drilling machines)	6393	3636
28412270	Non-numerically controlled milling machines for working metal (excluding boring-milling machines)	49576	36325
28412280	Threading or tapping machines for working metal (excluding drilling machines)	200661	141190
28412305	Numerically controlled flat-surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	3823	11152
28412315	Numerically controlled cylindrical surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	5209	10852
28412325	Other numerically controlled grinding machines in which the	2680	5987

	positioning in any one axis can be set up to accuracy >0.01mm		
28412335	Non-numerically controlled flat-surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	**8299**	**4668**
28412345	Non-numerically controlled cylindrical surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	**383**	**2024**
28412355	Grinding machines for working metal; any one axis can be set to an accuracy >=0.01mm excluding flat-surface grinding machines, cylindrical surface grinding machines	**72575**	**49332**
28412365	Numerically controlled sharpening (tool or cutter grinding) machines for working metal	**19068**	**43005**
28412375	Non-numerically controlled sharpening (tool or cutter grinding) machines for working metal	**43058**	**21950**
28412385	Honing or lapping machines for working metal	**461841**	**290527**
28412395	Machines for deburring or polishing metal (excluding gear finishing machines)	**56163**	**49371**
28412410	Broaching machines for working metal	**1358**	**916**
28412430	Gear cutting, gear grinding or gear finishing machines, for working metals, metal carbides or cermets (excluding planing, slotting and broaching machines)	**2478**	**6401**
28412470	Sawing or cutting-off machines for working metal	**175033**	**137080**
28412490	Planing, shaping or slotting machines and other machine-tools working by removing metal or cermets, n.e.c.	**24693**	**16187**
28413120	Numerically controlled bending, folding, straightening or flattening machines for working flat metal products (including presses)	**34504**	**76542**
28413140	Numerically controlled bending, folding, straightening or flattening machines for working metal (including presses) (excluding those for working flat metal products)	**9899**	**33993**
28413160	Non-numerically controlled bending, folding, straightening or flattening machines for working flat metal products (including presses)	**42817**	**48355**
28413180	Non-numerically controlled bending, folding, straightening or flattening machines for working metal (including presses) (excluding those for working flat metal products)	**not applicable**	**not applicable**
28413220	Numerically controlled shearing machines for working metal (including presses) (excluding combined punching and shearing machines)	**16901**	**37512**
28413240	Numerically controlled punching or notching machines for working metal (including presses, combined punching and shearing machines)	**9266**	**17591**
28413260	Non-numerically controlled shearing machines for working metal (including presses) (excluding combined punching and shearing machines)	**144300**	**146934**
28413280	Non-numerically controlled punching or notching machines for working metal (including presses, combined punching and shearing machines)	**367638**	**185759**
28413310	Numerically controlled forging or die-stamping machines and hammers for working metal (including presses)	**3036**	**5290**
28413320	Non-numerically controlled forging or die-stamping machines and hammers for working metal (including presses)	**224**	**291**
28413330	Presses for moulding metallic powders by sintering or for compressing scrap metal into bales	**4741**	**3221**
28413340	Other hydraulic presses, numerically controlled, for working metal	**32697**	**37583**

28413350[21]	Hydraulic presses for working metal	**not applicable**	**1869**
28413360	Non-hydraulic presses for working metal	**not applicable**	**17658**
28413370	Other non-hydraulic presses, numerically controlled, for working metal	**2553**	**5823**
28413380	Other non-numerically controlled presses for working metal	**638271**	**395426**
28413410	Draw-benches for bars, tubes, profiles, wire or the like of metal, sintered metal carbides or cermets	**9287**	**7570**
28413430	Thread rolling machines for working metal, sintered metal carbides or cermets	**19753**	**14334**
28413450	Machines for working wire (excluding draw-benches, thread rolling machines)	**187144**	**187384**
28413470	Riveting machines, swaging machines and spinning lathes for working metal, machines for manufacturing flexible tubes of spiral metal strip and electro-magnetic pulse metal forming machines, and other machine tools for working metal without removing metal	**345445**	**319683**
	Totals	**3.871.087**	**3.464.152**

Total installed stock of metal working machine tools is depicted in Figure 2-5.

21 In 2009 PRODCOM codes 28413340 and 28413370 were replaced by codes 28413350 and 28413360, which explains why no data is reported for 1995, as these were covered by other categories at that time

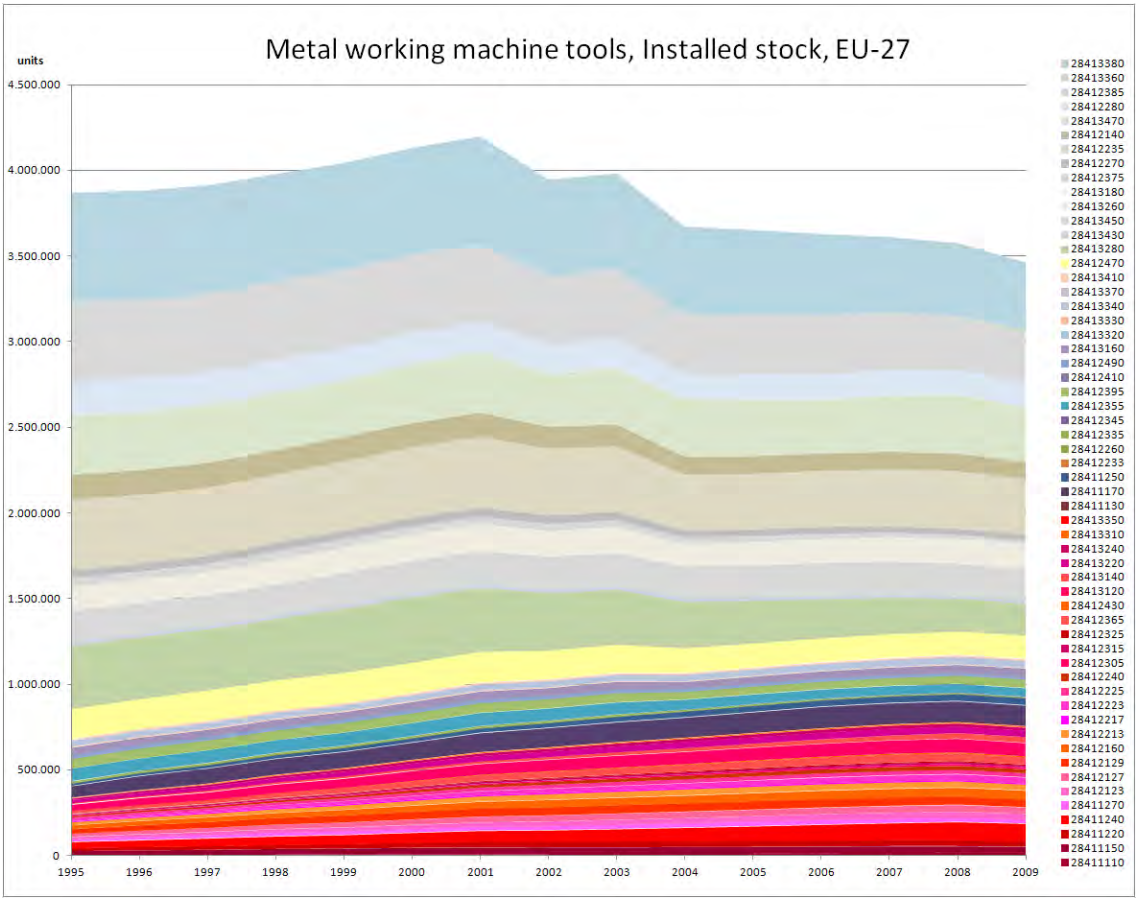

Figure 2-5: Installed Stock – Metal Working Machine Tools Categories – Development 1995 - 2009

The machine tools categories covering (or at least are dominated by) CNC machine tools are coloured in reddish in Figure 2-5. The number of **CNC machine tools** according to this stock model is on a 2009 level of **750.000 units in the EU27**. Considering all machine tools categories with plausible unit values **above 25.000 Euro** per machine tool, the totals are at **1.3 million machine tools** in operation in EU-27. Of these categories only for one there is a rather low plausibility of the data (marked in yellow). Another **2.1 million machines** (greyish in the figure) are in categories with reported (but largely plausible or revised) unit values **below 25.000 Euros**, hence these types of non-CNC machinery are rather expected in workshops, partly also equipment for semi-professional use might be covered, but units portable by hand are rather not covered as they have been ruled out in the plausibility check. In a few of these categories a very limited number of high-value, CNC machine tools might be allocated, but this share is likely to be negligible for this economic analysis.

Regarding the totals there is a slight decrease between 1995 and 2009. Given the stock model calculations the number of CNC machines in operation increased from 350.000 units in 1995 to 750.000 units in 2009 1995 whereas the stock of non-CNC categories above 25.000 Euro remained on the same level as it was in 1995: 500.000 units. Including also the lower value non-CNC machine tools the stock of all non-CNC machine tools decreased from 3.5 million units in stock in 1995 to 2.7 million units in 2009.

The total values seem to be roughly correct in relation to a survey provided by CECIMO for France: There were 230.000 [metal working] machine tools in 1998, where 60% of them were metal cutting. 50% of the population were NC machines. Similarly, market surveys (installed stock) in Germany in 1995 and in Italy in 2005 indicate an installed stock in the CECIMO countries of 1.5 – 4.4 million units[22], taking all three countries France, Italy and Germany as a basis, total stock is estimated with 2.4 million metal working machine tools in CECIMO countries[23], see Table 2-14 (calculation provided by CECIMO), compared to a figure of 3.5 million metal working machine tools in EU 27 according to our stock model.

Table 2-14: Metal Working Machine Tools – CECIMO estimate regarding installed stock in CECIMO countries

Estimation of machine tool stock

Share in CECIMO apparent metalworking machine tools consumption in 2010:

Item / Country	Germany	Italy	France	Total
Share in CECIMO app. consumption in € (%, 2010)	39,10%	21,50%	5,30%	65,90%
Number of machine tools ('000, acc. to the survey)	1040,0	324,5	232,0	1596,5
Year of the survey	1995	2005	1998	

Source: German, Italian and French surveys on machine tools installed stock

Implied CECIMO stock ('000)	000 units
Implied stock based on German data	2660
Implied stock based on Italian data	1509
Implied stock based on French data	4377
Total CECIMO stock weighted by consumption	**2423**

22 Lower boundary of this range based on extrapolation of data for Italy, upper boundary on data for France

23 Turkey and Switzerland included, some EU-27 countries excluded (such as Poland, Romania, and Slovakia)

CECIMO provided also historic survey data regarding the installed stock as outlined and analysed in Table 2-15. As this data spotlights only the situation in two countries and for selected years on a hi ghly aggregated level our stock model cannot directly build on these figures, but was adapted to reflect the change in total units and distinct for CNC / non-CNC: The annual growth rate in CNC stock for Germany was applied for the EU-27 to extrapolate from the calculated 1995 s tock backwards (new stock installed in former years).

Table 2-15: Metal Working Machine Tools – Stock survey in selected years and countries

	Germany		***Italy***	
	1985	*1995*	*1985*	*2005*
Total stock	*1.238.095*	*1.040.000*	*550.000*	*324.500*
CNC share	*6%*	*21%*	*4%*	*27%*
	74.286	218.400	22.000	87.615
annual increase	11,4%		7,2%	
Non-CNC machine tools	1.163.810	821.600	528.000	236.885
annual decrease	-3,42%		-3,93%	
Theoretical replacement rate non-CNC by CNC (number of CNC entering the stock for each non-CNC leaving the stock)	0,4211		0,2254	

(Data in italics as provided by CECIMO, all other calculated by Fraunhofer)

Given the fact, that the stock model demonstrates a rather stable level of installed metal working machine tools[24], the forecasts and scenarios presented in 2.1.1, which are based on economic figures and not on a unit basis, do not have much influence on the installed stock.

Based on historical data and surveys – which only provide snapshots of the situation in individual years in individual countries it is evident that the total stock of metal working machine tools is decreasing significantly. This is confirmed by our revised stock model.

A closer look at the EuroStat data unveils the fact that the unit value of CNC machine tools under most PRODCOM codes raised significantly since 1995. This trend is depicted in Figure 2-6. These data make clear indirectly, that CNC machine tools became more and more complex over time, which means, that not only the stock of CNC ma-

[24] Which, however, is in contradiction to a statement of CECIMO: According to some national market surveys in Germany (1985/1995) and Italy (1985/2005) the total stock decreased in the last few decades. Although this trend is plausible (trend towards more complex machine tools replacing a multitude of simpler ones), the EuroStat data, even after a plausibility check, did not confirm this trend. As there is no other robust data on the EU-27 level including robust historic figures, the stock model cannot be adjusted.

chine tools grew, but is composed today of machine tools of much higher complexity than years ago.

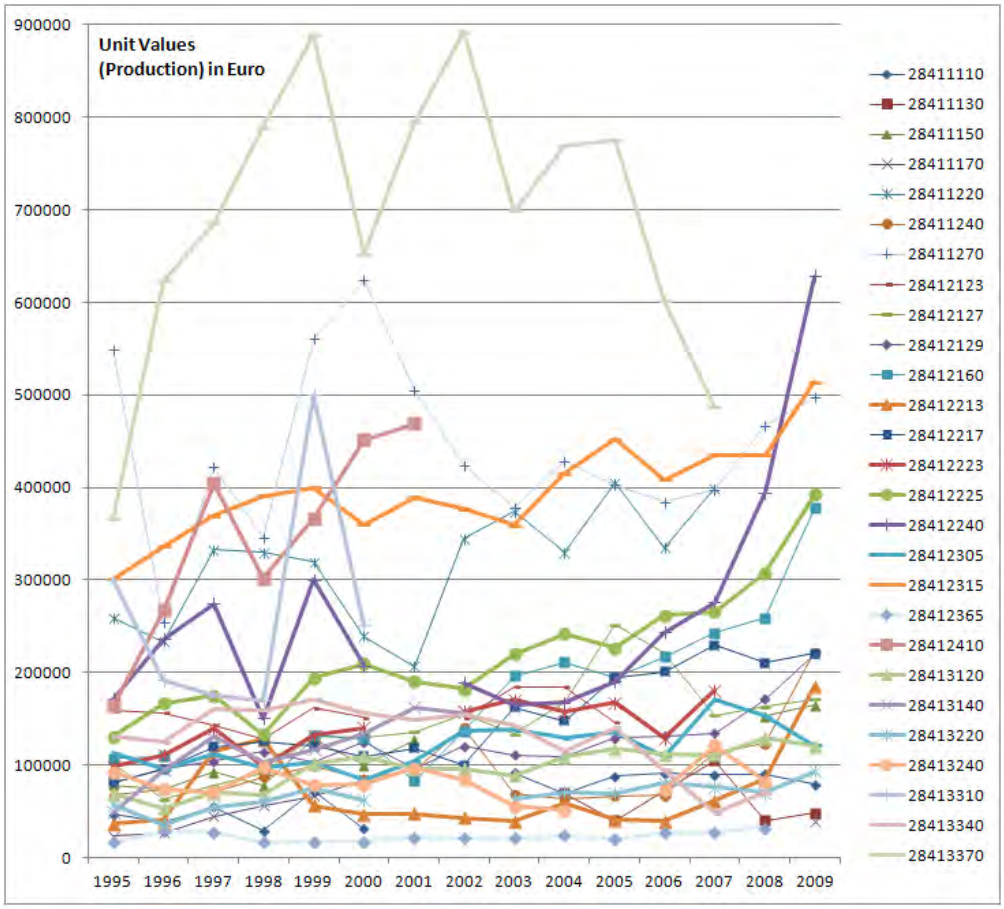

Figure 2-6: Unit values (Production) of CNC machine tools– Development 1995 - 2009

Given these trends in the market the stock model forecast is based on following assumptions:

- For each PRODCOM code the growth rate of "new stock"[25] of the periods 1995-1999 and 2005-2009 is compared and applied as an annual (positive or negative) growth rate for future "new stock", starting with the average of 2007-2009.
- PRODCOM categories with an annual growth rate of more than 5% (2005-09 vs.1995-99) are calculated with max. 5% growth rate to take into account inher-

[25] i.e., production + imports - exports

ent growth limitations, and from 2020 onwards the maximum growth is capped at 3% (reflecting likely market saturation for formerly fast growing markets)

These assumptions result in a stock development of metal working machine tools as depicted in Figure 2-7: The total stock will reach 2.8 million units by 2020 and will remain on this level also in 2025. The share of CNC machine tools will slightly exceed 800.000 units, but complexity and productivity of these will increase further.

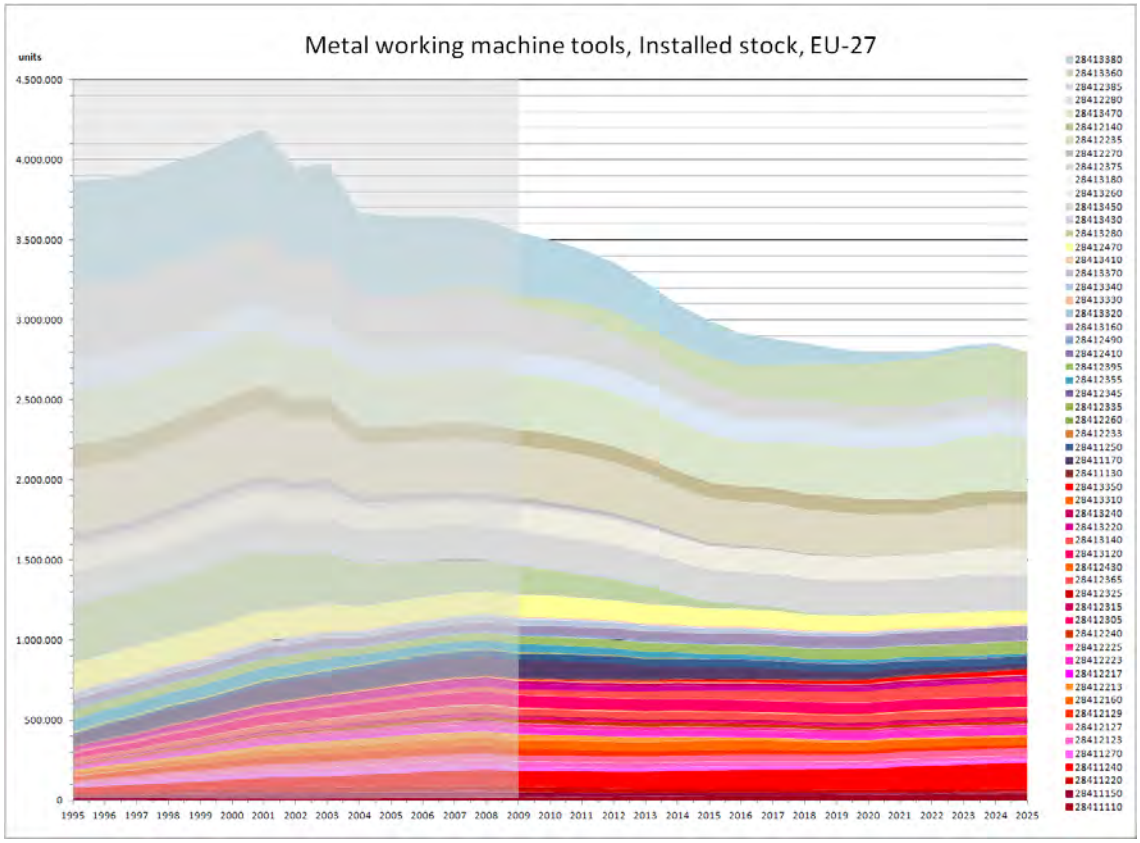

Figure 2-7: Installed Stock – Metal Working Machine Tools Categories – Forecast 2010 - 2025

Calculations of aggregated new installed stock since 2010 for the forthcoming years until 2025 are listed in Table 2-16 and Table **2-17**. Based on these calculations in **2020 2.2 million metal working machine tools will be units sold in 2010 and later**. In

2025 2.8 million metal working machine tools will have been replaced since 2010, and only **20.000 units in stock will be those constructed before 2010**[26].

[26] These figures are subject to the above disclaimers regarding plausibility of the stock model: Figures are appropriate for CNC machine tools, but might overestimate non-CNC machine tools

Table 2-16: Metal working machine tools – Aggregated new installed stock since 2010 (replacement sales) - 2010 - 2017

PRODCOM	Description	2010	2011	2012	2013	2014	2015	2016	2017
28411110	Machine-tools for working any material by removal of material, operated by laser or other light or photon beam processes	2.450	5.022	7.723	10.559	13.537	16.663	19.946	23.393
28411130	Machine-tools for working any material by removal of material, operated by ultrasonic processes (excluding machines for the manufacture of semiconductor devices or of electronic integrated circuits)	495	999	1.512	2.034	2.565	3.106	3.657	4.218
28411150	Machine tools for working any material by removal of material, operated by electro-discharge processes	1.210	2.309	3.308	4.216	5.040	5.789	6.470	7.089
28411170	Machine-tools for working any material by removal of material, operated by electro-chemical, electron-beam, ionic-beam or plasma arc processes	2.395	4.630	6.717	8.664	10.483	12.180	13.765	15.244
28411220	Horizontal machining centres for working metal	2.227	4.420	6.582	8.711	10.808	12.874	14.910	16.915
28411240	Vertical machining centres for working metal (including combined horizontal and vertical machining centres)	9.116	18.660	28.652	39.112	50.063	61.527	73.528	86.093
28411250	Unit construction machines (single station) for working metal	2.565	5.164	7.797	10.467	13.171	15.912	18.690	21.505
28411270	Multi-station transfer machines for working metal	2.012	3.993	5.943	7.862	9.751	11.611	13.442	15.244
28412123	Numerically controlled horizontal lathes, turning centres, for removing metal	2.132	4.256	6.373	8.484	10.587	12.683	14.772	16.854
28412127	Numerically controlled horizontal lathes, automatic lathes, for removing metal (excluding turning centres)	4.065	8.131	12.199	16.268	20.339	24.411	28.485	32.561
28412129	Numerically controlled horizontal lathes, for removing metal (excluding turning centres, automatic lathes)	2.828	5.527	8.101	10.557	12.900	15.136	17.269	19.304
28412140	Non-numerically controlled horizontal lathes, for removing metal	7.301	14.466	21.499	28.401	35.176	41.826	48.352	54.758

28412160	Lathes, including turning centres, for removing metal (excluding horizontal lathes)	2.964	5.918	8.863	11.798	14.724	17.640	20.546	23.443
28412213	Numerically controlled drilling machines for working metal (excluding way-type unit head machines)	832	1.607	2.330	3.005	3.633	4.220	4.767	5.277
28412217	Numerically controlled knee-type milling machines for working metal (excluding boring-milling machines)	394	760	1.100	1.416	1.709	1.981	2.233	2.468
28412223	Numerically controlled tool-milling machines for working metal (excluding boring-milling machines, knee-type machines)	3.064	6.237	9.521	12.922	16.442	20.087	23.860	27.766
28412225	Numerically controlled milling machines for working metal (including plano-milling machines) (excluding boring-milling machines, knee-type, tool-milling machines)	1.432	2.822	4.173	5.485	6.759	7.996	9.198	10.366
28412235	Non-numerically controlled drilling machines for working metal (excluding way-type unit head machines)	18.675	37.327	55.958	74.567	93.153	111.718	130.261	148.782
28412240	Numerically controlled boring and boring-milling machines for working metal (excluding drilling machines)	1.026	2.071	3.137	4.224	5.331	6.461	7.612	8.785
28412260	Non-numerically controlled boring and boring-milling machines for working metal (excluding drilling machines)	133	249	349	436	511	576	633	682
28412270	Non-numerically controlled milling machines for working metal (excluding boring-milling machines)	596	1.159	1.690	2.191	2.663	3.109	3.530	3.927
28412280	Threading or tapping machines for working metal (excluding drilling machines)	10.187	20.325	30.414	40.453	50.444	60.386	70.279	80.125
28412305	Numerically controlled flat-surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	1.052	2.156	3.316	4.533	5.812	7.154	8.563	10.043
28412315	Numerically controlled cylindrical surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	995	1.989	2.982	3.975	4.967	5.958	6.948	7.937
28412325	Other numerically controlled grinding machines in which the positioning in any one axis can be set up to	293	578	855	1.126	1.389	1.645	1.895	2.138

	accuracy >0.01mm								
28412335	Non-numerically controlled flat-surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	0	0	0	0	0	0	0	0
28412345	Non-numerically controlled cylindrical surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	332	663	995	1.327	1.658	1.990	2.322	2.653
28412355	Grinding machines for working metal; any one axis can be set to an accuracy >=0.01mm excluding flat-surface grinding machines, cylindrical surface grinding machines	1.869	3.605	5.217	6.716	8.107	9.401	10.602	11.718
28412365	Numerically controlled sharpening (tool or cutter grinding) machines for working metal	4.423	8.912	13.468	18.093	22.788	27.553	32.390	37.299
28412375	Non-numerically controlled sharpening (tool or cutter grinding) machines for working metal	0	0	0	0	0	0	0	0
28412385	Honing or lapping machines for working metal	15.878	31.152	45.844	59.976	73.570	86.646	99.225	111.324
28412395	Machines for deburring or polishing metal (excluding gear finishing machines)	4.446	9.007	13.688	18.492	23.420	28.478	33.667	38.992
28412410	Broaching machines for working metal	53	105	156	206	256	304	352	399
28412430	Gear cutting, gear grinding or gear finishing machines, for working metals, metal carbides or cermets (excluding planing, slotting and broaching machines)	626	1.270	1.932	2.614	3.314	4.035	4.776	5.539
28412470	Sawing or cutting-off machines for working metal	7.275	14.353	21.239	27.937	34.455	40.795	46.964	52.965
28412490	Planing, shaping or slotting machines and other machine-tools working by removing metal or cermets, n.e.c.	577	1.130	1.660	2.168	2.656	3.123	3.571	4.001
28413120	Numerically controlled bending, folding, straightening or flattening machines for working flat metal products	5.428	10.821	16.179	21.502	26.792	32.047	37.269	42.457

	(including presses)								
28413140	Numerically controlled bending, folding, straightening or flattening machines for working metal (including presses) (excluding those for working flat metal products)	4.825	9.891	15.211	20.796	26.661	32.819	39.285	46.074
28413160	Non-numerically controlled bending, folding, straightening or flattening machines for working flat metal products (including presses)	4.257	8.726	13.419	18.346	23.520	28.953	34.657	40.647
28413180	Non-numerically controlled bending, folding, straightening or flattening machines for working metal (including presses) (excluding those for working flat metal products)	0	0	0	0	0	0	0	0
28413220	Numerically controlled shearing machines for working metal (including presses) (excluding combined punching and shearing machines)	2.272	4.508	6.707	8.870	10.998	13.091	15.151	17.177
28413240	Numerically controlled punching or notching machines for working metal (including presses, combined punching and shearing machines)	1.516	3.011	4.484	5.936	7.366	8.776	10.166	11.535
28413260	Non-numerically controlled shearing machines for working metal (including presses) (excluding combined punching and shearing machines)	9.411	19.138	29.191	39.583	50.324	61.425	72.900	84.759
28413280	Non-numerically controlled punching or notching machines for working metal (including presses, combined punching and shearing machines)	827	1.494	2.034	2.469	2.821	3.106	3.335	3.521
28413310	Numerically controlled forging or die-stamping machines and hammers for working metal (including presses)	139	264	376	476	566	646	718	783
28413320	Non-numerically controlled forging or die-stamping machines and hammers for working metal (including presses)	18	37	55	74	92	111	129	148
28413330	Presses for moulding metallic powders by sintering or for compressing scrap metal into bales	241	476	706	930	1.150	1.365	1.574	1.779
28413340	Other hydraulic presses, numerically controlled, for working metal	0	0	0	0	0	0	0	0

28413350	Hydraulic presses for working metal	1.869	3.737	5.606	7.475	9.343	11.212	13.080	14.949
28413360	Non-hydraulic presses for working metal	17.658	35.316	52.974	70.632	88.289	105.947	123.605	141.263
28413370	Other non-hydraulic presses, numerically controlled, for working metal	0	0	0	0	0	0	0	0
28413380	Other non-numerically controlled presses for working metal	0	0	0	0	0	0	0	0
28413410	Draw-benches for bars, tubes, profiles, wire or the like of metal, sintered metal carbides or cermets	685	1.359	2.024	2.679	3.324	3.960	4.586	5.204
28413430	Thread rolling machines for working metal, sintered metal carbides or cermets	198	378	541	689	824	946	1.056	1.157
28413450	Machines for working wire (excluding draw-benches, thread rolling machines)	12.774	25.813	39.124	52.712	66.583	80.743	95.198	109.953
28413470	Riveting machines, swaging machines and spinning lathes for working metal, machines for manufacturing flexible tubes of spiral metal strip and electro-magnetic pulse metal forming machines, and other machine tools for working metal without removing metal	21.381	43.508	66.408	90.107	114.634	140.017	166.287	193.473
	Totals	**199.417**	**399.449**	**600.332**	**802.271**	**1.005.468**	**1.210.138**	**1.416.476**	**1.624.686**

Updated data for 2010 based on PRODCOM production, import and export figures for 2010 are reported in in the Annex.

Table 2-17: Metal working machine tools – Aggregated new installed stock since 2010 (replacement sales) - 2018 - 2025

PRODCOM	Description	2018	2019	2020	2021	2022	2023	2024	2025
28411110	Machine-tools for working any material by removal of material, operated by laser or other light or photon beam processes	27.013	30.813	34.728	38.760	40.463	42.168	43.873	45.575
28411130	Machine-tools for working any material by removal of material, operated by ultrasonic processes (excluding machines for the manufacture of semiconductor devices or of electronic integrated circuits)	4.789	5.370	5.962	6.564	7.177	7.802	8.437	9.084
28411150	Machine tools for working any material by removal of material, operated by electro-discharge processes	7.651	8.162	8.626	9.047	9.430	8.568	7.785	7.074
28411170	Machine-tools for working any material by removal of material, operated by electro-chemical, electron-beam, ionic-beam or plasma arc processes	16.624	17.913	19.116	20.240	21.288	22.267	23.180	24.033
28411220	Horizontal machining centres for working metal	18.890	20.836	22.754	22.415	22.082	21.754	21.431	21.113
28411240	Vertical machining centres for working metal (including combined horizontal and vertical machining centres)	99.246	113.017	127.200	141.809	147.740	153.695	159.667	165.649
28411250	Unit construction machines (single station) for working metal	24.358	27.248	30.178	33.147	36.155	39.204	42.293	45.424
28411270	Multi-station transfer machines for working metal	17.018	18.764	20.483	20.163	19.848	19.538	19.232	18.932
28412123	Numerically controlled horizontal lathes, turning centres, for removing metal	18.929	20.998	23.059	25.113	25.029	24.945	24.862	24.778
28412127	Numerically controlled horizontal lathes, automatic lathes, for removing metal (excluding turning centres)	36.638	40.717	44.797	44.814	44.831	44.849	44.866	44.883
28412129	Numerically controlled horizontal lathes, for removing metal (excluding turning centres, automatic lathes)	21.246	23.098	24.865	26.551	25.332	24.168	23.058	21.998
28412140	Non-numerically controlled horizontal lathes, for removing metal	61.045	67.215	73.272	79.216	85.050	90.777	89.096	87.447

28412160	Lathes, including turning centres, for removing metal (excluding horizontal lathes)	26.331	29.209	32.078	34.937	37.787	40.628	43.459	46.281
28412213	Numerically controlled drilling machines for working metal (excluding way-type unit head machines)	5.752	6.196	6.609	6.995	7.355	7.690	8.003	7.463
28412217	Numerically controlled knee-type milling machines for working metal (excluding boring-milling machines)	2.685	2.888	3.075	3.250	3.412	3.168	2.941	2.731
28412223	Numerically controlled tool-milling machines for working metal (excluding boring-milling machines, knee-type machines)	31.810	35.997	40.309	44.751	46.261	47.801	49.370	50.969
28412225	Numerically controlled milling machines for working metal (including plano-milling machines) (excluding boring-milling machines, knee-type, tool-milling machines)	11.500	12.602	13.672	14.711	15.720	15.269	14.831	14.405
28412235	Non-numerically controlled drilling machines for working metal (excluding way-type unit head machines)	167.281	185.758	204.214	222.647	241.059	259.449	259.143	258.837
28412240	Numerically controlled boring and boring-milling machines for working metal (excluding drilling machines)	9.982	11.201	12.445	13.712	15.004	16.322	17.665	18.008
28412260	Non-numerically controlled boring and boring-milling machines for working metal (excluding drilling machines)	724	761	793	821	845	866	750	651
28412270	Non-numerically controlled milling machines for working metal (excluding boring-milling machines)	4.301	4.654	4.988	5.302	5.599	5.879	5.546	5.233
28412280	Threading or tapping machines for working metal (excluding drilling machines)	89.923	99.673	109.375	119.031	128.639	138.201	137.529	136.861
28412305	Numerically controlled flat-surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	11.597	13.229	14.909	15.589	16.267	16.944	17.618	18.288
28412315	Numerically controlled cylindrical surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	8.925	9.913	10.900	10.891	10.882	10.873	10.864	10.856
28412325	Other numerically controlled grinding machines in which the positioning in any one axis can be set up to accuracy >0.01mm	2.374	2.605	2.829	3.047	2.967	2.889	2.813	2.739
28412335	Non-numerically controlled flat-surface grinding machines for working metal, in which the positioning in any one axis	0	0	0	0	0	0	0	0

	can be set up to a minimum accuracy of 0.01mm							
28412345	Non-numerically controlled cylindrical surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	2.985	3.317	3.648	3.980	4.312	4.643	4.643	4.643
28412355	Grinding machines for working metal; any one axis can be set to an accuracy >=0.01mm excluding flat-surface grinding machines, cylindrical surface grinding machines	12.755	13.718	14.613	15.445	16.217	16.935	15.733	14.616
28412365	Numerically controlled sharpening (tool or cutter grinding) machines for working metal	42.282	47.341	48.052	48.774	49.507	50.251	51.006	51.773
28412375	Non-numerically controlled sharpening (tool or cutter grinding) machines for working metal	0	0	0	0	0	0	0	0
28412385	Honing or lapping machines for working metal	122.963	134.158	129.049	124.134	119.406	114.859	110.484	106.277
28412395	Machines for deburring or polishing metal (excluding gear finishing machines)	44.457	50.064	55.817	61.721	67.779	73.995	75.928	77.912
28412410	Broaching machines for working metal	445	490	535	578	621	664	652	641
28412430	Gear cutting, gear grinding or gear finishing machines, for working metals, metal carbides or cermets (excluding planing, slotting and broaching machines)	6.323	7.130	7.960	8.813	9.065	9.324	9.591	9.865
28412470	Sawing or cutting-off machines for working metal	58.803	64.483	70.009	75.385	80.615	85.703	83.378	81.116
28412490	Planing, shaping or slotting machines and other machine-tools working by removing metal or cermets, n.e.c.	4.413	4.808	5.187	5.550	5.898	6.232	5.976	5.730
28413120	Numerically controlled bending, folding, straightening or flattening machines for working flat metal products (including presses)	47.611	52.733	57.821	62.877	67.900	67.463	67.029	66.597
28413140	Numerically controlled bending, folding, straightening or flattening machines for working metal (including presses) (excluding those for working flat metal products)	53.202	60.687	68.397	76.338	79.692	83.050	86.408	89.760
28413160	Non-numerically controlled bending, folding, straightening or flattening machines for working flat metal products	46.936	53.539	60.341	67.346	74.562	81.994	85.392	88.808

	(including presses)							
28413180	Non-numerically controlled bending, folding, straightening or flattening machines for working metal (including presses) (excluding those for working flat metal products)	0	0	0	0	0	0	0	0
28413220	Numerically controlled shearing machines for working metal (including presses) (excluding combined punching and shearing machines)	19.170	21.130	23.059	24.956	24.550	24.151	23.758	23.372
28413240	Numerically controlled punching or notching machines for working metal (including presses, combined punching and shearing machines)	12.885	14.215	15.526	16.818	16.574	16.335	16.098	15.865
28413260	Non-numerically controlled shearing machines for working metal (including presses) (excluding combined punching and shearing machines)	97.018	109.688	122.738	136.180	150.025	164.286	169.563	174.965
28413280	Non-numerically controlled punching or notching machines for working metal (including presses, combined punching and shearing machines)	3.671	3.792	3.889	3.968	4.032	4.084	3.332	2.665
28413310	Numerically controlled forging or die-stamping machines and hammers for working metal (including presses)	841	892	939	980	1.018	1.051	1.081	1.108
28413320	Non-numerically controlled forging or die-stamping machines and hammers for working metal (including presses)	166	185	203	222	240	259	259	259
28413330	Presses for moulding metallic powders by sintering or for compressing scrap metal into bales	1.980	2.176	2.367	2.554	2.737	2.916	2.850	2.786
28413340	Other hydraulic presses, numerically controlled, for working metal	0	0	0	0	0	0	0	0
28413350	Hydraulic presses for working metal	16.818	18.686	20.555	22.424	24.292	26.161	28.029	29.898
28413360	Non-hydraulic presses for working metal	158.921	176.579	194.237	211.895	229.552	247.210	264.868	282.526
28413370	Other non-hydraulic presses, numerically controlled, for working metal	0	0	0	0	0	0	0	0
28413380	Other non-numerically controlled presses for working metal	0	0	0	0	0	0	0	0

28413410	Draw-benches for bars, tubes, profiles, wire or the like of metal, sintered metal carbides or cermets	5.812	6.412	7.002	7.584	8.158	8.723	9.144	8.470
28413430	Thread rolling machines for working metal, sintered metal carbides or cermets	1.249	1.332	1.407	1.475	1.537	1.594	1.493	1.314
28413450	Machines for working wire (excluding draw-benches, thread rolling machines)	125.016	140.393	156.089	172.113	188.470	205.167	222.212	213.799
28413470	Riveting machines, swaging machines and spinning lathes for working metal, machines for manufacturing flexible tubes of spiral metal strip and electro-magnetic pulse metal forming machines, and other machine tools for working metal without removing metal	221.609	250.727	280.718	311.610	332.692	343.548	354.617	330.090
	Totals	**1.834.963**	**2.047.512**	**2.241.394**	**2.427.243**	**2.575.673**	**2.706.312**	**2.771.836**	**2.774.167**

2.2.2.2 Wood working machine tools

Actually, it has to be noticed that average machine tool lifetime – which is quite uncertain as such - changes with the economic cycle and does not keep stable over time. However, these dynamics in detail are not known.

Having said this, the stock model for wood working machine tool product categories (NACE codes) is as listed in the table below for 1995 as Kyoto reference year and 2009 as most recent year, for which Eurostat data is available. This covers explicitly also what is called "light stationary" machinery by EPTA (see Task 1), which is in the terminology of this study rather "transportable" equipment.

Table 2-18: Wood working machine tools - Installed stock 1995 and 2009

PRODCOM	Description	1995	2009
28491210	Multi-purpose machines where the workpiece is manually transferred between operations, for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	80.874	85.973
28491220	Multi-purpose machines where the workpiece is automatically transferred between operations for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	95.377	134.938
28491233	Band saws for working wood, cork, bone and hard rubber, hard plastics or similar hard materials	150.692	171.091
28491235	Circular saws for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	1.256.347	1.265.651
28491237	Sawing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials (excluding band saws, circular saws)	1.774.961	2.252.145
28491250	Planing, milling or moulding (by cutting) machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	682.899	857.192
28491263	Grinding, sanding or polishing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	166.293	159.022
28491265	Bending or assembling machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	56.602	51.460
28491267	Drilling or morticing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	143.810	144.628
28491275	Splitting, slicing or paring machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	213.330	284.247
28491279	Machine tools for working wood, cork, bone, hard rubber, hard plastics or similar hard materials, n.e.c.	248.868	378.955
	Totals	**4.872.048**	**5.787.311**

Total installed stock of wood working machine tools is depicted in Figure 2-8.

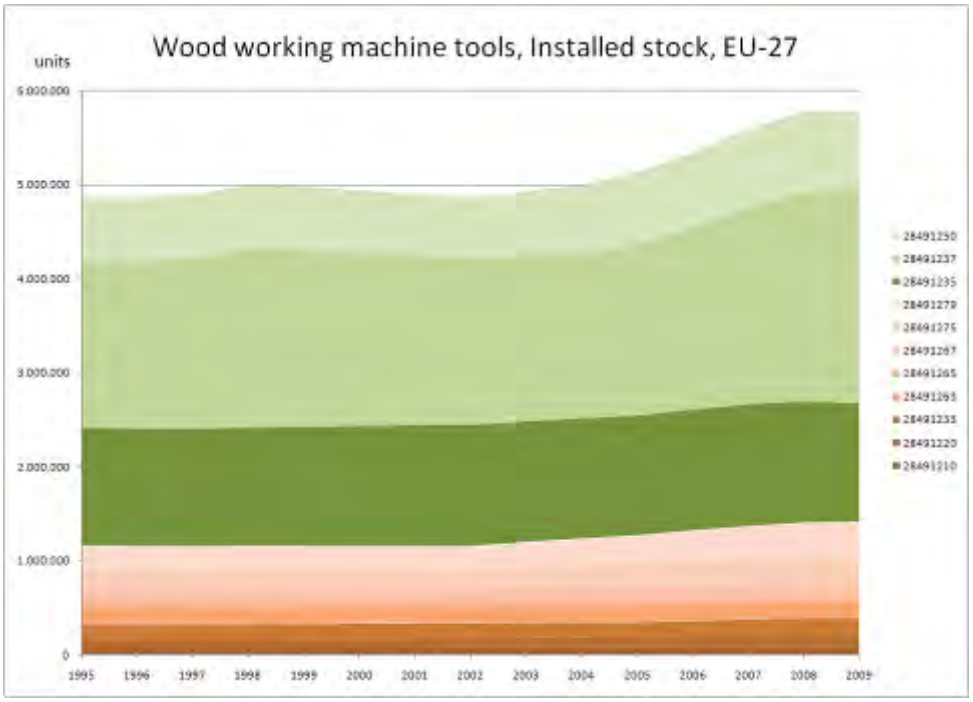

Figure 2-8: Installed Stock – Wood Working Machine Tools Categories – Development 1995 - 2009

The 3 wood working machine tools categories covering (or at least are dominated by) "light stationary", i.e. low value transportable tools are coloured in green in Figure 2-8. The **number of larger stationary machinery** according to this stock model is slightly increasing over the years, totalling in **1.4 million units in the EU27** currently. Considering all wood working machine tools categories, including the "light stationary" ones, the totals are at **5.8 million wood working machine tools** in operation in EU-27. For some of the covered categories in some years non-plausible figures are reported by EuroStat, which could be corrected only with rather rough assumptions. Hence, the stock model is less reliable than for the metal working machine tools.

Regarding the totals there is a slight increase between 1995 and 2009. Even the economic crisis 2008/09 with an effect on the newly installed stock, which significantly dropped for several product categories in 2009, does not result in a visible decrease of total installed stock. This effect is due to the long anticipated machinery lifetimes and presumably due to the fact that the wood working sector partly benefitted from economic recovery packages investing in building and construction.

Given the stable basis of crafts shops in the EU, usage of wood working machinery for domestic building and construction and a s till strong furniture industry in Europe despite partial shift of production to low cost countries, there is little evidence that the

trend in installed units will change drastically in coming years. Hence, in **2025** as a rough estimation the installed stock of wood working machinery is likely to be on the same level as today.

For later calculations of achievable improvements on the EU-27 level the future stock is assumed to remain on the same level as calculated for 2009, and all new wood working machine tools installed are replacement sales. Consequently, depending on the estimated lifetime a certain share of machine tools will be newly installed. The resulting annual replacement rate is listed in Table 2-19 and applied in the following stock forecasts.

Table 2-19: Wood Working Machine Tools – Replacement rate for stock forecasts

PRODCOM	Description	annual replacement rate
28491210	Multi-purpose machines where the workpiece is manually transferred between operations, for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	5%
28491220	Multi-purpose machines where the workpiece is automatically transferred between operations for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	5%
28491233	Band saws for working wood, cork, bone and hard rubber, hard plastics or similar hard materials	5%
28491235	Circular saws for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	5%
28491237	Sawing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials (excluding band saws, circular saws)	5%
28491250	Planing, milling or moulding (by cutting) machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	5%
28491263	Grinding, sanding or polishing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	5%
28491265	Bending or assembling machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	5%
28491267	Drilling or morticing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	5%
28491275	Splitting, slicing or paring machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	5%
28491279	Machine tools for working wood, cork, bone, hard rubber, hard plastics or similar hard materials, n.e.c.	5%

Calculations of aggregated new installed stock since 2010 for the forthcoming years until 2025 are listed in Table 2-20 and Table 2-21. Based on these calculations in **2020 3.2 million wood working machine tools will be units sold in 2010 and later**. In **2025 4.6 million wood working machine tools will have been replaced since 2010**, and the remaining **1.2 million units in stock will be those constructed before 2010**.

Table 2-20: Wood working machine tools – Aggregated new installed stock since 2010 (replacement sales) - 2010 - 2017

PRODCOM	Description	2010	2011	2012	2013	2014	2015	2016	2017
28491210	Multi-purpose machines where the workpiece is manually transferred between operations, for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	4.299	8.597	12.896	17.195	21.493	25.792	30.091	34.389
28491220	Multi-purpose machines where the workpiece is automat-ically transferred between operations for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	6.747	13.494	20.241	26.988	33.734	40.481	47.228	53.975
28491233	Band saws for working wood, cork, bone and hard rubber, hard plastics or similar hard materials	8.555	17.109	25.664	34.218	42.773	51.327	59.882	68.436
28491235	Circular saws for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	63.283	126.565	189.848	253.130	316.413	379.695	442.978	506.260
28491237	Sawing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials (excluding band saws, circular saws)	112.607	225.214	337.822	450.429	563.036	675.643	788.251	900.858
28491250	Planing, milling or moulding (by cutting) machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	42.860	85.719	128.579	171.438	214.298	257.157	300.017	342.877
28491263	Grinding, sanding or polishing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	7.951	15.902	23.853	31.804	39.755	47.706	55.658	63.609
28491265	Bending or assembling machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	2.573	5.146	7.719	10.292	12.865	15.438	18.011	20.584
28491267	Drilling or morticing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	7.231	14.463	21.694	28.926	36.157	43.388	50.620	57.851
28491275	Splitting, slicing or paring machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	14.212	28.425	42.637	56.849	71.062	85.274	99.486	113.699
28491279	Machine tools for working wood, cork, bone, hard rubber, hard plastics or similar hard materials, n.e.c.	18.948	37.896	56.843	75.791	94.739	113.687	132.634	151.582
	Totals	**293.564**	**582.829**	**872.095**	**1.161.358**	**1.450.624**	**1.739.887**	**2.024.856**	**2.314.120**

Table 2-21: Wood working machine tools – Aggregated new installed stock since 2010 (replacement sales) - 2018 - 2025

PRODCOM	Description	2018	2019	2020	2021	2022	2023	2024	2025
28491210	Multi-purpose machines where the workpiece is manually transferred between operations, for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	38.688	42.987	47.285	51.584	55.883	60.181	64.480	68.779
28491220	Multi-purpose machines where the workpiece is automat-ically transferred between operations for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	60.722	67.469	74.216	80.963	87.709	94.456	101.203	107.950
28491233	Band saws for working wood, cork, bone and hard rubber, hard plastics or similar hard materials	76.991	85.545	94.100	102.654	111.209	119.763	128.318	136.872
28491235	Circular saws for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	569.543	632.826	696.108	759.391	822.673	885.956	949.238	1.012.521
28491237	Sawing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials (excluding band saws, circular saws)	1.013.465	1.126.072	1.238.680	1.351.287	1.463.894	1.576.501	1.689.109	1.801.716
28491250	Planing, milling or moulding (by cutting) machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	385.736	428.596	471.455	514.315	557.174	600.034	642.894	685.753
28491263	Grinding, sanding or polishing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	71.560	79.511	87.462	95.413	103.364	111.315	119.266	127.217
28491265	Bending or assembling machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	23.157	25.730	28.303	30.876	33.449	36.022	38.595	41.168
28491267	Drilling or morticing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	65.083	72.314	79.545	86.777	94.008	101.240	108.471	115.702
28491275	Splitting, slicing or paring machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	127.911	142.123	156.336	170.548	184.760	198.973	213.185	227.397
28491279	Machine tools for working wood, cork, bone, hard rubber, hard plastics or similar hard materials, n.e.c.	170.530	189.478	208.426	227.373	246.321	265.269	284.217	303.164
	Totals	**2.603.386**	**2.892.651**	**3.181.916**	**3.471.181**	**3.760.444**	**4.049.710**	**4.338.976**	**4.628.239**

Updated data for 2010 based on PRODCOM production, import and export figures for 2010 are reported in in the Annex.

2.2.2.3 Welding, soldering and brazing equipment

Actually, it has to be noticed that average machinery lifetime changes with the economic cycle and does not keep stable over time. In particular, it can be assumed that during the economic crisis in 2008/2009 a significant share of welding equipment might have been kept in stock or operation respectively instead of being replaced by new equipment. However, these dynamics in detail are not known.

Having said this, the stock model for welding, soldering and brazing equipment product categories (NACE codes) is as listed in the table below for 1995 as Kyoto reference year and 2009 as most recent year, for which Eurostat data is available.

Table 2-22: Welding, soldering and brazing equipment - Installed stock 1995 and 2009

PRODCOM	Description	1995	2009
27903118	Electric brazing or soldering machines and apparatus (excluding soldering irons and guns)	87.474	76.626
27903145	Electric machines and apparatus for resistance welding of metal	1.038.241	1.014.599
27903154	Fully or partly automatic electric machines for arc welding of metals (including plasma arc)	1.678.333	1.271.472
27903163	Other for manual welding with coated electrodes	1.688.136	1.868.230
27903172	Other shielded arc welding	1.000.348	1.406.819
27903181	Machines and apparatus for welding or spraying of metals, n.e.c.	219.543	209.110
27903190	Machines and apparatus for resistance welding of plastics	892.322	1.087.628
27903199	Machines and apparatus for welding (excluding for resistance welding of plastics, for arc and plasma arc welding, for treating metals)	87.450	139.121
28297090	Machinery and apparatus for soldering, brazing, welding or surface tempering (excluding hand-held blow pipes and electric machines and apparatus)	51.321	59.533
	Totals	**6.745.163**	**7.135.147**

Total installed stock of welding, soldering and brazing equipment is depicted in Figure 2-9.

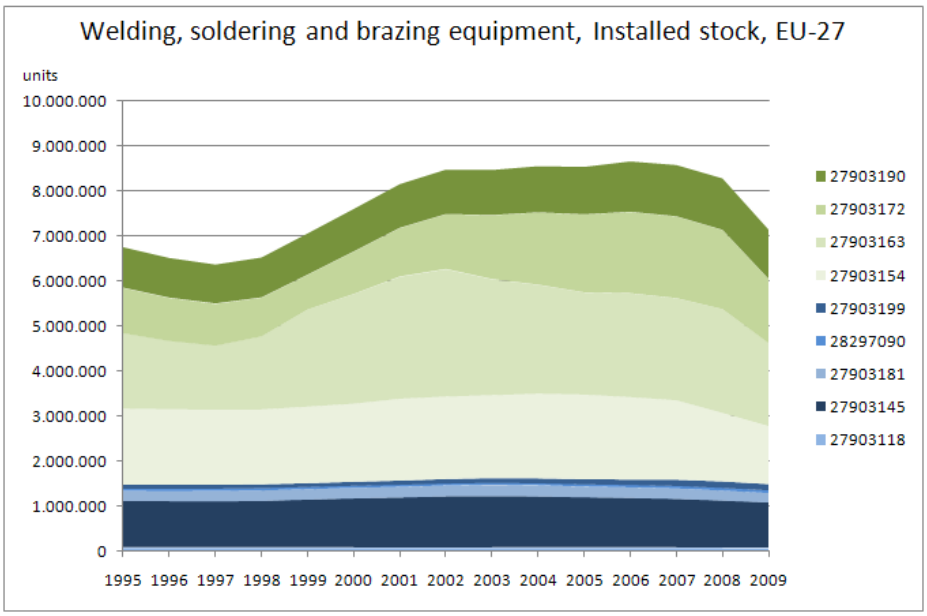

Figure 2-9: Installed Stock – Welding, Soldering and Brazing Equipment Categories – Development 1995 - 2009

The categories covering (or at least are dominated by) rather stationary equipment (indication is a unit value of 10.000 Euro and above) are coloured in blue in Figure 2-9. Smaller, transportable units are those coloured in green. As the transportable units have a shorter lifetime than the installed stationary ones fluctuations in the economic cycles and production figures result also in much higher year-to-year variations according to the simplified stock model. The number of **stationary units** according to this stock model is on a stable level at roughly **1.5 million units in the EU27**. This includes roughly 60.000 soldering machines (PRODCOM 28297090), which are likely to be covered by the scope of the Product Group Study Lot 4 - Industrial and Laboratory Furnaces and Ovens**.** There are another estimated **5.5 – 7 million smaller transportable units**, frequently in the range of a few 100 Euros unit value.

Despite the year-to-year fluctuation there is nearly no difference between 1995 and 2009.

Future developments of the stock are subject to the long-term effect of the 2008/2009 economic crisis and the general trend to shift production to low cost countries – the latter being irrelevant for the consumption of welding equipment to be used on-site (construction sites). A closer look at the newly installed stationary units per year gives the impression, that there was a peak in 2003 and thereafter a downward trend in terms of new equipment installed (unit based), and even the economic growth years

2006-2008 do not fully reverse this trend (Figure 2-10). In particular electric machines and apparatus for resistance welding of metal (PRODCOM 27903145) determine this tendency. The trend observed for metal working machine tools, that there is a shift from lower value industrial machines to rather high value automated (but fewer) machines, is not confirmed for the welding sector by EuroStat figures. In case the observed trend continues this might reduce the number of **installed stationary units** from 1.5 million units currently to roughly **1 - 1.2 million units in 2025** in EU-27.

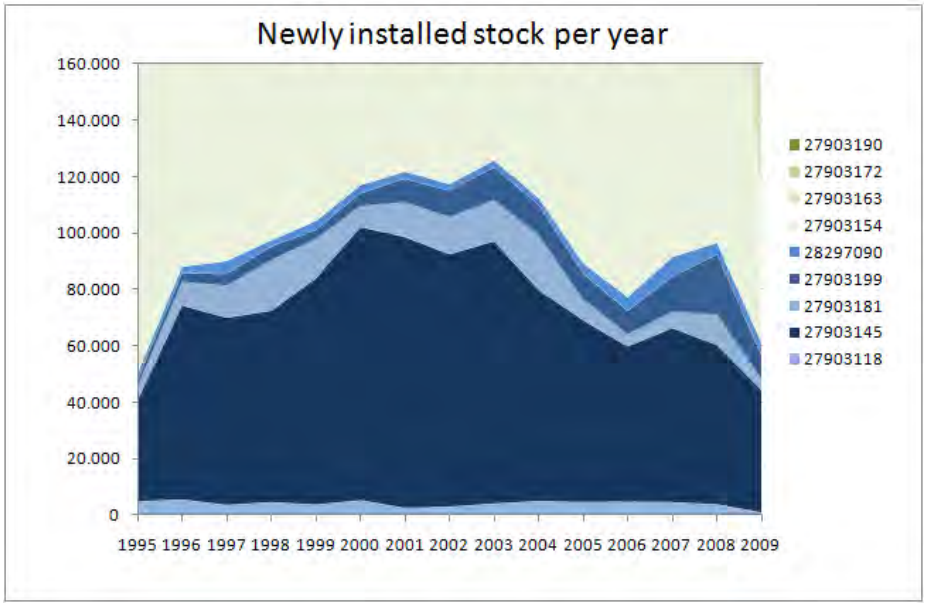

Figure 2-10: Newly Installed Stock per Year – Welding, Soldering and Brazing Equipment (Stationary Units) – Development 1995 - 2009

In developed economies, such as the EU-27, growth of the welding industry and thus consumption of welding equipment is closely related to industrial production. Consumption sectors of particular growth are the energy sector including wind turbine constructions as well as repairs and maintenance of machinery. According to a recent report by Global Industry Analysts, Inc. adopting newer technologies has emerged as the single-most significant trend in the market, whereby numerous segments have given up traditional welding methodologies in favour of modern ones. There has been a sharp decline in the demand for metal welding equipment, with a shift to plastics and other synthetic materials[27]. Furthermore, advancements in welding technology and greater automation will set the momentum for future growth in the industry.

[27] Global Industry Analysts, Inc.: Welding Machinery: A Global Strategic Business Report, October 25, 2010, San Jose

Taking into account these economic trends a rather stable stock of transportable units in forthcoming years can be anticipated.

For later calculations of achievable improvements on the EU-27 level the future stock is assumed to remain on the same level as calculated for 2009, and all welding, soldering and brazing units installed are replacement sales. Consequently, depending on the estimated lifetime a certain share of this kind of equipment will be newly installed. The resulting annual replacement rate is listed in Table 2-23 and applied in the following stock forecasts.

Table 2-23: Welding, soldering and brazing equipment – Replacement rate for stock forecasts

PRODCOM	Description	annual replacement rate
27903118	Electric brazing or soldering machines and apparatus (excluding soldering irons and guns)	5,0%
27903145	Electric machines and apparatus for resistance welding of metal	6,7%
27903154	Fully or partly automatic electric machines for arc welding of metals (including plasma arc)	14,3%
27903163	Other for manual welding with coated electrodes	20,0%
27903172	Other shielded arc welding	20,0%
27903181	Machines and apparatus for welding or spraying of metals, n.e.c.	5,0%
27903190	Machines and apparatus for resistance welding of plastics	5,0%
27903199	Machines and apparatus for welding (excluding for resistance welding of plastics, for arc and plasma arc welding, for treating metals)	5,0%
28297090	Machinery and apparatus for soldering, brazing, welding or surface tempering (excluding hand-held blow pipes and electric machines and apparatus)	5,0%

Calculations of aggregated new installed stock since 2010 for the forthcoming years until 2025 are listed in Table 2-24 and Table 2-25. Based on these calculations in **2020 6.2 million units of welding, soldering and brazing equipment will be units sold in 2010 and later**. In **2025 6.8 million welding, soldering and brazing units will have been replaced since 2010**, and the remaining **300.000 units in stock will be those constructed before 2010** (larger installed units with longer lifetimes).

Table 2-24: Welding, Soldering and Brazing Equipment – Aggregated new installed stock since 2010 (replacement sales) - 2010 - 2017

PRODCOM	Description	2010	2011	2012	2013	2014	2015	2016	2017
27903118	Electric brazing or soldering machines and apparatus (excluding soldering irons and guns)	3.831	7.663	11.494	15.325	19.156	22.988	26.819	30.650
27903145	Electric machines and apparatus for resistance welding of metal	67.640	135.280	202.920	270.560	338.200	405.839	473.479	541.119
27903154	Fully or partly automatic electric machines for arc welding of metals (including plasma arc)	181.639	363.278	544.916	726.555	908.194	1.089.833	1.271.472	1.271.472
27903163	Other for manual welding with coated electrodes	373.646	747.292	1.120.938	1.494.584	1.868.230	1.868.230	1.868.230	1.868.230
27903172	Other shielded arc welding	281.364	562.728	844.091	1.125.455	1.406.819	1.406.819	1.406.819	1.406.819
27903181	Machines and apparatus for welding or spraying of metals, n.e.c.	10.455	20.911	31.366	41.822	52.277	62.733	73.188	83.644
27903190	Machines and apparatus for resistance welding of plastics	54.381	108.763	163.144	217.526	271.907	326.288	380.670	435.051
27903199	Machines and apparatus for welding (excluding for resistance welding of plastics, for arc and plasma arc welding, for treating metals)	6.956	13.912	20.868	27.824	34.780	41.736	48.692	55.649
28297090	Machinery and apparatus for soldering, brazing, welding or surface tempering (excluding hand-held blow pipes and electric machines and apparatus)	2.977	5.953	8.930	11.907	14.883	17.860	20.837	23.813
	Totals	**982.889**	**1.965.780**	**2.948.667**	**3.931.558**	**4.914.446**	**5.242.326**	**5.570.206**	**5.716.447**

Updated data for 2010 based on PRODCOM production, import and export figures for 2010 are reported in in the Annex.

Table 2-25: Welding, Soldering and Brazing Equipment – Aggregated new installed stock since 2010 (replacement sales) - 2018 - 2025

PRODCOM	Description	2018	2019	2020	2021	2022	2023	2024	2025
27903118	Electric brazing or soldering machines and apparatus (excluding soldering irons and guns)	34.482	38.313	42.144	45.975	49.807	53.638	57.469	61.301
27903145	Electric machines and apparatus for resistance welding of metal	608.759	676.399	744.039	811.679	879.319	946.959	1.014.599	1.014.599
27903154	Fully or partly automatic electric machines for arc welding of metals (including plasma arc)	1.271.472	1.271.472	1.271.472	1.271.472	1.271.472	1.271.472	1.271.472	1.271.472
27903163	Other for manual welding with coated electrodes	1.868.230	1.868.230	1.868.230	1.868.230	1.868.230	1.868.230	1.868.230	1.868.230
27903172	Other shielded arc welding	1.406.819	1.406.819	1.406.819	1.406.819	1.406.819	1.406.819	1.406.819	1.406.819
27903181	Machines and apparatus for welding or spraying of metals, n.e.c.	94.099	104.555	115.010	125.466	135.921	146.377	156.832	167.288
27903190	Machines and apparatus for resistance welding of plastics	489.432	543.814	598.195	652.577	706.958	761.339	815.721	870.102
27903199	Machines and apparatus for welding (excluding for resistance welding of plastics, for arc and plasma arc welding, for treating metals)	62.605	69.561	76.517	83.473	90.429	97.385	104.341	111.297
28297090	Machinery and apparatus for soldering, brazing, welding or surface tempering (excluding hand-held blow pipes and electric machines and apparatus)	26.790	29.767	32.743	35.720	38.697	41.673	44.650	47.627
	Totals	**5.862.688**	**6.008.930**	**6.155.169**	**6.301.411**	**6.447.652**	**6.593.892**	**6.740.133**	**6.818.735**

2.2.2.4 Other machine tools

EuroStat figures for other machine tools are of limited accuracy. For the segment stone and ceramics working machine tools the export value in some years exceeded the production value (PRODCOM code 28491150), which could be the case, if imports are re-exported, but is rather unlikely and leads to the assumption, that systematically export statistics cover more machinery types than the production statistics. These inconsistencies could not be verified, and the resulting stock figures are subject to a high level of uncertainty.

Having said this, the stock model for stone and ceramics working machine tools and the like product categories (NACE codes) is as listed in the table below for 1995 as Kyoto reference year and 2009.

Table 2-26: Stone and ceramics working machine tools - Installed stock 1995 and 2009

PRODCOM	Description	1995	2009
28491130	Sawing machines for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold working glass	488.852	656.877
28491150	Grinding or polishing machines for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold working glass	105.601	108.832
28491170	Machine-tools for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold working glass (excluding sawing machines, grinding or polishing machines)	127.710	178.201
	Totals	**724.158**	**945.919**

Total installed stock of stone and ceramics working machine tools as one major segment of “other machine tools” is depicted in Figure 2-11. The number of installed machine tools rose from **720.000 units** in 1995 to nearly **950.000 units** in 2009 according to this stock model. The economic crisis of 2009 is not visible in this stock model: Although sales volume went down significantly the newly installed stock was in a similar range as 20 years before (the anticipated average lifetime) which leads to a stable stock according to the simplified model.

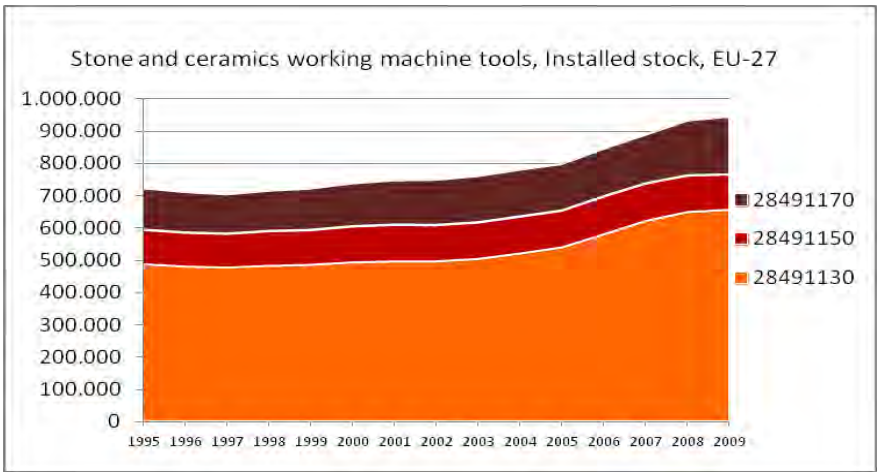

Figure 2-11: Installed Stock – Stone and Ceramics Working Machine Tools Categories – Development 1995 - 2009

For future years it is assumed, that the installed stock remains on a stable level.

Calculations of aggregated new installed stock since 2010 for the forthcoming years until 2025 are listed in Table 2-27 and Table 2-28. Based on these calculations in **2020 520.000 stone and ceramics working machine tools will be units sold in 2010 and later**. In **2025 750.000 stone and ceramics working machine tools will have been replaced since 2010**, and the remaining **200.000 units in stock will be those constructed before 2010**.

Table 2-27: Stone and ceramics working machine tools – Aggregated new installed stock since 2010 (replacement sales) - 2010 - 2017

PRODCOM	Description	2010	2011	2012	2013	2014	2015	2016	2017
28491130	Sawing machines for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold working glass	32.844	65.688	98.532	131.375	164.219	197.063	229.907	262.751
28491150	Grinding or polishing machines for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold working glass	5.442	10.883	16.325	21.766	27.208	32.649	38.091	43.533
28491170	Machine-tools for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold working glass (excluding sawing machines, grinding or polishing machines)	8.910	17.820	26.730	35.640	44.550	53.460	62.370	71.280

Updated data for 2010 based on PRODCOM production, import and export figures for 2010 are reported in in the Annex.

Table 2-28: Stone and ceramics working machine tools – Aggregated new installed stock since 2010 (replacement sales) - 2018 - 2025

PRODCOM	Description	2018	2019	2020	2021	2022	2023	2024	2025
28491130	Sawing machines for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold working glass	295.595	328.439	361.282	394.126	426.970	459.814	492.658	525.502
28491150	Grinding or polishing machines for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold working glass	48.974	54.416	59.857	65.299	70.741	76.182	81.624	87.065
28491170	Machine-tools for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold working glass (excluding sawing machines, grinding or polishing machines)	80.190	89.101	98.011	106.921	115.831	124.741	133.651	142.561

2.2.3 Summary

Based on a comprehensive stock model an installed number of machine tools as listed in the following table can be estimated.

Table 2-29: EU-27 installed stock – Summary (stock model by Fraunhofer)

Category	Installed stock (units, EU-27, 1995)	Installed stock (units, EU-27, 2009)	Installed stock (units, EU-27, 2025)	thereof newly installed between 2010 and 2025 (units, EU-27)
Metal working machine tools	**3.9 million**	**3.5 million**	**2.8 million**	2.8 million
Thereof numerical-controlled	***0.35 million***	***0.75 million***	***0.8 million***	
Wood working machine tools	**5 million**	**5.8 million**	**5.8 million**	4.6 million
thereof larger stationary woodworking tools	***1.2 million***	***1.4 million***	***1.4 million***	
Welding, soldering and brazing equipment	**6.7 million**	**7.1 million**	**7.1 million**	6.8 million
thereof stationary units	***1.5 million***	***1.5 million***	***1.5 million***	
Stone and ceramics working machine tools (as sub-segment of "other machine tools")	**0.72 million**	**0.95 million**	**0.95 million**	0.75 million
Totals	**16.3 million**	**17.4 million**	**16.7 million**	15 million

The major share of the stock will be replaced between 2010 and 2025. Given the long lifetime of industrial equipment a larger number of machine tools constructed before 2010 will be still in operation in 2025.

2.3 Market channels and production structures

The objective of the task 2.3 is the analysis of general market structure and respective trends.

2.3.1 Market Players and Production

2.3.1.1 Metal working machine tools

The main producers of machine tools in Europe are Germany (with a share of almost 50%) and Italy (26%), see Figure 2-12[28]. All other European countries are much less important. Similarly, within the European Union 41% of all machine tools were sold within or to Germany, 24% within or to Italy (see Figure 2-17).

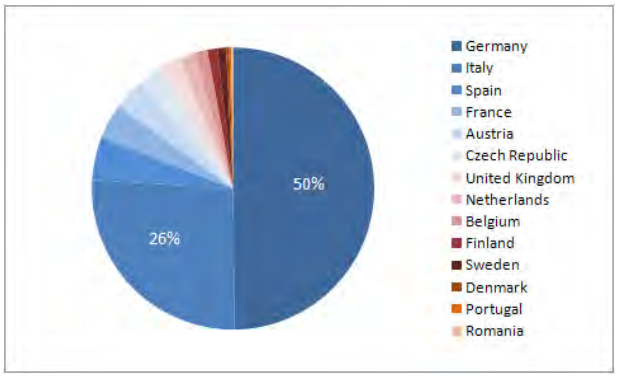

Figure 2-12: Machine tool production share of most relevant EU countries (2008, in monetary units)

Table 2-30 lists the major companies relevant for the machine tool market and the country, where these companies are based. This shows again the strong position of the European machine tool market. Among the top 50 there are 19 manufacturers from the EU-27, thereof 13 from Germany.

There is a trend towards market concentration in the machine tools business, which is driven by the general trend towards globally distributed industrial production: Setting up a production at various locations requires from machine tool providers also a global representation, and customers want a broad spectrum of machine tools they can

[28] Based on: Gardner Publications, Inc.: 2009 World Machine Tool Output & Consumption Survey, http://www.gardnerweb.com/consump/survey.html, accessed: March 11, 2010

choose from, which can be provided rather by machine tool manufacturers exceeding a turnover of at least 1 billion Euro per year. The prediction, that the 20 leading machine tools manufacturer might represent more than 50% global market share mid-term is confirmed by experts[29] (up from below 35% in 2008, see Table 2-30).

Table 2-30: Top 50 Machine Tool Manufacturers Worldwide[30]

	Company Name	Country	Machine tool revenue US $-Mill.	Major Brands
1.	Trumpf	Germany	2,770.3	Trumpf, TruPunch, TruBend, TruLaser
2.	Yamazaki Mazak	Japan	2,525.0	Mazak
3.	Gildemeister	Germany	2,507.9	Gildemeister, Deckel Maho, Gildemeister Italiana
4.	Amada	Japan	2,099.0	Amada, Amada Wasino
5.	Okuma	Japan	1,877.4	Okuma
6.	MAG	U.S.A.	1,654.0	Cincinnati, G&L, Fadal, Cross Hueller, Lamb, XLO
7.	Shenyang	China	1,626.7	Shenyang, Schiess, Liaoning Precsn, Yunnan CY
8.	Mori Seiki	Japan	1,572.0	Mori Seiki, Dixi, Mori Seiki Hitech
9.	Dalian	China	1,525.7	Dalian, Ingersoll Production Systems, BoKo
10.	Jtekt	Japan	1,524.6	Toyoda, Koyo
11.	Schuler	Germany	1,452.9	Schuler, Müller-Weingarten, SMG, Gräbener, Hydr
12.	GF AgieCharmilles	Switzerland	1,000.6	Charmilles, Agie, Mikron, ActSpark
13.	Haas	U.S.A.	880.0	Haas
14.	Doosan Infracore	So. Korea	856.3	Doosan, Daewoo
15.	Makino	Japan	782.8	Makino
16.	Emag	Germany	758.0	Emag; SW; NaxosUnion
17.	Wia	So. Korea	726.0	Hyundai-Kia
18.	Körber Schleifring	Germany	715.1	Blohm, Ewag, Jung, Mägerle, Studer, Walter
19.	Bystronic	Switzerland	690.3	Bystronic, Beyeler, AFM Tianjin.
20.	Index	Germany	675.8	Index, Traub
21.	Komatsu NTC	Japan	609.1	NTC, Nippei Toyama
22.	Aida	Japan	606.8	Aida, Manzoni, Rovetta
23.	Chiron	Germany	598.8	Chiron, STAMA
24.	Rofin-Sinar	Germany	575.3	Rofin, PRC, Lee
25.	A-TEC Industries	Austria	544.5	Emco-Maier, -Mecof, -Famup, Intos, Dorries
26.	Gleason	U.S.A.	542.4	Gleason, Gleason-Pfauter, -Hurth, -M&M
27.	Prima	Italy	540.4	Prima, Convergent Laser, Laserdyne
28.	Heller	Germany	515.8	Heller
29.	Grob	Germany	510.5	Grob
30.	Komatsu Press	Japan	502.1	Komatsu, Komatsu Maypres
31.	Hermle	Germany	409.6	Hermle
32.	Danobat	Spain	400.2	Danobat, Soraluce, Estarta, Overbeck, Newall
33.	Sodick	Japan	389.9	Sodick
34.	Liebherr	Switzerland	375.2	Liebherr, Sigma Pool
35.	Star Micronics	Japan	353.9	Star Micronics
36.	Hardinge	U.S.A.	345.0	Hardinge, Kellenberger, HTT, Bridgeport

[29] See Interview with Dr. Rüdiger Kapitza, CEO Gildemeister AG, and Dr. Masahiko Mori,CEO Mori Seiki Co., Ltd., in: Die Zukunft der Werkzeugmaschinen-Industrie, Produktion Nr. 24, 2007

[30] Metalworking Insiders' Report, Machine Tool Scoreboard, updated July 24, 2009

	Company Name	Country	Machine tool revenue US $-Mill.	Major Brands
37.	Feintool	Switzerland	341.0	Feintool, Schmid, Hydrel
38.	Citizen	Japan	332.3	Citizen Cincom
39.	Nachi-Fujikoshi	Japan	312.0	Nachi
40.	Finn-Power	Finland	306.3	Finn-Power
41.	Comau	Italy	298.5	Comau, PICO, Renault Automation
42.	Mitsubishi H.I.	Japan	292.8	Mitsubishi
43.	Niles-Simmons	Germany	291.0	Niles-Simmons, Hegenscheidt-MFD
44.	StarragHeckert	Switzerland	284.3	Starrag (Rigid), Heckert, SIP
45.	Fagor Arrasate	Spain	270.7	Fagor Arrasate, Ona Pres
46.	Toshiba	Japan	252.9	Shibaura, Toshiba
47.	Autania	Germany	251.1	Elb, WFL Millturn, Profiroll, Wirth & Gruffat, Sieber
48.	OKK	Japan	247.7	OKK
49.	Romi	Brazil	245.1	Romi
50.	Tornos	Switzerland	243.6	Tornos

Table 2-31: Machine tool production in Germany, 2008

Segment	Million Euro
Laser-, ion beam-, ultrasonic machines	473,0
Electrical discharge machines	74,2
Machining centres, flexible systems	1.913,4
Unit construction machines, transfer machines	566,4
Turning machines, turning centres	1.561,9
Drilling machines, boring machines, boring-milling machines	208,6
Milling machines	1.090,2
Grinding, honing, lapping and polishing machines	1.225,6
Gear cutting and finishing machines	748,3
Sawing and cutting-off machines	267,6
Other metal cutting machine tools	85,6
Metal cutting machine tools	**8.214,8**
Forging machines and hammers (incl. presses)	148,7
Bending, folding and straightening machines (incl. presses)	542,6
Shearing, punching, notching machines (incl. presses)	432,9
Other presses	615,8
Wire working machines	299,4
Other metal forming machine tools	462,1
Metal forming machine tools	**2.501,5**
Total machine tools	**10.716,2**
Parts, accessories	2.537,4
Installation, repairs etc.	925,1
Machine tools incl. parts and accessories, installation, repair, maintenance	**14.178,8**

The economic structure of one of the major producing countries for machine tools in Europe – Germany – is listed in Table 2-31[31].

[31] Verein Deutscher Werkzeugmaschinenfabriken: Werkzeugmaschinen-Produktion Deutschland nach Maschinengruppen, 2009

Machine tools production in Italy as the second large player in EU-27 is dominated by small- and medium sized enterprises, meaning a much more fragmented market than in other countries, according to UCIMU[32],[33]: There are roundabout 500 machine tools manufacturer in Italy, considering the manufacturer base of *metal working* machine tools. Most of them do not have more than 70 employees – which is less than in Germany and Japan -. and are family-owned and -managed. According to 2007 data 60,3% of the Italian machine tools companies employ less than 50 people, 16,4% are in the range of 50 – 100 employees, and 23,3% are with more than 100 employees[34]. Export orientation is important even for the smallest machine tools manufacturers; however the export orientation among the larger Italian companies is even more important, see Figure 2-13.

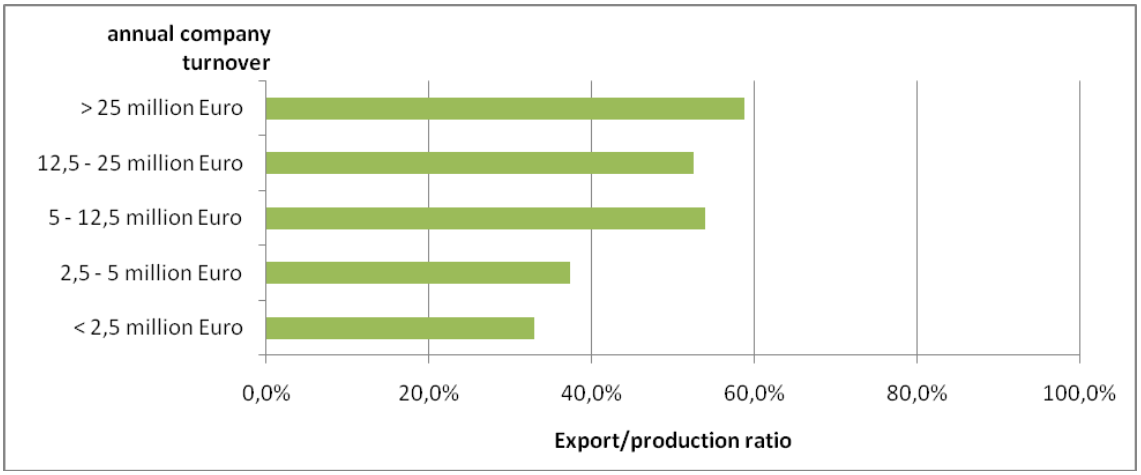

Figure 2-13: Exports/ production ratio of Italian metal working machine tools manufacturers (2007)[35]

32 UCIMU: The Sector Italian Machine Tool: A worldwide success, http://www.ucimu.it/ucimu/eng/index.cfm?id=19

33 Bates, C.: Italian Machine Tools: A Family Affair, IndustryWeek, November 24, 2009, http://www.italianmachinetools.com/news2.asp?id=135

34 UCIMU: 2008 Rapporto di Settore

35 Adapted from: UCIMU: 2008 Rapporto di Settore

2.3.1.2 Wood working machine tools

Wood working machine tools manufacturing is dominated by a multitude of SMEs, exemplarily the situation in Italy and Spain is as follows:

The Italian sector of wood working machinery and tools comprises 300 companies with 40 employees in average[36].

In Spain over 600 companies manufactured wood working machines in 2006 in which SMEs represent 90% of this business sector[37]. Major products of the Spanish market are machine tools like milling machines, classic CNC lathes, production lines for pellets, UV production lines and CNC turning lathes. The industry is concentrated in the three major regions Catalonia (30%), Basque region (23%) and Valencia (22%).

2.3.1.3 Welding, soldering and brazing equipment

According to 2009 PRODCOM figures Germany has a monetary market share in welding, soldering and brazing equipment production of about 55%. As shown in Figure 2-14[38] Germany, Italy, Sweden and France produce more than three quarter of this type of equipment in EU. Other countries in EU27 have no significant relevance.

[36] According to ACIMALL Italian Woodworking Machinery and Tool Manufacturers Association

[37] Instituto Español de Comercio Exterior: Branchenreport – Spanien: Maschinen und Werkzeuge für die Holz- und Möbelbearbeitung, May 2007

[38] Eurostat: PRODCOM 2009 released 12.07.2010

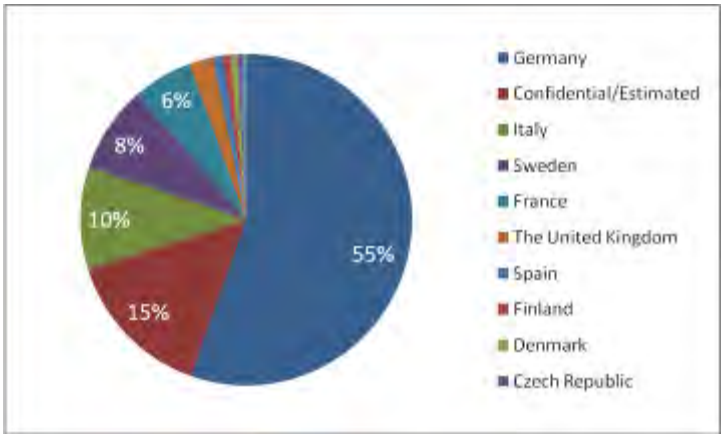

Figure 2-15: Welding, soldering, brazing equipment production share of most relevant EU countries (2009, in monetary units)

France and Italy hold two third of market value of production in category "Other for manual welding with coated electrodes". In terms of units – not economically - this category stands for half of the welding machines.

There is a limited number of companies manufacturing this type of equipment: In Germany for example maximum 10 to 15 companies report into each of the relevant 9 PRODCOM categories[39].

According to EuroStat figures[40] there is an EU-27 production value of roughly 3 billion Euros per year, thereof a value of 1.26 billion exported to non-EU countries and another 360 million Euros value in welding, soldering and brazing equipment imported from non-EU countries.

DVS Deutscher Verband für Schweißen und verwandte Verfahren e.V. (German Welding Society) regularly surveys the market for joining technologies, and states higher production values for the EU, based on 2007 data, than what is identified by our EuroStat evaluation. DVS covers devices, machines and systems[41]: Around one third of the European production of joining technology devices originates from Germany. In 2007, goods with a production value of € 7.5 billion were manufactured in Europe,

39 Statistisches Bundesamt: Produzierendes Gewerbe - Produktion des Verarbeitenden Gewerbes sowie des Bergbaus und der Gewinnung von Steinen und Erden - 2009, Fachserie 4 Reihe 3.1, May 11, 2010

40 years 2005-2009 in average

41 Middeldorf, K.: The Economic Importance of Welding and Joining in Europe Production Values, Values Added and Employees, DVS, July 24, 2009

thereof almost € 2.6 billion in Germany. Other important manufacturers of these devices are Italy with a production value of nearly € 1.2 billion and France with € 320 million, but no information about the laser production in these countries was available. Therefore, their actual production could turn out to be even somewhat higher. In Europe, welding technology devices account for around € 3.9 billion of the production values amounting to € 7.5 billion. This corresponds to a proportion of 52 %. Germany is also the most important welding technology producer in Europe. Almost 43 % of the European welding technology production originates from Germany, 18 % from Italy and 6 % from France.

2.3.2 Target markets: Countries and Sectors

In terms of numbers of enterprises using (potentially) machine tools the target market is very diverse: Machine tools constitute an important part of the production processes in the following sectors:

- DD20: Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
- DH252: Manufacture of plastic products
- DI2612: Shaping and processing of flat glass
- DI2615: Manufacture and processing of other glass, including technical glassware
- DI262: Manufacture of non-refractory ceramic goods other than for construction purposes; manufacture of refractory ceramic products
- DI267: Cutting, shaping and finishing of ornamental and building stone
- DJ28: Manufacture of fabricated metal products, except machinery and equipment
- DK29: Manufacture of machinery and equipment n.e.c.
- DL31: Manufacture of electrical machinery and apparatus n.e.c.
- DL32: Manufacture of radio, television and communication equipment and apparatus

- DL33: Manufacture of medical, precision and optical instruments, watches and clocks
- DM34: Manufacture of motor vehicles, trailers and semi-trailers
- DM35: Manufacture of other transport equipment
- DN36: Manufacture of furniture; manufacturing n.e.c.

These sectors in total represent 1.373 million enterprises in the EU-27 (Eurostat, 2007), see below.

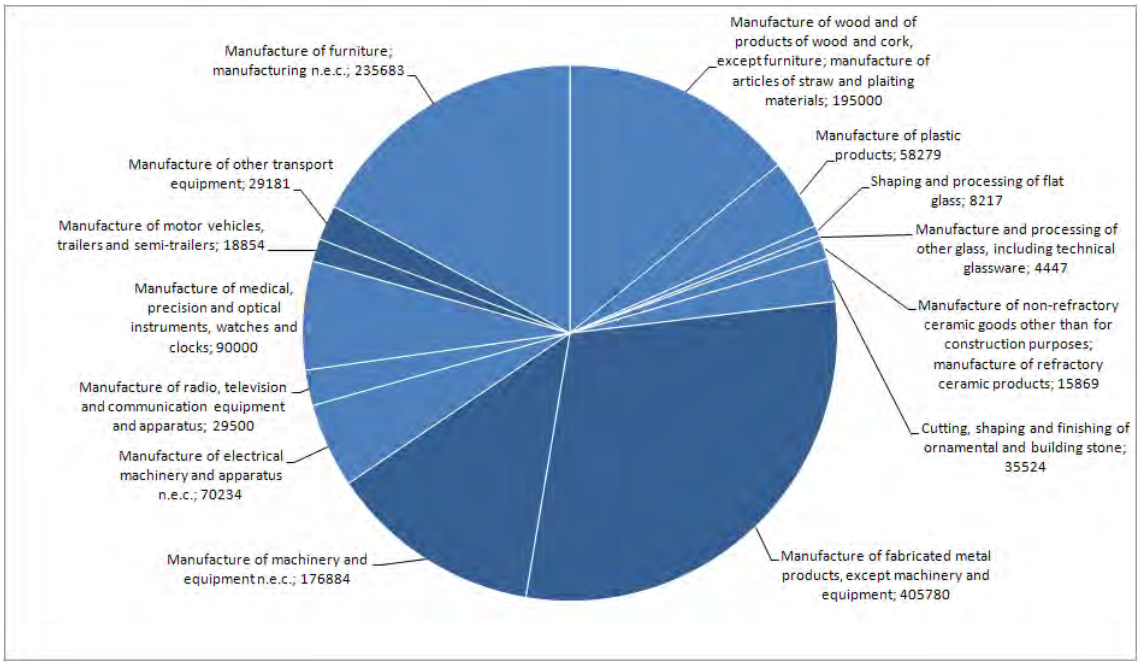

Figure 2-16: Number of enterprises in the target sectors for machine tools (EU-27, 2007)

In some of these sectors almost all companies use machine tools as a core part of the process chain. These sectors alone comprise 640,000 companies in EU-27 (DJ28, DK29, DM34, DM35), most of them small and medium-size enterprises, partly even micro-enterprises. For the other sectors the penetration rate with machine tools is much more uncertain, but widespread use of machine tools can be assumed, although in most enterprises only for few process steps among many other processes. Having this in mind, the **number of machine tools using companies in EU-27 can be estimated at roughly 800,000 – 1,200,000 enterprises**.

Looking at the country split for the most relevant sectors unveils that for both “manufacture of fabricated metal products, except machinery and equipment” and “manufacture of machinery and equipment n.e.c.” the country with the most enterprises is Italy, next are Spain, Germany and France, followed by Poland and the United Kingdom. This reflects also the industry structure in the countries as Italy is characterized by a huge number of micro-scale enterprises.

2.3.2.1 Metal working machine tools

Main consumers of metal processing machine tools in Europe are Germany and Italy, followed by France. The main consumer market in France is the automotive sector.

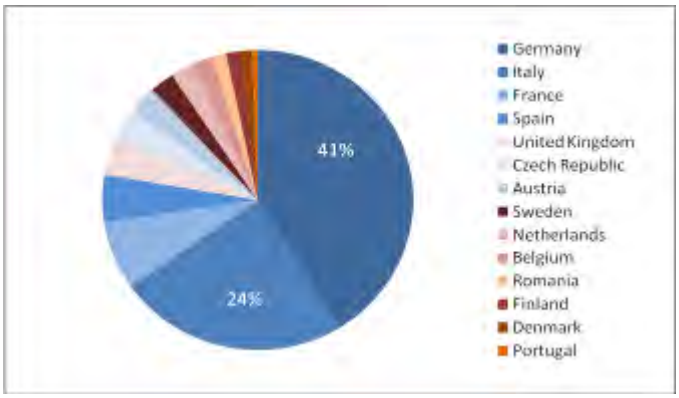

Figure 2-17: Metal working machine tool procurement share of most relevant EU countries (2008, in monetary units)

The automotive sector, although being the most important customer for metal working machine tools in terms of economic value (see below), comprises much less companies as SMEs play a minor role compared to large automotive brands. The large automotive manufacturers each have installed thousands of machine tools, whereas the micro-scale enterprises in manufacture of fabricated metal products might work with only one or two rather simple machine tools.

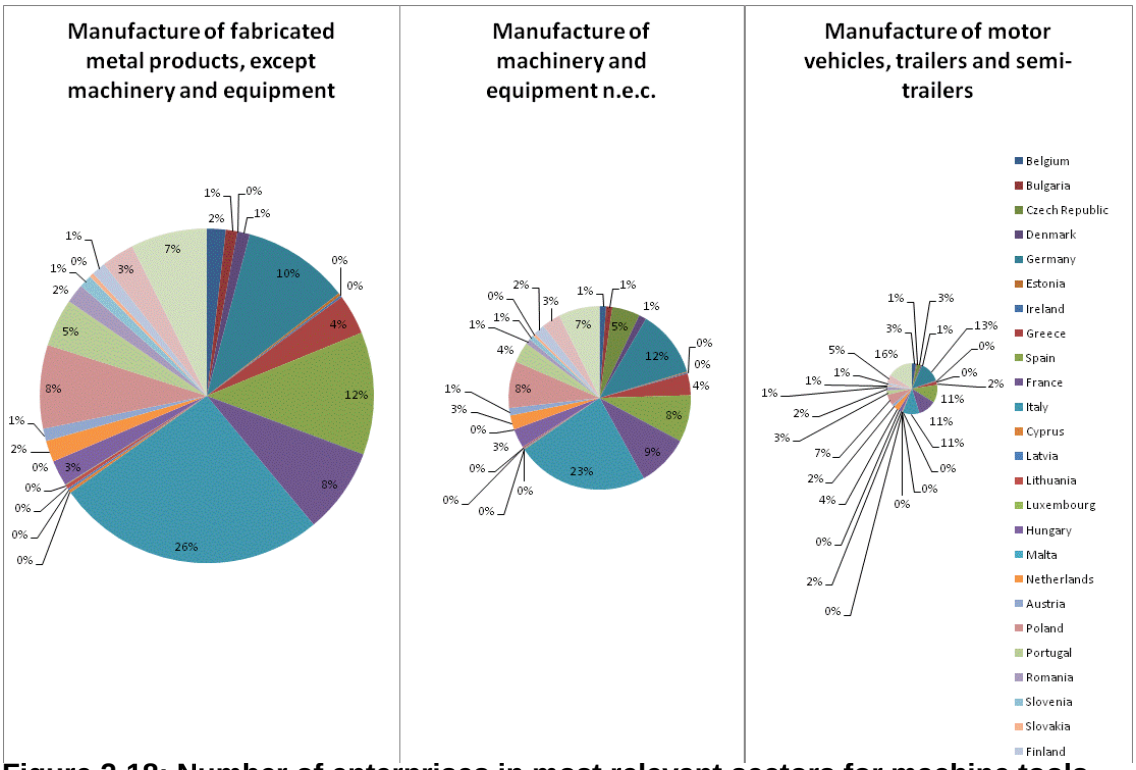

Figure 2-18: Number of enterprises in most relevant sectors for machine tools, per country (2007)

The German project "Werkzeugmaschinen-Initiative 20XX" researched in detail the market for machine tools in Germany, having in mind the metal processing machine tools, and classified the user groups of machine tools as structured in the matrix below[42]. Clearly, the automotive sector is the most important customer for the machine tools industry. Furthermore, the machine tools industry itself actually is in both positions, supplying machine tools, but also being a very important customer. The market segment of manufacturing products of limited complexity as single parts or maximum in small batches is dominated by tool and mould construction. Automotive suppliers clearly dominate the segment of producing less complex products in mass production.

42 Gausemeier, J.; Kinkel, S.: Strategische Technologieplanung mit Zukunftsszenarien - Methoden, Hilfsmittel, Beispiele, VDMA Verlag GmbH, 2008, p. 12

Table 2-32: Most important machine tools users (market share according to machine tools turnover)

		Complexity of products	
		Simple products	Complex products
Number of units per lot	Single part or small-series production	Total: 11%  dominated by **tool and mould construction** (59%)	Total: 14%  dominated by **machine tool building** (33%)
	Medium-size lots or mass production	Total: 28%  dominated by **automotive suppliers** (75%)	Total: 35%  dominated by **automotive manufacturing** (91%)

Increasingly, the European machine tools manufacturers produce for a global market, exporting an increasing share of machine tools abroad. This holds true not only for the larger machine tools manufacturers, but is stated also for the SME dominated machine tools manufacturers from Italy[43].

2.3.2.2 Wood working machine tools

As the sectors depicted above rather represent the target market for metal working machine tools it is worthwhile to look at the target markets for wood working machine tools as well, although in the aggregated sectors “Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials” and “Manufacture of furniture; manufacturing n.e.c.” (Figure 2-19) the penetration rate of machine tools might be slightly lower: Again, the number of enterprises is highest in Italy. Now, also the Czech Republic is very relevant. Other countries with a significant share comprise France, Poland, Spain and Germany.

[43] Bates, C.: Italian Machine Tools: A Family Affair, IndustryWeek, November 24, 2009, http://www.italianmachinetools.com/news2.asp?id=135

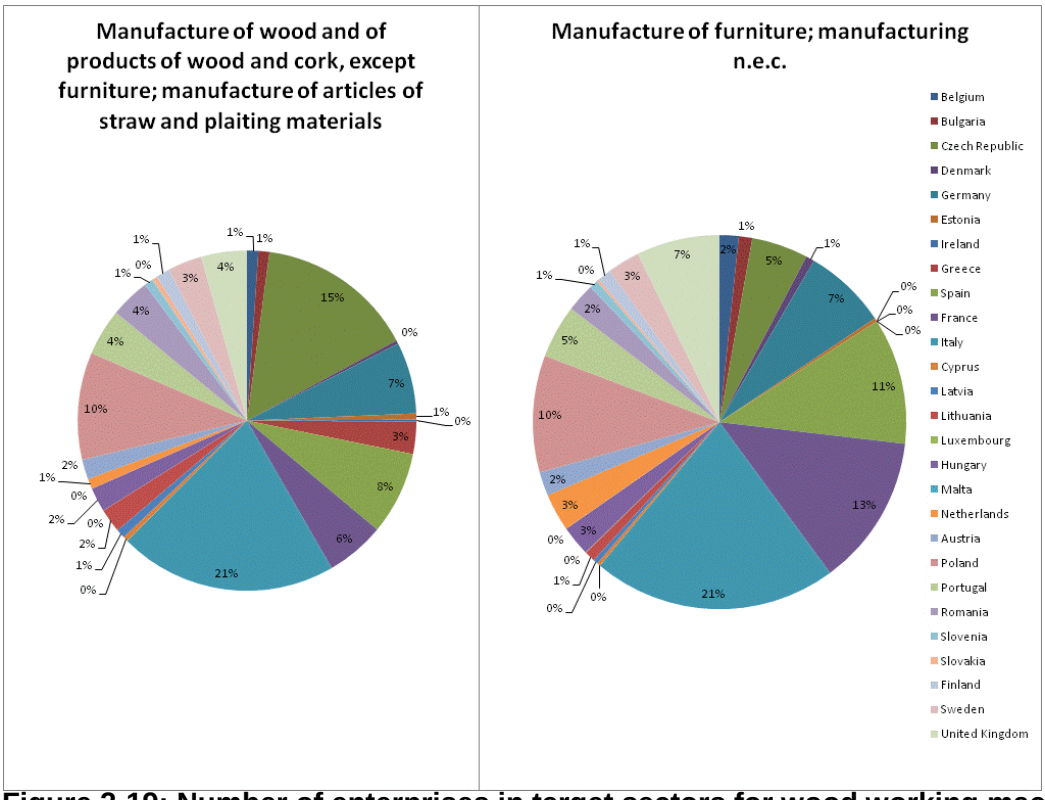

Figure 2-19: Number of enterprises in target sectors for wood working machine tools, per country (2007)

Wood working crafts shops and furniture industry each represent roughly 1/3 of the turnover of the wood working sector in Germany, building and construction parts, and saw mills represent a much smaller economic market share. Among the saw mills there is a trend towards fewer, but larger facilities. In Germany more than 50% of the turnover is generated by only 2% of the saw mills[44]. Most likely this results also in an increasing demand for rather larger, automated wood working machinery.

2.3.2.3 Welding, soldering and brazing equipment

Key target markets for welding equipment comprise the following[45]:

- Automotive sector, where a technology shift is observed from steel to aluminium welding due to the demand for light-weight vehicles

[44] Fraunhofer Institut für Produktionstechnik und Automatisierung: Delphi-Studie "Holzbearbeitungstechnologien 2015", 2005

[45] Chauhan, A.: Will the Energy and Repairs and Maintenance Industry Drive the Global Welding Market Out of Recession? Frost & Sullivan, August 4, 2009

- Aerospace industry, including building new aircrafts and maintenance of existing ones.
- Shipbuilding
- Heavy machinery building
- Energy and power industry, in particular manufacturing of wind turbines, which sees a steady and stable growth against the trend of the economic crisis. (the energy generation market currently occupies a share of 11 per cent in the total global welding market)
- Repair and maintenance in various sectors, frequently done by small enterprises.

2.3.3 Production Structures and Trends

2.3.3.1 Metal working machine tools

There are a couple of indicators and trends with potentially important effects for the machine tools industry, influencing the specifications and market conditions:

- Batch size
- Product size
- Precision requirements
- Product cycles

The *batch size* is a very important factor for configuration and use patterns regarding machine tools and frequently there is a trend mentioned towards “one piece flow”, which has been confirmed as being relevant in a comprehensive survey of Fraunhofer ISI, Heinrich-Nixdorf Institut and VDW among German users of machine tools back in 2003 (covering 1,450 companies) [46], but not as a dramatic change: In total 24% of the companies from the metalworking and electrical industry stated, that the number of variants required by their customers increased significantly, 51% stated a slight increase in number of variants, 22% stated no changes. The sub-sector with the strongest trend towards an increased number of variants is the vehicle construction (i.e. dominated by the automotive manufacturing industry; 32% - significant increase, 55% - slight increase). Whether an increased spectrum of variants also results in smaller batches produced depends on further conditions, e.g. process planning and order management. The survey revealed, that actually at 10% of the companies in the metalworking and electrical industry the manufactured lot size shrunk significantly, 24%

46 Gausemeier, J.; Kinkel, S.: Strategische Technologieplanung mit Zukunftsszenarien - Methoden, Hilfsmittel, Beispiele, VDMA Verlag GmbH, 2008, p. 18-21

stated a slightly shrinking lot size in average, whereas among 42% of the companies lot sizes remained the same, 20% and 5 % even stating a trend towards larger and much larger lot sizes. Gausemeier and K inkel conclude, that industry did not (yet) broadly implement a “one piece flow”, nor is it likely to happen short- to mid-term; usage of machine tools is likely to remain **dominated by mid-size lots and mass production**, although **more flexible machine tools configurations** are required for a couple of applications. Recently the VDW published another survey among member companies regarding lot sizes of machine tools production[47]: At maximum 150 machine tools of a given model are produced per year, stated by one of the large manufacturers, whereas most models are produced in less than 50 units per year, frequently even below 10 units per year, indicating the high level of customisation among metal working machine tools.

Product size matters for the dimension of machine tools. Both developments are observed, the trend towards smaller, miniaturised objects and processing of larger units the survey of “Werkzeugmaschinen-Initiative 20XX” identified, that product dimensions have been considered to remain roughly the same by 63% of the users of machine tools, and from the remaining, more state a trend towards larger products than smaller ones. The trend towards smaller product dimensions is clearly dominating in the sector “manufacturing of electrical machinery and apparatus” (10% report a significantly reduced size, 18% a slight size reduction), whereas the adverse trend towards larger objects is most significant in vehicles construction (15% report significantly increased product sizes, 23% a slight increase) [48].

Precision requirements are an important quality criterion for machine tools, but also for process stability, and thus influence the use patterns for machine tools in the production environment. More than one quarter of those machine tools users replying to the survey under the “Werkzeugmaschinen-Initiative 20XX” stated, that precision requirements increased significantly, another 44% state a slight increase[49]. In particular those sectors which are major consumers of machine tools (tool and mould construction, automotive manufacturing) are characterized by increasing precision requirements.

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47 Hagemann, D.: Die energieeffiziente Werkzeugmaschine – Rahmenbedingungen und Lösungen für eine nachhaltige Fertigungstechnik, Symposium „Energieeffiziente Werkzeugmaschinen“, Düsseldorf, February 24, 2010

48 Gausemeier, J.; Kinkel, S.: Strategische Technologieplanung mit Zukunftsszenarien - Methoden, Hilfsmittel, Beispiele, VDMA Verlag GmbH, 2008, p. 24-25

49 Gausemeier, J.; Kinkel, S.: Strategische Technologieplanung mit Zukunftsszenarien - Methoden, Hilfsmittel, Beispiele, VDMA Verlag GmbH, 2008, p. 26

Product cycles have an impact on investment decisions: The more frequently a production line has to be changed to produce new products, the shorter the return on investment time span has to be. Changing product portfolios might also require more flexibility for machine tools configurations, i.e. modularity and adaptability. However, a survey regarding the product cycles of products manufactured with machine tools revealed, that in the metalworking and electrical industry only 13% of the revenue stems from products introduced within the last 3 years, another 53% from products introduced first up to 10 years ago and nearly one-third of the product revenue is even from products introduced more than 10 years ago[50].

The sub-segment of special purpose machinery manufacture lost market shares in the past despite the increasing demand for customized solutions: 72% of the machinery investment of the metalworking and electrical industry is spent for machinery, which is based on standard equipment. 14% of investments is spent for machinery developed specifically for a given application, and 13% is spent for internal machinery developments[51]. Obviously, the market of "standard" machine tools became more diverse, more flexible to address specific customer requirements with a given machinery platform.

The production structures of Gildemeister are somewhat typical for the European market[52]: Material is sourced inter alia in Russia, Romania and Poland. Due to the high wages in Germany, only the machining of key components and high-quality assembling takes place there. Actually Gildemeister manufactures high-tech machine tools in Germany, so-called "entry" machine tools are manufactured in Poland and China, machine tools according to specific customer requirements in Italy.

2.3.3.2 Wood working machine tools

The wood working machine industry is currently undergoing a major change, which focuses on fully automated equipment and the topic of sustainability and energy efficiency gains importance. The furniture production sector represents the most important

50 Gausemeier, J.; Kinkel, S.: Strategische Technologieplanung mit Zukunftsszenarien - Methoden, Hilfsmittel, Beispiele, VDMA Verlag GmbH, 2008, p. 28-29

51 Gausemeier, J.; Kinkel, S.: Strategische Technologieplanung mit Zukunftsszenarien - Methoden, Hilfsmittel, Beispiele, VDMA Verlag GmbH, 2008, p. 40

52 See Interview with Dr. Rüdiger Kapitza, CEO Gildemeister AG, and Dr. Masahiko Mori,CEO Mori Seiki Co., Ltd., in: Die Zukunft der Werkzeugmaschinen-Industrie, Produktion Nr. 24, 2007

driver for those changes. Even the international market describes a trend to fully automated equipment with the furniture industry as major driver for mass production. Conferences and industry fairs in the business sector recently integrate topics like sustainable production and energy efficient products. Medium sized and large-scale enterprises drive those topics.

Technology trends

Regarding the general trend of higher automated products a 2005 report on future technology trends in the woodworking machine sector identified a growing usage of industrial robots for load and unloads operations.[53] The industry estimated that wood as raw material is more and more industrial produced with improved material properties. This means that there is a change to improved raw materials with chipped wood as basis and the development of new surface treatment and finish treatment for solid wood. Those trends of new and improved raw materials require new and adapted machines for transforming processes. In Europe, particularly in Germany or Spain there is an upcoming trend for “one piece flow” production in the furniture sector. Concerning this changed user demand the traditional use of single machines switch to the use of modular systems with a central control system. Existing machines gets upgraded with computer controlled information systems to integrate them into a new central controlled system. The advantage of this system trend is a better integration of power management for all connected machine modules. It is possible to send each module individually into a standby mode after the defined task is finished. A manual power on and –off becomes obsolete. The potential disadvantage of the additional power consumption by the integrated ICT components could be disregarded related to the energy savings of a well-integrated power management system.

The growing use of laser technology for improved differentiation and positioning of machine tools stands for a potential aspect for increased energy consumption. Laser technology in woodworking is used increasingly for edge gluing, where laser technology could save energy compared to usage of conventional hot melt adhesives[54], or engraving, but also for wood cutting of finely wrought workpieces. Compared to processing other types of materials, laser applications for wood working are a rather minor

[53] Fraunhofer Institut für Produktionstechnik und Automatisierung: Delphi-Studie "Holzbearbeitungstechnologien 2015", 2005

[54] HOMAG Group: ecoPlus – Technology that really pays off, Schopfloch

segment of the whole laser market[55]. No information is available regarding market growth of laser processing for wood in particular.

The use of nanotechnology is an innovation that affects the wood industry in two different aspects. First, the development of wood coatings particular for UV absorbing and penetration requires new machines for coating processes. Second, the increased durability of both, machine parts and tools with the application of nano-modified materials will have effects on the configuration and sustainability of wood working machines. Today nano technologies affect are widely present in research activities. In 2005 experts expected the implementation into the product design for woodworking machines by 2010[56].

2.3.3.3 Welding, soldering and brazing equipment

Given the fact, that joining technologies are cross-sectorial technologies, which are applied in multiple sectors, large industry and small enterprises, as well as for infrastructure, this industry is considered relatively resistant to economic cycles.

Technology Trends

Important changes in the welding branch are related with emerging new and advanced technologies and changes regarding materials to be processed – which are closely related to technology changes: The trend towards lightweight construction, joining of coated sheets and in general modularization of fabrication among other trends leads to a competition between joining technologies. The dominating thermal joining processes are challenged by low-heat and cold joining processes, such as adhesive bonding[57]. This might result in a general power consumption reduction for joining processes, but this is a question of proper technology choice, not of the equipment as such. Combined, hybrid technologies such as the combination of gas-shielded metal-arc welding

55 LaserFocusWorld: Annual Review and Forecast: Skies may be clearing, but fog still lingers, January 1, 2011, http://www.laserfocusworld.com

56 Fraunhofer Institut für Produktionstechnik und Automatisierung: Delphi-Studie "Holzbearbeitungstechnologien 2015", 2005

57 Grote, K.-H.; Antonsson, E. K. (Eds.): Springer Handbook of Mechanical Engineering, Springer, 2009, pp. 660-662

and laser welding gain ground and are subject to intensive research work. Miniaturization drives the trend towards micro joining technologies. Research in joining technologies currently focuses on highest-strength steel, light metals (aluminium and magnesium alloys) and mixed joints. Grote et al. state the following major trends regarding individual technologies:

- Gas-shielded arc welding retains a dominant position, but is likely not to grow as quickly as in the past years
- Resistance welding processes will hold a dominant position among joining processes given the high productivity and process performance, but will be replaced for certain applications by mechanical joining technologies and adhesive bonding
- Laser beam welding processes are likely to gain increasing importance

Expectations for future technology development and application stated by companies surveyed by the German DVS are depicted in Figure 2-20, confirming the trends stated above.

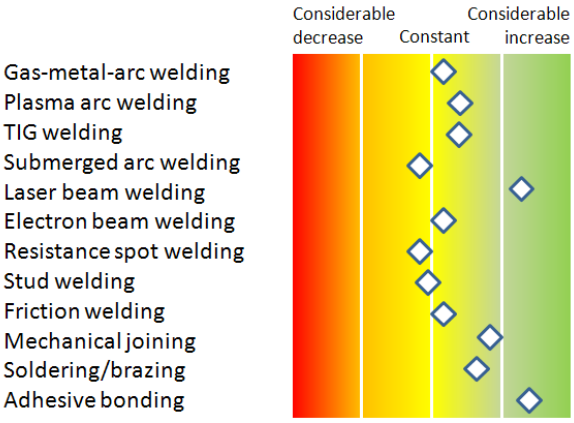

Figure 2-20: Prospective development of joining processes

The forecasted increase in laser beam welding stems from improvements of the laser beam source: With an increase in the maximum power output, and improvements in the ability to focus the laser beam, new applications emerged in particular in the automotive sector, shipbuilding, and apparatus construction[58].

58 Grote, K.-H.; Antonsson, E. K. (Eds.): Springer Handbook of Mechanical Engineering, Springer, 2009, pp. 668

2.3.4 Suppliers

System components for machine tools are of importance when investigating the industry structure of the machine tools industry. Key technology components comprise control technology, pneumatic and hydraulic systems, spindles, drives, motors, bearings, gears, pumps, compressors, taps and valves. Iron and steel are typically the most relevant supply materials.

As most machine tools manufacturers are small and medium sized enterprises, they are not capable of having all the technology know-how in-house for all the components and have to rely on numerous suppliers for key components and modules. Some machine tools manufacturers even rather operate as a type of engineering company, assembling customized machines from components sourced from suppliers.

There are only a very limited number of relevant hardware suppliers for **control technology**, i.e. Computer Numerical Controller (CNC): The market is dominated by Siemens, with global market share of 33,3 % in 2006, followed by Fanuc and Mitsubishi Electric with 32 % and 12,4 % respectively. Total global market size is 4,5 billion US-$[59]. A couple of smaller companies are also active in some market niches as suppliers of CNC technology, but their number and market share is rather limited[60]. A survey among CNC users in Germany revealed in 2007 the current usage of CNC systems: Being asked, what is the CNC system you are working most frequently with, 40,5% gave Heidenhain as a reply, another 28,8% Siemens[61], see Figure 2-21.

[59] Tsakiridou, E.: The Buzz About Automation, Pictures of the Future, Fall 2007, p. 19

[60] The leading German directory of suppliers „wer liefert was?“ lists as suppliers of control technology for machine tools in total 23 companies (as of March 2010)

[61] Strutzke, A.: CNC-Marktstudie zeigt Anwenderwünsche, Marktstudie: MM Maschinenmarkt, Internetforum CNC-Arena, Whitepaper, October 8, 2007, 1338 respondents covered with this survey, http://www.maschinenmarkt.vogel.de/index.cfm?pid=1610&pk=95048&icmp=aut-artikel-artikel-80

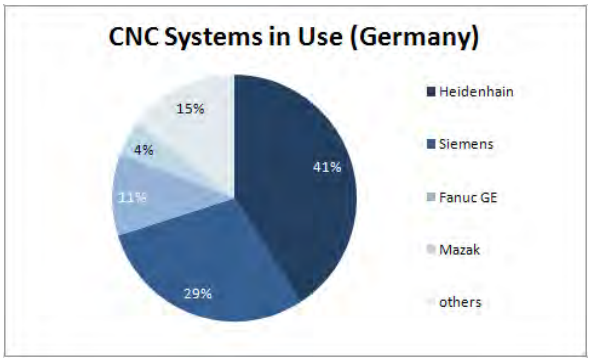

Figure 2-21: CNC Systems in Use in Germany (2007) according to recent surveys

In the broader programmable logic controllers (PLCs) business with a size of 8,9 billion US-$ globally the hardware, software, and services market share of Siemens is 31,3 %, followed by Rockwell with 22,1 % and Mitsubishi with 12,7 %[62,63], see Figure 2-22: 8 companies cover nearly 90% of the global market.

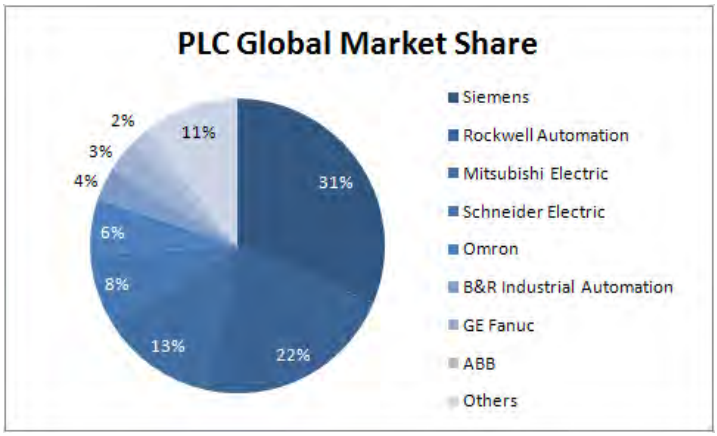

Figure 2-22: PLC Global market shares (2007)

The market for **cooling lubricants** is also dominated by few companies, among them Rhenus Lub with a 2009 production volume of 14.000 t (compare to totals of consumption as stated below), Fuchs, Henkel, SKF. Many of the manufacturers of cooling lubricants are based in the EU-27.

62 ARC Advisory Group, referenced in Rick Zabel: State of Manufacturing & Automation in the U.S. Looks Good, July 30, 2008, automation.com, http://www.automation.com/content/state-of-manufacturing-and-automation

63 These figures refer to the PLC market in general, not only the machine tools market

The machine tools industry furthermore is a supplier of its own: Machine tools are key to the manufacture of machine tools and components. The broad spectrum of specialized machine tool manufacturers constitutes therefore also the base of investment good suppliers to this branch.

2.4 User expenditure base data

The objective of this subtask is to gather base data about user expenditure which will be used to calculate Life Cycle Costs (LCC).

There is no robust, comprehensive single source on life cycle costs for machine tools, but some exemplary calculations, indicating cost relations for some metal working machine tools (but not to be considered as representative for the whole range of machine tools).

LCC of a vertical machining-centre (3 axes)

The CO$TRA project by PTW published an exemplary LCC calculation for a machining centre with following settings and assumptions[64]:

- Initial investment (purchase price, installation, start-up, initial set of tools and spare parts, training of operators): 198,000 Euro
- 2-shifts operation at 224 days/year (3,584 h/year)
- Product: simple milled part, processing time 145 s, annual output 85,000 units
- Assumed yield 99,99%, resulting in a machine running time of 2,928 h/year, remaining time (656 h/year) in standby
- Power consumption (average, including cooling lubricant supply, exhaust system): 22kW during operation, 11kW in standby.
- Free warranty: 12 months, response time of service personnel: 12 hours
- Unscheduled down times calculated with 75 Euro/hour (corresponding to the hourly rate of an operator)
- The calculation covers a period of 10 years

Total life cycle costs under these conditions are stated at 582,000 Euro, thereof 34% initial investment, 20% maintenance and planned overhauling, 15% unscheduled overhauling, 17% energy costs, 5% pressurized air, 5% occupancy costs (building), 4% expenses for capital commitment. Costs for yield losses, tools and setup time are explicitly not taken into account, furthermore the calculation does not state costs for material, personnel costs during operation and for cooling lubricants.

64 Dervisopoulos, M.: CO$TRA – Life Cycle Costs Transparent, Abschlussbericht, Kurzfassung, PTW, Technische Universität Darmstadt, 2008, p. 26-27

Life cycle costs are largely dependent on the individual use patterns. As a first approximation Abele et al.[65] consider initial investment representing roughly 30% of total life cycle costs for a machine tool as appropriate, 10 years lifetime assumed.

Another exemplary cost calculation by PTW for a machine tool states the following cost relations[66]:

- Initial investment: 100,000 Euro
- Annual running costs: 39,000 Euro, thereof
    - 8% expenses for capital commitment
    - 37% planned maintenance
    - 8% unscheduled overhaul
    - 6% occupancy costs
    - 21% electricity costs
    - 3% pressurized air
    - 16% cooling lubricant

Failure reasons for downtimes of machine tools have been analysed by Fleischer[67]: An analysis of representative field data unveiled, that that there are basically four main component groups responsible for most downtimes, in declining order of importance:

- drive axes,
- spindle and tool changer,
- electronics and
- fluidics

As every downtime is a cost issue, maintenance and repair of these assemblies constitutes a major cost factor in terms of life cycle costs of machine tools.

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65 Abele, E.; Dervisopoulos, M.; Kuhrke, B.: Bedeutung und Anwendung von Lebenszyklusanalysen bei Werkzeugmaschinen, in: Schweiger, S. (Edt.): Lebenszykluskosten optimieren – Paradigmenwechsel für Anbieter und Nutzer von Investitionsgütern, Gabler, Wiesbaden, 2009

66 Abele, E.: Begrüßung und Einstimmung, Symposium „Energieeffiziente Werkzeugmaschinen“, Düsseldorf, Germany, February 24, 2010; remark by Abele: 21% electricity costs rather to be seen as a maximum value, not average

67 Fleischer, J.; Broos, A.; Schopp, M.; Wieser, J.; Hennrich, H.: Lifecycle-oriented component selection for machine tools based on multibody simulation and component life prediction, CIRP Journal of Manufacturing Science and Technology, Volume 1, Issue 3, 2009, p.179-184

In the welding business workpiece related costs are determined by multiple factors. Some of these are related to investment and consumables, but in addition for the user it is important to consider other process related costs as listed in [68].

Table 2-33: Welding cost parameters

Preparatory costs	Process and equipment related costs	Post-core-process costs
■ Time for joint preparation. ■ Time to prepare the material for welding (blasting, removal of oils, etc.). ■ Time for assembly. ■ Time to preheat the joint (when required). ■ Time for tack-up. ■ Time for positioning.	■ Welding equipment invest. ■ Time for welding. ■ Time for changing electrodes. ■ Time to move the welder from one location to another. ■ Time to change welding machine settings. ■ Cost of electrodes. ■ Cost of shielding materials. ■ Cost of electric power. ■ Cost of fuel gas for pre-heat (when required).	■ Time to remove slag (when applicable). ■ Time to remove spatter. ■ Time for inspection. ■ Time to repair or re-work defective welds. ■ Costs associated with any required stress relief.

2.4.1 Electricity, fuel and interest and inflation rates

Eurostat provides data on electricity prices. Most recent ones for industrial customers are compiled for the second half of 2009 by EU-27 member state in Table 2-34.

The EU-27 average electricity price for industrial customers was 0.0952 Euro/kWh in 2009.

Electricity prices in the no. 2 machine tools consuming country Italy are significantly above the EU-27 average, partly by 30% and more, in Germany as no. 1 machine tools consuming country electricity tariffs are roughly 10% above average, similarly in Spain (no. 4), in Italy by even more than 30%. In the number 3 machine tools consuming country France the electricity tariffs are well below the EU-27 average. Between France and Italy there is a factor of more than 2, demonstrating the significant spread of electricity prices across Europe.

Smaller crafts enterprises for wood working (carpenter's shops and the like) are in the 20 – 500 MWh/a range, the large brand name automotive manufacturers consume typ-

[68] adapted from D.K. Miller: Determining the Cost of Welding, Welding Design & Fabrication, March 1, 2004

ically more than 150 000 MWh in their main production countries. A larger metal-working company such as Heidenhain with 3,000 employees and a production facility in Traunreut, Germany – actually also an important supplier for the machine tools industry itself – is in the 20 – 70 GWh range. The majority of small and medium sized metal and wood working companies can be assumed to be in the range of 500 – 2 000 MWh. In the case of Italy, there is a tendency towards even smaller companies, and thus an even lower power consumption range.

Table 2-34: Electricity Prices for Industrial Customers in EU-27, 2nd half 2009

	Band IA : < 20 MWh	Band IB : 20 - 500 MWh	Band IC : 500 - 2 000 MWh	Band ID : 2 000 - 20 000 MWh	Band IE : 20 000 - 70 000 MWh	Band IF : 70 000 - 150 000 MWh	Band IG : > 150 000 MWh
EU-27	0,1632	0,1198	0,1023	0,0911	0,0833	0,0758	:
Belgium	:	:	:	:	:	:	:
Bulgaria	0,0767	0,0721	0,0639	0,0583	0,0516	0,0476	0,0476
Czech Republic	0,1720	*0,1398*	0,1122	0,0978	0,0912	0,0916	:
Denmark	0,1800	0,0967	0,0927	0,0900	0,0820	0,0806	:
Germany	0,1888	*0,1323*	**0,1134**	0,1007	0,0901	0,0861	:
Estonia	0,0815	0,0693	0,0645	0,0572	0,0460	0,0461	:
Ireland	0,1688	0,1406	0,1175	0,0971	0,0888	0,0788	:
Greece	0,1540	0,1159	0,0936	0,0811	0,0729	0,0636	0,0595
Spain	0,1770	*0,1335*	**0,1120**	0,0934	0,0823	0,0709	0,0499
France	0,1158	*0,0824*	**0,0656**	0,0621	0,0628	0,0532	:
Italy	0,2384	***0,1530***	**0,1370**	0,1224	0,1081	0,0888	0,0845
Cyprus	0,1563	0,1574	0,1494	0,1362	0,1221	0,1217	:
Latvia	0,1161	0,0967	0,0893	0,0835	0,0767	0,0712	:
Lithuania	0,1057	0,0921	0,0790	0,0666	0,0622	:	:
Luxembourg	0,1986	0,1312	0,1158	0,0936	0,0655	:	:
Hungary	0,1271	0,1226	0,1297	0,1146	0,1055	0,0877	0,0952
Malta	0,1460	0,1425	0,1291	0,0860	0,0860	0,0860	0,0860
Netherlands	0,2010	0,1450	0,1110	0,1010	0,0940	0,0920	0,0740
Austria	:	:	:	:	:	:	:
Poland	0,1455	*0,1115*	0,0933	0,0842	0,0803	0,0731	0,0779
Portugal	0,1613	0,1148	0,0944	0,0827	0,0692	0,0544	:
Romania	0,1020	0,0970	0,0828	0,0714	0,0625	0,0571	:
Slovenia	0,1641	0,1276	0,0962	0,0798	0,0748	0,0758	:
Slovakia	0,2180	0,1673	0,1403	0,1263	0,1094	0,1011	0,0903
Finland	0,0837	0,0773	0,0683	0,0664	0,0552	0,0525	:
Sweden	0,1166	0,0780	0,0689	0,0601	0,0560	0,0502	:
United Kingdom	0,1379	0,1160	0,1012	0,0900	0,0867	0,0869	0,0781

In Table 2-34 the most important countries / segments are market in **bold** for metal working companies and in italics for *wood working* companies. Roughly the "typical" electricity price for use of **metal working machine tools** is **0,11 Euro/kWh**, for **wood working machine tools 0,14 Euro/kWh**.

For **welding, soldering and brazing equipment** a typical electricity price is much more difficult to state as the target sectors and enterprises cover an even broader spectrum from small-size to large industrial. Hence, the EU-27 average can be taken as an approximation with rounded **0,10 Euro/kWh**.

Interest minus inflation is given as the discount rate, for which (currently) the value 4% is applied in line with Commission impact assessment practice.

2.4.2 Purchase Price

As a distinction of purchase prices for the various machine tools types the unit values as stated by EuroStat in the PRODCOM statistics and checked for plausibility by Fraunhofer are the best available approximation for "typical" purchase prices of machine tools.

These unit values are listed in 2.1 Generic economic data:

- Metal working machine tools: Table 2-4, p. 12
- Wood working machine tools: Table 2-5, p. 18, and Table 2-6, p. 20
- Welding, soldering and brazing equipment: Table 2-7, p. 22

Despite all uncertainties of the EuroStat data this approach at least allows to estimate the order of magnitude for average purchase prices in each category. The unit values for some important product categories, indicating also the broad spread of machine tools and equipment, are as follows:

- Horizontal machining centres for working metal: 480,000 Euro
- Lathes, including turning centres: 380,000 Euro
- Hydraulic presses for working metal: 210,000 Euro
- Non-numerically controlled horizontal lathes for working metal: 24,000 Euro
- Multi-purpose machines where the workpiece is automatically transferred between operations for working wood: 50,000 Euro

- Band saws for working wood: 8,000 Euro
- Machinery for soldering, brazing, welding or surface tempering: 30,000 Euro
- (Other) shielded arc welding equipment: 600 Euro

For the various major branches, average unit values for machine tools (revision after plausibility check) are as follows:

- Metal working machine tools (NACE 28.41): 64,000 Euro
- Wood working machine tools (industrial stationary ones, NACE 28.49): 20,000 Euro
- Wood working machine tools ("light stationary", i.e. transportable, NACE 28.49): 600 Euro
- Welding, soldering and brazing equipment (NACE 27.90, 28.29): 1,400 Euro
- Stone and ceramics working machine tools (NACE 28.49.11): 18,000 Euro

2.4.3 Consumables

2.4.3.1 Cooling lubricants

Consumption of cooling lubricants constitutes a major share of life cycle costs of many machine tools. Following a top-down-approach consumption is derived national from sales statistics: Table 2-35 lists the use of cooling lubricants in Germany in tonnes, based on data by the German BAFA[69]. These data show a high impact of the economic cycles, specifically of the drastically reduced number of productive hours in 2009, resulting in a decreasing amount of cooling lubricant usage by 35-40% compared to 2008, although the stock of installed machine tools did not decrease in a similar way. Therefore, the 2008 data is closer to representativeness for consumption and costs of cooling lubricant use (and machine tools usage in industry in general) than the more recent year 2009.

[69] Bundesamt für Wirtschaft und Ausfuhrkontrolle: Amtliche Mineralöldaten, BAFA Ref. 423

Table 2-35: Use of Cooling Lubricants in Germany – BAFA data – mineral oil based

	2009	2008	2007	2006	2005	2004
all lubricants [t]	**862.381**	**1.109.383**	**1.149.432**	**1.173.850**	**1.023.044**	**1.039.680**
of those, cooling lubricants [t]	**42.029**	**65.777**	**72.308**	**67.821**	**75.701**	**73.856**
non-water miscible CL [t]	24.779	38.370	41.532	38.339	45.094	46.846
water miscible CL (concentrate) [t]	17.250	27.407	30.776	29.482	30.607	27.010
emulsions and solutions created from water-miscible CL [t][70]	790.000	1.260.000	1.410.000			
total amount of cooling lubricants used [t]	815.000	1.300.000	1.450.000			

Given the fact that cooling lubricants are mainly used for metal working machine tools[71] and that Germany consumes 41% of all metal working machine tools in EU 27, the consumption for EU 27 can be estimated based on the assumption, that the ratio of cooling lubricant usage in other EU 27 countries correlates in a similar way with the installed value of machine tools[72]. In 2009 the EU-27 usage of cooling lubricants for metal working machine tools is estimated at 161.000 t, thereof 94.000 t non-water miscible cooling lubricants and 67.000 t water-miscible cooling lubricants. The latter total roughly 3.1 million tonnes of emulsions and solutions.

Table 2-36: Use of Cooling Lubricants in EU-27 - estimate – mineral oil based

	2009	2008	2007	2006	2005	2004
all lubricants [t]	**n.a.**	**n.a.**	**n.a.**	**n.a.**	**n.a.**	**n.a.**
of those, cooling lubricants [t]	**102.000**	**161.000**	**176.000**	**165.000**	**185.000**	**180.000**
non-water miscible CL [t]	60.000	94.000	101.000	94.000	110.000	114.000
water miscible CL (concentrate) [t]	42.000	67.000	75.000	72.000	75.000	66.000
emulsions and solutions created from water-miscible CL [t]	1.900.000	3.100.000	3.400.000			
total amount of cooling lubricants used [t]	2.000.000	3.200.000	3.500.000			

70 Domrös, R.; Spieß, G.; Mehr, G.: Sustainable Production – using minimal quantity lubrication, SKF Evolution online, 2009; estimate for 2007, figures extrapolated for other years

71 Ratio of cooling lubricants usage per type of processed material is unknown, use for metal processing is widespread, usage for processing of other hard materials, such as stone, ceramics, glass is relevant as well

72 i.e. multiplying the German consumption figures with 1/0,41. This approach neglects the economic differences in the various EU countries regarding degree of capacity utilization, types of production (e.g. volume production vs. single-part production, types of metals processed etc.), and the actual differences in distinct machinery installed.

Typical prices for cooling lubricants (concentrates) are in the range of 3 – 8 Euro/l, depending on type, specification and order volume, package size. Assuming a price of 5 Euro/kg, the total sales volume for EU-27 for **non-water miscible cooling lubricants** was **470 million Euros** in 2008, and for **water miscible cooling lubricants** another **330 million Euros**.
As cooling lubricants are typically used for processing of hard materials, such as metals, stone, ceramics, the related costs are relevant for these two segments only.
The total value of these machine tools categories for the 2009 sales (not stock), is 15 billion Euro. Compared to this figure a total sales volume of 800 million Euro for mineral oil based cooling lubricants seems reasonable. This also corresponds to industry sources[73], stating that the proportion of costs in production for conventional cooling lubricants is in the range of 14-18% depending on the complexity of the components and that on average 10 % of workpiece-related costs are cooling lubricant costs respectively. A survey by Astakhov[74] revealed, that metal working fluids (including the handling of these, such as supply system and disposal of residues etc.) are correlated with 8-10% of the manufacturing costs in such sectors as the automotive industry.

A typical CNC machine may use 10 to 10,000 l/h of cooling lubricant or related emulsion depending on application. Whilst much is reconditioned and recycled, due to natural wastage as aerosol spray into the atmosphere and adherence to swarf, overall losses can amount to between 3 and 15 l/h[75].

Other auxiliary substances, such as deep drawing lubricants and hydraulic oil for machine tools are not yet considered, and so are the additional costs of lubricant management (logistics, OHS measures, and disposal).

2.4.3.2 Welding, soldering and brazing consumables

Supplies, consumables and services for the joining industry, including welding filler materials, adjuvants, gases, protective clothing, testing machines and training services

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73 See e.g: BILZ: General Information MQL, http://www.bilz.de/MMS_Vorteile.pdf; Domrös, R.; Spieß, G.; Mehr, G.: Sustainable Production – using minimal quantity lubrication, SKF Evolution online, 2009

74 Astakhov, V.P.: Ecological Machining: Near-dry machining, in: Davim, J.P. (Edt.): Machining: Fundamentals and Recent Advances, Band 10, Springer, 2008

75 Hughes, J.: Minimum quantity cooling lubricants for CNC machinery, November 6, 2009, TheDailyEngineer.com

constitute a 12.5 billion Euros production value in the EU-27 as of 2007[76]. Germany has the highest production value (€ 2.1 billion) closely followed by Italy (€ 1.8 billion) and France (€ 1.5 billion). Germany, France and Italy stand out with high production values for the manufacture of welding consumables (€ 576 million in Germany, € 312 million in France and € 303 million in Italy). The production values of welding gases are in the same order of magnitude in these countries.

Comparing the production value of devices and complementary joining technology goods for welding, soldering and brazing there is a relation of 12,5 billion Euros for consumables and the like to 7.5 billion Euros for devices, indicating also the fact, that in terms of total life cycle costs consumables for joining technologies are significantly higher than the actual initial investment in equipment.

Welding gases comprise helium, argon, oxygen, nitrogen, hydrogen, carbon dioxide and hydrocarbons, such as acetylene, ethene, propene, propane, butane, methane. These constitute a relevant share of welding equipment usage costs, but vary broadly depending on type of gas and amount purchased.

Electrodes and welding wires respectively can be considered consumables, but it should be noted, that the material makes it into the final product. Depending on process, technology and application the deposition efficiency is a cost relevant factor: The deposition efficiency is the relationship of the electrode used to the amount of the weld metal deposited.

2.4.4 Tools, Work Holders, Spare Parts

EuroStat provides data for production of tools and parts for machine tools, which can be considered basically as initial sets of tools, spare parts and replacement parts. Not all of these parts are relevant for all types of machine tools. Table 2-37 provides a matrix where some major machine tool categories are correlated with the potentially corresponded parts according to NACE nomenclature.
The value of these **parts and components** in total for EU 27 production in 2008 is **7,6 billion Euros**, compared to a sales volume (sold production) of 26,4 billion Euros for machine tools in the same year. This sounds reasonable, but it is clear, that costs for tools vary broadly, depending on the complexity of the product: Astakhov[77] states a

[76] Middeldorf, K.: The Economic Importance of Welding and Joining in Europe Production Values, Values Added and Employees, DVS, July 24, 2009

[77] Astakhov, V.P.: Ecological Machining: Near-dry machining, in: Davim, J.P. (Edt.): Machining: Fundamentals and Recent Advances, Band 10, Springer, 2008

share of the tool costs for advanced power train plants to be in the range of 12-15% related to the high cost of gear manufacturing, and for simpler automotive plants dominated by turning and milling processes, such as shaft production, a cost range of direct tooling of 5-7% of manufacturing costs.

For welding equipment the nozzles are relevant in particular as these are subject to wear and tear.

Table 2-37: Major Machine Tools Categories and Corresponding Parts

		EU27 Value in EUR (Production, 2008)	Selection of Machine Tools categories 28.41 / 28.49																				
			28491233	28491140	28491263	28491279	28491237	28491170	28491130	28412233	28412235	28412470	28412270	28411270	28491235	28491250	28412223	28412395	28412375	28412490	28412160	28491287
28414030	Parts and accessories for metal cutting machine tools (excluding tool holders and self-opening dieheads, work holders, dividing heads and other special attachments for machine-tools)	2.728.072.081								x	x		x	x			x	x	x	x		
28414050	Parts and accessories for metal forming machine-tools (excluding tool holders and self-opening dieheads, work holders, dividing heads and other special attachments for machine-tools)	1.650.000.000										x									x	
28414070	Parts and accessories for machine-tools operated by ultrasonic processes	125.789.508																				
28492110	Arbors, collets and sleeves for machine-tools and hand tools	334.364.885	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
28492130	Tool holders for lathes (excluding arbors, collets and sleeves)	206.806.155				x		x		x				x								
28492140	Tool holders, self-opening dieheads and workholders of a kind used solely or principally for the manufacture of semiconductor boules or wafers, semiconductor devices, electronic integrated circuits or flat panel displays	58.264.769																				
28492150	Tool holders, n.e.c.	415.006.839	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
28492170	Self-opening dieheads for machine-tools and hand tools	6.183.170								x				x								
28492230	Jigs and fixtures for specific applications, and sets of standard jig and fixture components for machine-tools and hand tools	660.585.706	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
28492250	Work holders for lathes (excluding jigs and fixtures for specific applications, and sets of standard jig and fixture components)	321.898.858				x		x		x				x								
28492270	Work holders for machine-tools and hand tools (excluding jigs and fixtures for specific applications, and sets of standard jig and fixture components, those for lathes)	156.539.954	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
28492350	Dividing heads and other special attachments for machine-tools and hand tools	380.874.896	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
28492450	Parts and accessories for machines of HS 84.65	561.542.384	x		x	x	x	x	x						x	x						x
	Totals	**7.605.929.205**																				

3 Annex I – Stock model methodology

As no robust, detailed data on installed stock of machine tools, reflecting the definition of “machine tools” as provided in Task 1, for the relevant reference years 1995, 2009 and 2025 is available, the stock model has to be based on available statistical data regarding production, sales, imports and exports, verified with additional evidence, and checked for plausibility.

3.1 Production

Starting point for the stock model are the PRODCOM production figures for 2009 as published by EuroStat.

- The plausibility check intends to **identify the number of sold units, which are stationary or transportable units falling under the definition of “machine tools” as stated in Task 1 and to rule out all consumer products, misallocated parts and cases, where estimates by EuroStat result in non-plausible amounts of units**
- A similar unit value for different countries serves as indication, that there is a similar understanding of the machinery grouped in this product class.
- In case the unit value differs among the countries, those market shares (economic value, not unit based) with a very low unit value (indicatively below 4.000 Euro for metal working machine tools) are not taken into account, as they presumably do not represent industrial, stationary or transportable types of machinery (but DIY, handheld, mobile units, parts). This approach does not allow for distinctions within one country, where possibly a huge diversity of machinery types are allocated to the same product class. In case there are larger differences regarding the unit value among the market leading countries (indicatively difference of a factor of 4 or more) this is taken as an indication, that in these countries different types of machinery are allocated to this product class, and it might be needed to subdivide this product class in two, reflecting the specifics of the different manufacturing markets. This split is depicted in the production figures only, but not subject to distinction in the stock model.
- If the EU-27 totals - in terms of units sold - are based on EuroStat estimates, it is checked whether non-confidential data from those countries with highest market shares justify roughly the EU-totals. Where the EU-27 totals are significantly higher than the aggregated value of the market leading countries, only the market share of these market leading countries is taken into consideration.

This should result in a market coverage of at least 80% (economic value) for any given machine category.

- It is checked, whether the unit value (corrected, non-plausible market shares ruled out) reflects the likely sales prices of the machine tools likely to be covered in this group. For this check, common understanding of the machine tools category and the indication numerically controlled / non-numerically controlled is the basis.
- Largest uncertainties remain, where major market shares are confidential (no economic value, no sold volume for important countries stated). The approach for these cases is to divide the EU27-total sold volume by estimated typical price (experts estimate or median value or similar). This approach works well for product categories, which are economically dominated by high value machines, but is critical, if only a few high value machines are reported by the companies to these categories and the majority of total economic value is made up by low value units. Following the above approach of dividing the total economic volume by likely sales prices of "machine tools in scope" leads to an overestimate of total machine tools in the scope, neglecting that this total category leads to an underestimate of the total machine tools in scope.
- The resulting "level of plausibility" for each category is listed in the revised production tables and for clarity marked with the following colour code:

EU27-totals plausible as is
adjustments of EU27-totals made or data uncertainties are obvious, but data base does not allow for a correction
additional estimates required to fill data gaps / to rule out inappropriate data

This plausibility check by Fraunhofer was communicated with the relevant associations, inviting their market experts to counter-check the revised figures and to provide clarifications on specific categories and country figures.

3.2 Import and Export – Installed New Stock

The calculation of installed new stock intends to **quantify, how many machine tools in any given year are taken in operation in the EU-27**.

Import and export figures are derived from the EU-27 figures provided by EuroStat. Data following NACE Rev. 2 are available for years since 1995. However, the figures for number of units of imported and exported are frequently implausible and thus in general not suitable to calculate the installed new stock in EU-27. For several catego-

ries reported exports (in terms of units) are much higher than imports and production, which is not logic at all. Hence, the new stock installed is re-calculated as follows:

- For the years 1995 – 2002 only EU-15 figures are reported. No extrapolation to EU-27 is applied for these years.
- Import and export figures are likely to include also larger numbers of used equipment, but this cannot be verified and is not taken into account.
- Production value plus import value minus export value is the anticipated economic value of newly installed machine tools in the EU-27
- For each year 1995-2009 the calculated economic value of newly installed machine tools is divided by the production unit value. This approach neglects that exported machine tools are likely to be of a higher average value than imported ones, thus leading rather to an underestimate of installed new stock. Referring to a calculated production unit value individually for each year takes into account, that the production unit value is not constant, but subject to a trend towards more complex machine tools of higher value
- Following criteria are checked to verify, whether the resulting newly installed stock is plausible:
    - Export value (significantly) smaller than production and import value for most years
    - Overall low export and import figures, which means the more reliable production figures constitute the major share of newly installed stock, thus overall results are more robust
    - Production quantity figures changes from year to year are plausible
    - Resulting new stock value corresponds with economic cycles without major inconsistencies, new stock value year to year changes are not subject to excessive fluctuations
    - New stock quantity roughly plausible in most years in relation to verified 2009 production data
    - Production unit values plausible for most years (i.e. in the range of the 2009 figures, potentially with a tendency towards increasing unit values from year to year)

- Due to a check against these criteria, occasionally adaptations where made to enhance plausibility of the data. These corrections include
    - taking a plausible unit value also for years where reported unit values are implausible,
    - taking a plausible production quantity where reported quantity does not match with data from other years
    - for remaining cases approximation of newly installed stock with data from other years (potentially with an correction reflecting economic cycles)

For illustration, Table 3-1 provides the data subject to the plausibility check and verification for “28.41.21.40 Non-numerically controlled horizontal lathes, for removing metal”.

Further adaptations have been made to approximate the economic conditions:

- EuroStat data is available on the EU15 level only up to 2002. Based on the data provided for 2003 and consecutive years for EU 15 and EU 27 correction factors are introduced for some categories, where a major additional production, export to or import from the new member countries is evident.

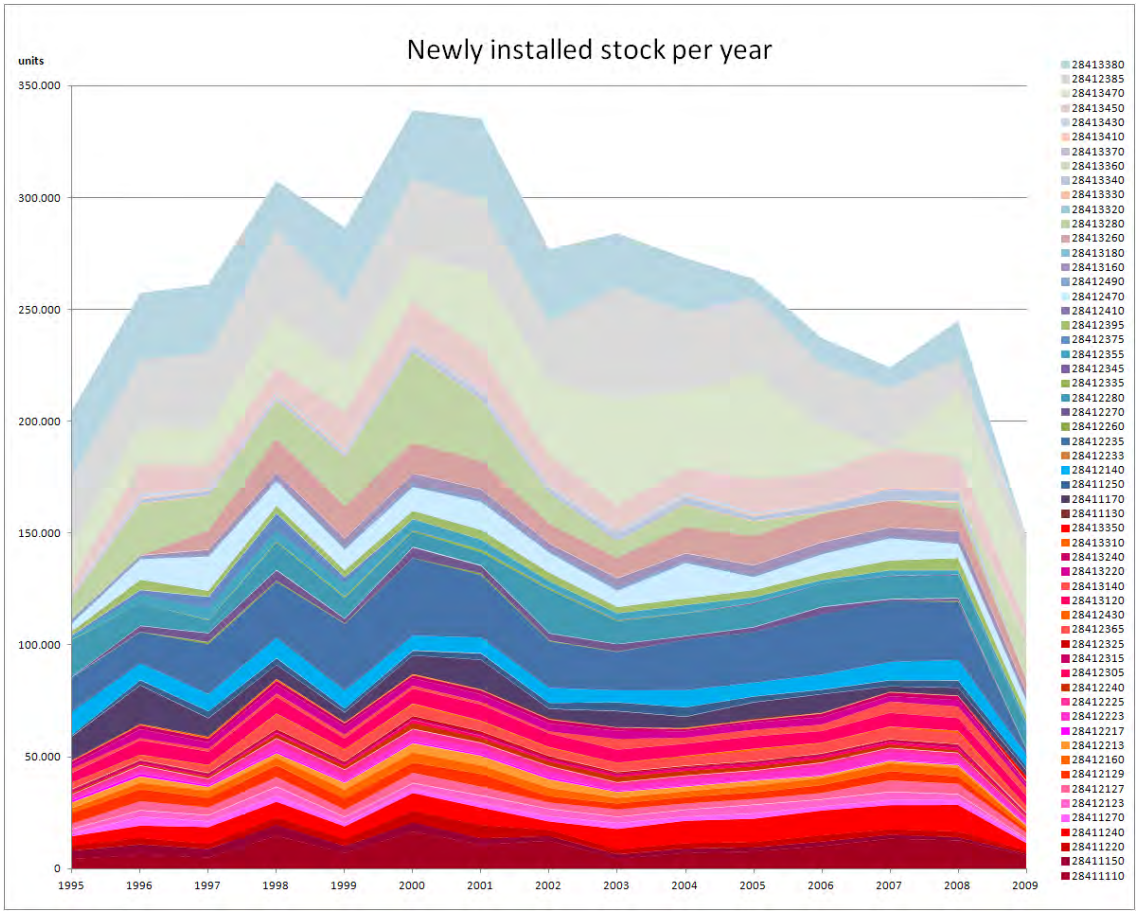

Figure 3-1: Metal working machine tools – newly installed stock 1995 - 2009

The newly installed stock of metal working machine tools exemplarily is depicted in Figure 3-1: The number of newly installed machine tools roughly remains stable, with a sharp decline in 2009 due to the economic crisis. The economic down-turn years 2002-2004 are also visible with this model. The particularly low values in 1995-1997 can partly be related to the economic situation, but even more to the fact, that 2 major product categories are not reported for these years (28.41.33.80 in greyish-blue, 28.41.23.85 in grey), thus not covered by the statistics. These findings confirm that the model for newly-installed stock is plausible and fluctuations are explainable.

Table 3-1: Plausibility Check New Installed Stock "28.41.21.40 Non-numerically controlled horizontal lathes, for removing metal"

PRODCOM EuroStat data „as is"								Calculation and plausibility check Fraunhofer				Data quality check Fraunhofer											
PERIOD_LAB	EXPQNT	EXPVAL	IMPQNT	IMPVAL	PRODQNT	PRODVAL	PROD unit value	new STOCK quantity	new STOCK value	new STOCK quantity based on Production unit values	Correction	Quota IMPVAL/PRODVAL	Quota EXPVAL/PRODVAL	2009 PROD plausible	EXPVAL < 60% in 12 years	EXPVAL < 45% in all years	IMPVAL < 40% in 12 years	IMPVAL < 25% in all years	new STOCK value corresponds with economic cycles	new STOCK value year to year changes w/o major inconsistencies	new STOCK quantity roughly plausible in several years	PROD unit values plausible in 12	TOTAL data quality no adjustments required
1995	7995	73933000	31384	69508380	10609	181489039	17107	33.998	177.064.419	**10.350**		38%	41%										
1996	6437	75129130	14213	72534220	7397	206477431	27914	15.173	203.882.521	**7.304**		35%	36%										
1997	26646	69072900	22408	80535710	7147	173260692	24242	2.909	184.723.502	**7.620**		46%	40%										
1998	4465	69949930	23982	102327040	7552	192074680	25434	27.069	224.451.790	**8.825**		53%	36%										
1999	5158	58444290	18289	87277100	6631	213378397	32179	19.762	242.211.207	**7.527**		41%	27%										
2000	4305	68819040	4019276	88987900	5793	204780910	35350	4.020.764	224.949.770	**6.364**		43%	34%										
2001	9261	68304830	18433	94918010	17649	169561922	9607	26.821	196.175.102	***6.942***	PRODQNT estimate: 6,000	56%	40%	1	1	0	0	0	1	1	0	1	0	**5**
2002	4331	58608280	17001	73712500	6047	140633821	23257	18.717	155.738.041	**6.696**		52%	42%										
2003	10891	77799740	30530	48305250	9171	164184678	17903	28.810	134.690.188	**7.524**		29%	47%										
2004	37216	65925900	22883	57745490	10508	147865481	14072	-3.825	139.685.071	**9.927**		39%	45%										
2005	20293	69589130	27851	62309510	8460	149976369	17728	16.018	142.696.749	**8.049**		42%	46%										
2006	9236	69762720	25430	56723430	8957	187925710	20981	25.151	174.886.420	**8.336**		30%	37%										
2007	19743	78057640	73561	73115780	10027	227085195	22647	63.845	222.143.335	**9.809**		32%	34%										
2008	59866	69736080	31369	83281410	10060	224730386	22339	-18.437	238.275.716	**10.666**		37%	31%										
2009	3732	36611660	20365	34187170	5990	143325496	23927	22.623	140.901.006	**5.889**		24%	26%										

3.3 New Stock Totals

Above calculations result in the verified newly installed stock for each of the years 1995 – 2009. The accumulated stock has to consider also historic data before 1995 due to the long lifetime of machine tools. For simplification, newly installed stock before 1995 is calculated with the average of the following 10 years, i.e. the data for 1994 is based on the average of the years 1995-2004 (which represents one economic cycle). For CNC machines newly installed stock is set at 0 for all years before 1975 as this technology was introduced in the mid-70s.

This “retrospective extrapolation” results in a newly installed stock, exemplarily for metal working machine tools, as depicted in Figure 3-2.

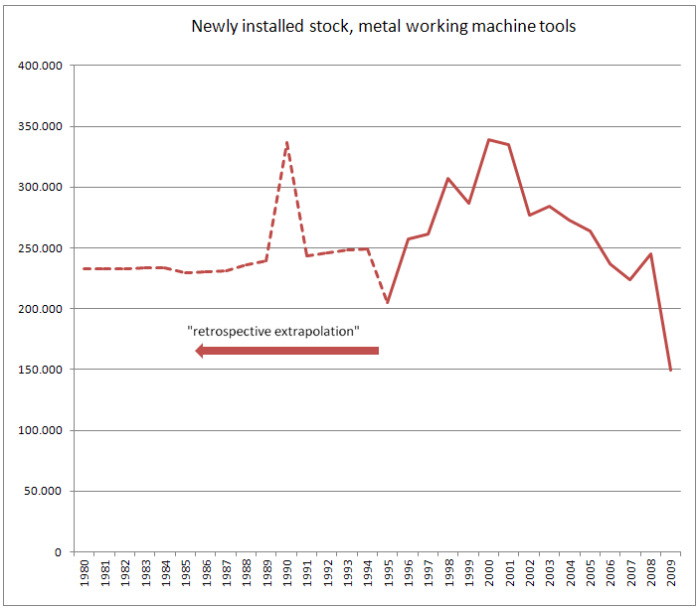

Figure 3-2: Metal working machine tools – newly installed stock 1980 - 2009

Based on the lifetime estimates, the stock model follows a scenario that 100% of the machine tools stay in operation the stated lifetime and are completely taken out of operation once this lifetime expired. This is a simplification, as there will be a phase-out stretching over several years, partly even over 1 to 2 decades. However, given the long lifetime – and thus rather small share of stock being mathematically exchanged in any given year – this approach is accurate enough for the purpose of the study.

The results of this stock model show a rather stable number of installed units, which leads vice versa to the conclusion, that a more distinct phase-out model stretching of several years phase-out time would not add any value to the findings.

Further adaptations have been made to approximate the economic conditions:

- Given the steady replacement of non-CNC machine tools by CNC machine tools in recent decades it was assumed, that the lifetime of non-CNC machine tools in the economic recession 2002-2004 was reduced by 3 years (by taking over capacity machine tools out of operation)
- As an approximation of the historic development of installed CNC machine tools before 1995, for which no EuroStat data was extracted, an annual growth rate of 11,4% (according to German machine tools surveys in 1985 and 1995) was anticipated
- The economic boom of the late 1980s / early 1990s is addressed with a factor of 1,5 applied to the new stock installed in 1990 (adaptation of the retrospective extrapolation of stock data)

3.4 PRODCOM 2010 update

In the course of the study, new PRODCOM data became available for 2010 production, imports and exports. Table 3-2 lists in the right column the new calculated stock for 2010 based on the aforementioned stock model, which takes into account real PRODCOM data until 2009, and the 2010 data based on recently reported PRODCOM figures (calculating new stock based on reported 2010 production, import and export data; rules for plausibility checks apply). It is obvious that there are major deviations due to the inherent limitations of the Eurostat data, but in general the order of magnitude is confirmed. For metal working machine tools in most categories the PRODCOM based figures are 20-60% lower, which is not surprising, as 2010 has been affected by the economic crisis. Hence, new stock is logically lower than the estimation based on the Fraunhofer stock model, which does not consider the economic cycles (as these cycles cannot be predicted with a 2025 horizon, in any case).

Table 3-2: Machine tools – new installed stock in 2010 according to PRODCOM figures and according to the stock forecast model

PRODCOM	Description	2010	2010
		Applying stock model methodology to 2010 PRODCOM data	Fraunhofer stock model based on extrapolation of historic trends (data used for calculations)
27903118	Electric brazing or soldering machines and apparatus (excluding soldering irons and guns)	4.080	3.831
27903145	Electric machines and apparatus for resistance welding of metal	108.590	67.640
27903154	Fully or partly automatic electric machines for arc welding of metals (including plasma arc)	41.658	181.639
27903163	Other for manual welding with coated electrodes	503.139	373.646
27903172	Other shielded arc welding	264.297	281.364
27903181	Machines and apparatus for welding or spraying of metals, n.e.c.	9.095	10.455
27903190	Machines and apparatus for resistance welding of plastics	not available	54.381
27903199	Machines and apparatus for welding (excluding for resistance welding of plastics, for arc and plasma arc welding, for treating metals)	not available	6.956
28297090	Machinery and apparatus for soldering, brazing, welding or surface tempering (excluding hand-held blow pipes and electric machines and apparatus)	obvious data reporting error (296.812)	2.977
28411110	Machine-tools for working any material by removal of material, operated by laser or other light or photon beam processes	6.990	2.450
28411130	Machine-tools for working any material by removal of material, operated by ultrasonic processes (excluding machines for the manufacture of semiconductor devices or of electronic integrated circuits)	541	495
28411150	Machine tools for working any material by removal of material, operated by electro-discharge processes	718	1.210
28411170	Machine-tools for working any material by removal of material, operated by electro-chemical, electron-beam, ionic-beam or plasma arc processes	3.044	2.395
28411220	Horizontal machining centres for working metal	1.290	2.227
28411240	Vertical machining centres for working metal (including combined horizontal and vertical machining centres)	4.573	9.116
28411250	Unit construction machines (single station) for working metal	1.885	2.565
28411270	Multi-station transfer machines for working metal	1.577	2.012
28412123	Numerically controlled horizontal lathes, turning centres, for removing metal	1.376	2.132

28412127	Numerically controlled horizontal lathes, automatic lathes, for removing metal (excluding turning centres)	2.837	4.065
28412129	Numerically controlled horizontal lathes, for removing metal (excluding turning centres, automatic lathes)	1.032	2.828
28412140	Non-numerically controlled horizontal lathes, for removing metal	4.442	7.301
28412160	Lathes, including turning centres, for removing metal (excluding horizontal lathes)	1.580	2.964
28412213	Numerically controlled drilling machines for working metal (excluding way-type unit head machines)	456	832
28412217	Numerically controlled knee-type milling machines for working metal (excluding boring-milling machines)	210	394
28412223	Numerically controlled tool-milling machines for working metal (excluding boring-milling machines, knee-type machines)	1.708	3.064
28412225	Numerically controlled milling machines for working metal (including plano-milling machines) (excluding boring-milling machines, knee-type, tool-milling machines)	1.644	1.432
28412235	Non-numerically controlled drilling machines for working metal (excluding way-type unit head machines)	5.454	18.675
28412240	Numerically controlled boring and boring-milling machines for working metal (excluding drilling machines)	272	1.026
28412260	Non-numerically controlled boring and boring-milling machines for working metal (excluding drilling machines)	60	133
28412270	Non-numerically controlled milling machines for working metal (excluding boring-milling machines)	3.548	596
28412280	Threading or tapping machines for working metal (excluding drilling machines)	10.237	10.187
28412305	Numerically controlled flat-surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	540	1.052
28412315	Numerically controlled cylindrical surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	437	995
28412325	Other numerically controlled grinding machines in which the positioning in any one axis can be set up to accuracy >0.01mm	42	293
28412345	Non-numerically controlled cylindrical surface grinding machines for working metal, in which the positioning in any one axis can be set up to a minimum accuracy of 0.01mm	256	332
28412355	Grinding machines for working metal; any one axis can be set to an accuracy >=0.01mm excluding flat-surface grinding machines, cylindrical surface grinding machines	2.087	1.869

28412365	Numerically controlled sharpening (tool or cutter grinding) machines for working metal	3.596	4.423
28412375	Non-numerically controlled sharpening (tool or cutter grinding) machines for working metal	7.797	not plausible
28412385	Honing or lapping machines for working metal	6.252	15.878
28412395	Machines for deburring or polishing metal (excluding gear finishing machines)	3.142	4.446
28412410	Broaching machines for working metal	50	53
28412430	Gear cutting, gear grinding or gear finishing machines, for working metals, metal carbides or cermets (excluding planing, slotting and broaching machines)	287	626
28412470	Sawing or cutting-off machines for working metal	6.672	7.275
28412490	Planing, shaping or slotting machines and other machine-tools working by removing metal or cermets, n.e.c.	87	577
28413120	Numerically controlled bending, folding, straightening or flattening machines for working flat metal products (including presses)	3.799	5.428
28413140	Numerically controlled bending, folding, straightening or flattening machines for working metal (including presses) (excluding those for working flat metal products)	2.273	4.825
28413160	Non-numerically controlled bending, folding, straightening or flattening machines for working flat metal products (including presses)	9.142	4.257
28413180	Non-numerically controlled bending, folding, straightening or flattening machines for working metal (including presses) (excluding those for working flat metal products)	- 217	n.a.
28413220	Numerically controlled shearing machines for working metal (including presses) (excluding combined punching and shearing machines)	1.943	2.272
28413240	Numerically controlled punching or notching machines for working metal (including presses, combined punching and shearing machines)	1.364	1.516
28413260	Non-numerically controlled shearing machines for working metal (including presses) (excluding combined punching and shearing machines)	23.410	9.411
28413280	Non-numerically controlled punching or notching machines for working metal (including presses, combined punching and shearing machines)	7.266	827
28413310	Numerically controlled forging or die-stamping machines and hammers for working metal (including presses)	189	139
28413320	Non-numerically controlled forging or die-stamping machines and hammers for working metal (including presses)	not available	18
28413350	Hydraulic presses for working metal	2.205	1.869

28413360	Non-hydraulic presses for working metal	21.185	17.658
28413410	Draw-benches for bars, tubes, profiles, wire or the like of metal, sintered metal carbides or cermets	not plausible	685
28413430	Thread rolling machines for working metal, sintered metal carbides or cermets	122	198
28413450	Machines for working wire (excluding draw-benches, thread rolling machines)	14.287	12.774
28413470	Riveting machines, swaging machines and spinning lathes for working metal, machines for manufacturing flexible tubes of spiral metal strip and electro-magnetic pulse metal forming machines, and other machine tools for working metal without removing metal	51.247	21.381
28491130	Sawing machines for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold working glass	not available	32.844
28491150	Grinding or polishing machines for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold working glass	not available	5.442
28491170	Machine-tools for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold working glass (excluding sawing machines, grinding or polishing machines)	83.005	8.910
28491210	Multi-purpose machines where the workpiece is manually transferred between operations, for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	8.404	4.299
28491220	Multi-purpose machines where the workpiece is automatically transferred between operations for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	9.252	6.747
28491233	Band saws for working wood, cork, bone and hard rubber, hard plastics or similar hard materials	11.221	8.555
28491235	Circular saws for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	36.274	63.283
28491237	Sawing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials (excluding band saws, circular saws)	53.525	112.607
28491250	Planing, milling or moulding (by cutting) machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	29.735	42.860
28491263	Grinding, sanding or polishing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	32.684	7.951
28491265	Bending or assembling machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	not plausible	2.573

28491267	Drilling or morticing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	4.768	7.231
28491275	Splitting, slicing or paring machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials	19.503	14.212
28491279	Machine tools for working wood, cork, bone, hard rubber, hard plastics or similar hard materials, n.e.c.	20.405	18.948