D5.1 Third Annual Report – February 2007

Lead-free soldering status survey 2006

TUB, Germany

23 March 2007

Contract No:	NMP2-CT-2003-505504
Acronym:	ELFNET
Title:	European Lead-Free Soldering Network
Coordinator:	ITRI Ltd, UK

ELFNET Unit 3 - Curo Park Frogmore St Albans Hertfordshire AL2 2DD United Kingdom Tel +44 (0) 870 458 4242 Fax +44 (0) 870 458 4273

European Lead-Free Soldering Network is funded by The European Commission

Contents

List of Figures

Background and Participation

1.1 Questionnaire

The results discussed in this report are based on a questionnaire distributed from November 2006 to February 2007 via the ELFNET and other webpages on congresses and fairs (CARE Innovation 2006 in Vienna, Austria, Electronica 2006 in Munich/Germany), and through direct contacts with industry partners inside and outside ELFNET.
Additionally, national and international associations had been contacted via phone using the ELFNET members' networks and contacts. The representatives were informed to raise awareness and to ensure the associations' support for the distribution of the questionnaire. They were also contacted again after a while asking them to ask their members again to fill out and send back the questionnaires.
As an additional incentive, the ELFNET consortium offered the chance to win a latest generation MP3-Player to those who had sent back their questionnaire until 27 January 2007.
The priority was to increase the responses to the utmost in order to obtain a more diversified and representative picture. For that reason the questionnaire intentionally was kept short so that it could be filled out completely within a maximum of 15 minutes. As the deadline 1 July 2006 for the start of RoHS compliance has already passed, some of the questions from previous surveys have become obsolete anyway.

1.2 Participation in ELFNET Surveys

TU Berlin received 115 answers in total. Compared to the previous surveys, the participation increased considerably. The 2006 survey was the first one including Asian and North American companies.
Figure 1 shows the total number of participants in the ELFNET surveys. Only 18 European participants took part in the first ELFENT survey in 2004. In 2005, the participation had almost doubled to 32 companies. In 2006, the number of replies to the questionnaire was at 115, from which 94 ones are European companies. From Asia (Japan and Singapur), 11 answers arrived at TU Berlin, and from North America it was 10 answers (USA and Canada).

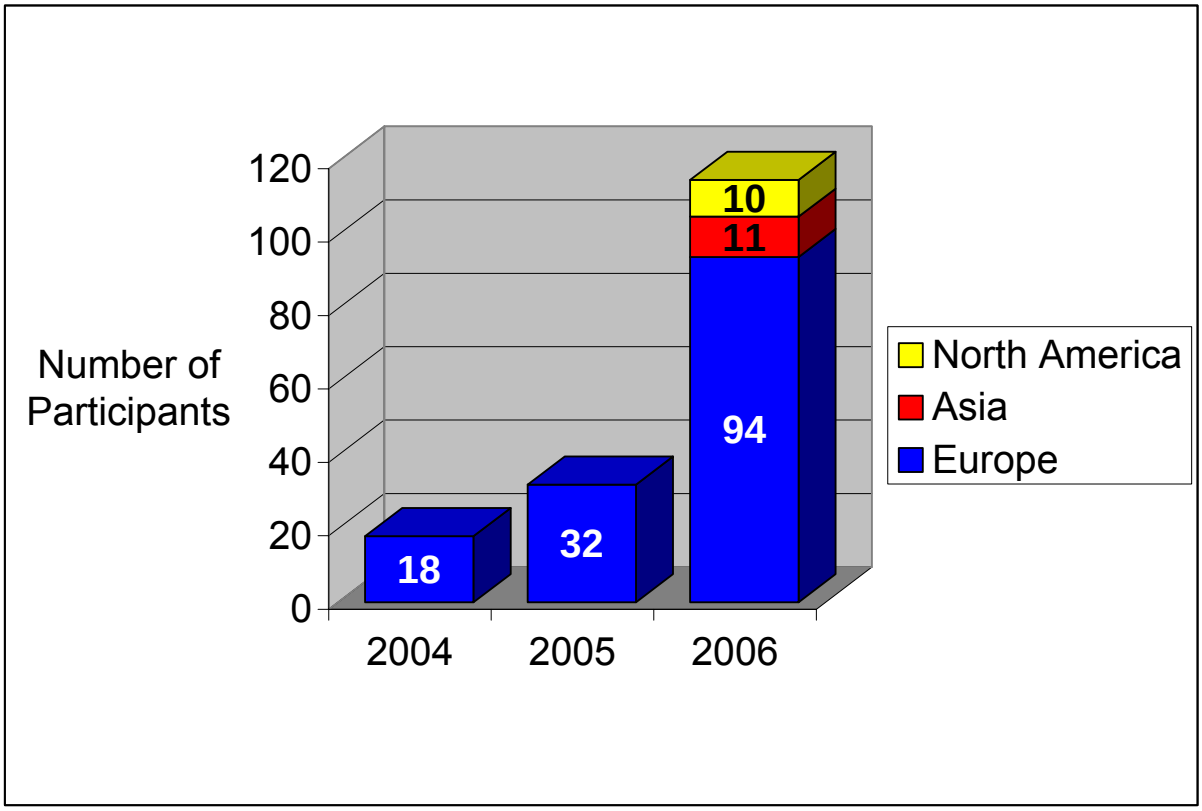

Figure 1: Participation in ELFENT surveys from 2004 to 2006

For comparisons of solder material preferences between the surveys 2004, 2005 and 2006, it must be kept in mind, that in particular the representativeness of the 2004 survey suffered from the low participation.

Figure 2 displays the participation of the different countries within and outside the EU.

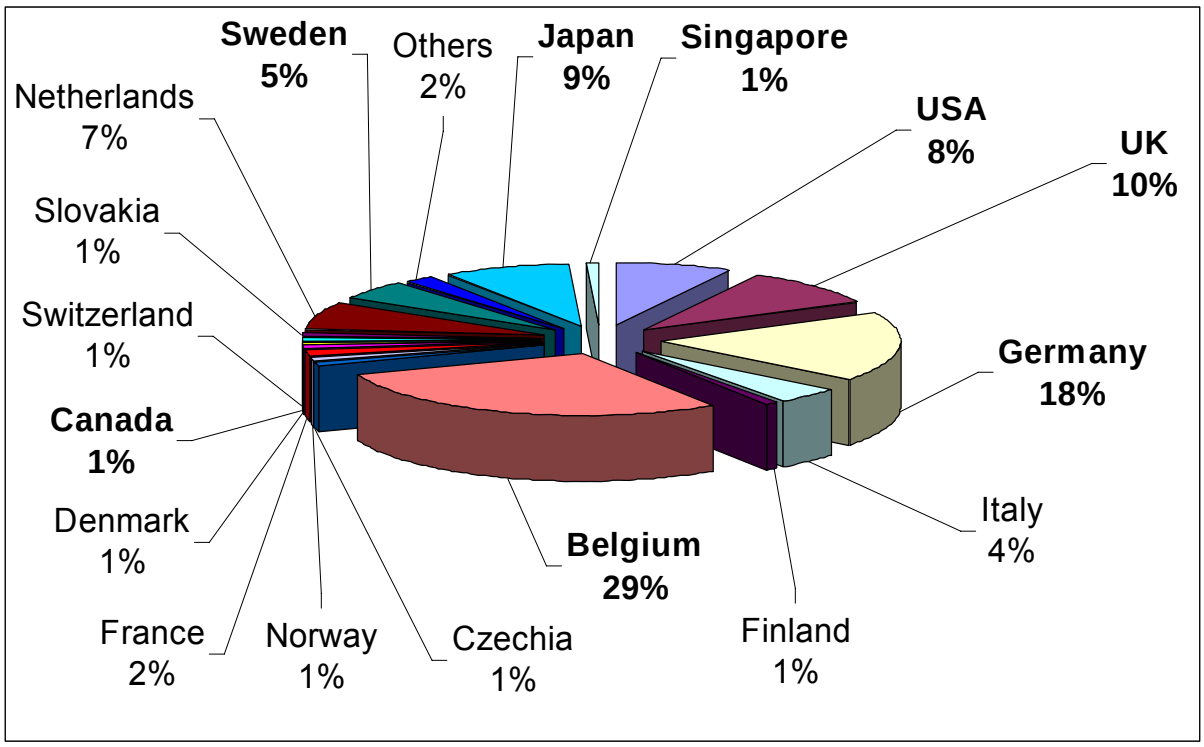

Figure 2: Participating countries in the ELNET survey
(bold: countries outside the EU and/or with a share of 5 % and more)

For all results differentiated for America and Asia, it must be kept in mind that the Asian and American results are based on 10 and 11 questionnaires only and thus probably lack representativeness.

1.3 Participants

Most of the participants, almost 80 %, are operating globally, as Figure 3 shows. The other participants to approximately equal shares do business all over Europe (13 %) or only in a single European Union member state (11 %).
The participation of SME (≤ 250 employees) in the survey is around 50 %.

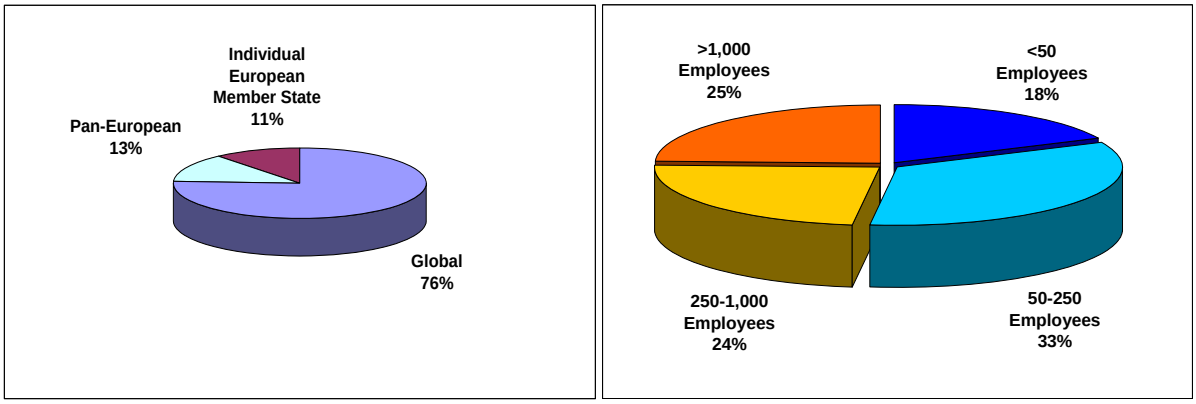

Figure 3: Participant's operating regions (left) and company sizes
(100 %: total number of business region and company size nominations respectively; all values rounded)

Figure 4 indicates the participants' business and product categories. Most survey participants are end producers (58 %) and material/component manufacturers (25 %). Equipment manufacturers account for 4 % of the answers, recyclers for 2 %. The share of EMS (electronics manufacturing services) with 1 % is the smallest business sector.

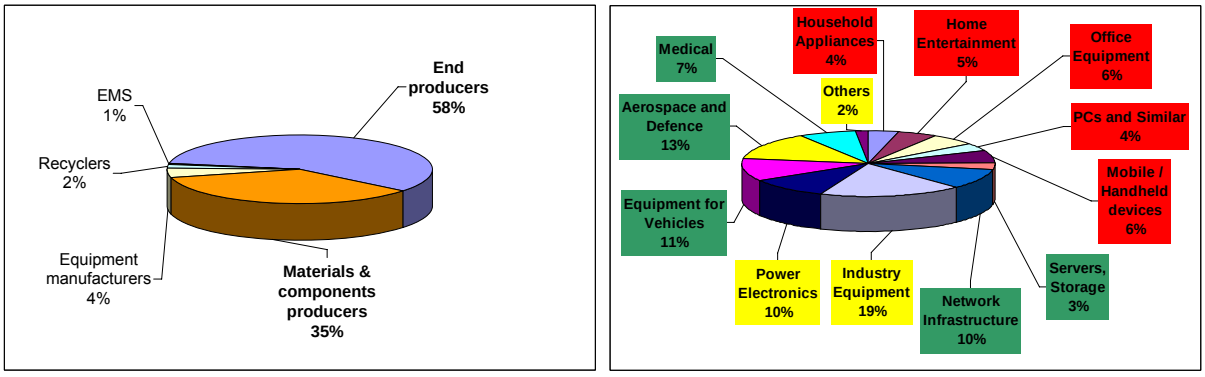

Figure 4: Partipants' business and product categories
(100 %: total number of answers for business and product categories respectively; all values rounded)

Remarkably, most of the participants (44 %) manufacture products, which are exempted or out of the scope of the RoHS Directive (in green/dark boxes). Another 31 % produce in or for sectors that may be at least partially out of scope or exempted (yellow/bright boxes). The rest (25 %) fully falls under the RoHS Directive with their products.

The use of solders and finishes reflects this product portfolio, as the next chapter shows.

2 Use of Soldering Materials

This chapter shows which solders and finishes on components and printed wiring boards the companies use.

2.1 Use of Wave and Reflow Solders

The focus in this chapter is on the total and the regional use of wave and reflow solders as well as on the development of the preferences for certain lead-free solders throughout the three ELFNET surveys 2004, 2005 and 2006.

2.1.1 Total Use of Wave and Reflow Solders

Figure 5 shows the wave solders, which the European, Asian and North American companies in the survey use.

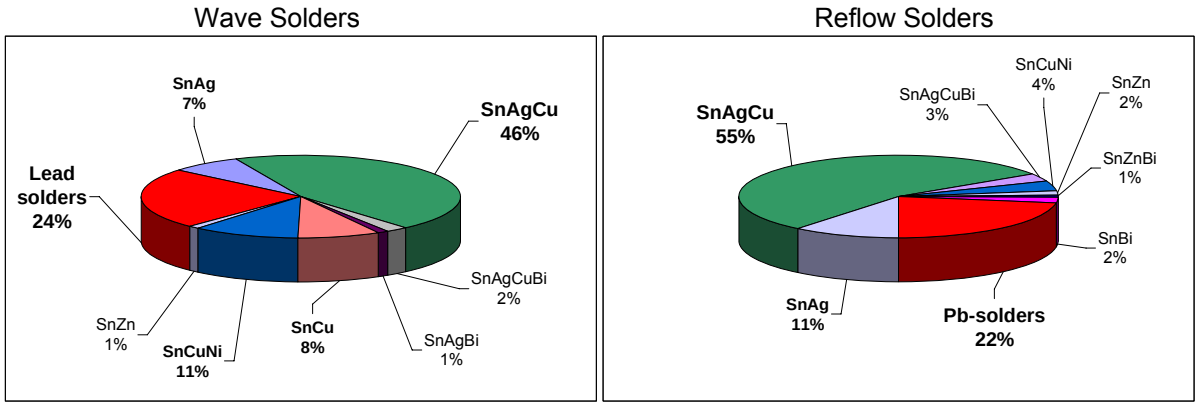

Figure 5: Use of wave (left) and reflow solders
(100 %: total number of wave and reflow solder nominations respectively; all values rounded)

The share of lead-solders in wave soldering is around 24 %, and around 22 % in reflow soldering, due to the industry sectors or products, which are out of scope of the RoHS Directive or (partially) exempted (see Figure 4 on page 7). Additionally, around 76 % of the survey participants are serving global markets, beyond the borders of the EU (Figure 3 on page 7), and thus may continue using lead-solders for wave soldering. Given the high share of such companies, the lead-solder ratio of the is unexpectedly low. Chapter 2.5 on page 27 will give more details about this fact.

Figure 6 on page 9 shows the shares of the different lead-free solders in the total use of lead-free solders.

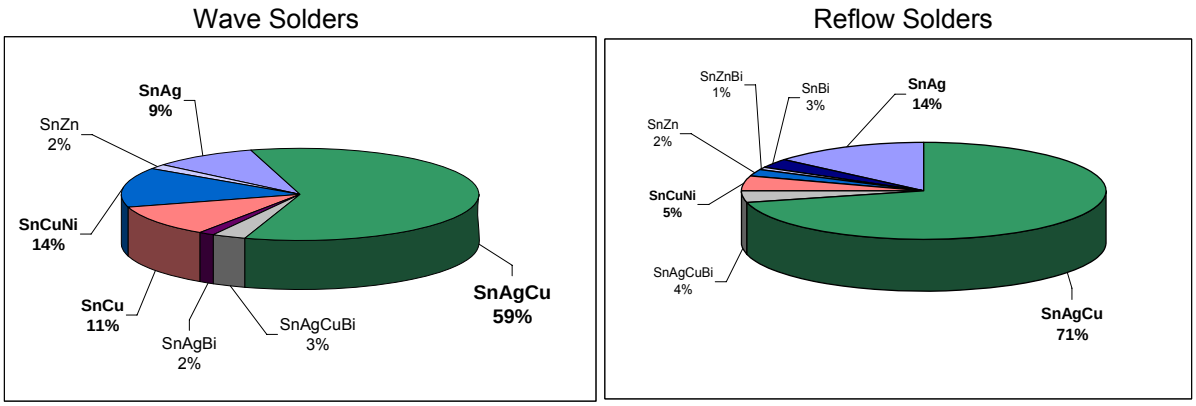

Figure 6: Share of lead-free wave (left) and reflow solders in total lead-free solder use
(100 %: number of all lead-free wave and reflow solders nominated respectively; all values rounded)

Both in wave and reflow soldering, the tin-silver-copper (SnAgCu) solder is the preferred lead-free solder. It accounts for around 59 % of the total lead-free wave solder use and even for 71 % of the lead-free reflow solder use.
The second main lead-free wave solder is the SnCuNi (SCN) solder with around 14 % of the total wave solder use. The SnCu and the SnAg wave solder use is almost equal with 11 % and 9 %.
The other lead-free wave solders have a much lower share. The tin-silver-copper-bismuth (SnAgCuBi) alloy use is around 3 % of the total lead-free wave solder. The tin-zinc (SnZn) alloy and the tin-silver-bismuth alloy (SnAgBi) alloy both have a share of around 2 % in the total lead-free solder use.

The main lead-free reflow solder is the tin-silver-copper (SnAgCu) solder, which accounts for around 71 % of the total use of lead-free solders. The second main lead-free reflow solder is the SnAg solder with around 14 % of the total reflow solder use.
The SnCuNi (5 %) and the SnAgCuBi solder use (4 %) in reflow soldering is almost equal. The same applies to the SnBi (3 %) and the SnZn alloys (2 %) in the total use of lead-free solders. The SnZnBi alloy has the lowest use with around 1 % only.

Silver containing lead-free solders account for around 73 % in wave soldering and for even 89 % in reflow soldering. The total use of bismuth-containing wave solders is around 5 % of the total lead-free solder use. For lead-free reflow solders, this share is around 8 %.
Both the use of silver and of bismuth have high influences in life cycle assessments. While silver mainly drives the energy consumption in lead-free soldering □[2]□[6], bismuth has a positive resource impact □[1].

Unlike in previous surveys, there are no manufacturers who do not know what to use or are undecided yet, which is, however, plausible, as the deadline 1 July 2006 for the ban of lead has already passed.

2.1.2 Regional Use of Wave Solders

Figure 7 displays the regional use of wave solders. As mentioned before, it must be kept in mind that the Asian and American wave solder use patterns are based on

around 10 replies only and therefore possibly are not representative (see chapter 2.5.1 on page 27).

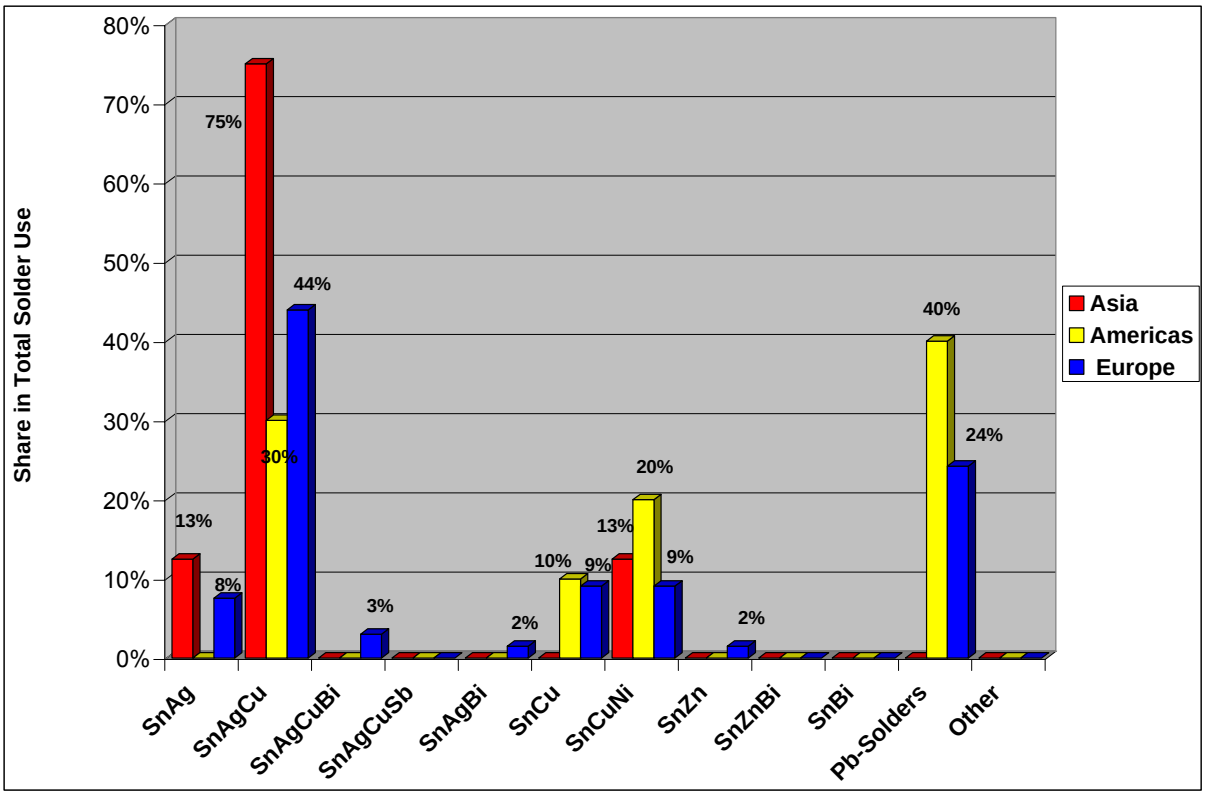

Figure 7: Regional use of wave solders
(100 %: Wave solder nominations per region; all values rounded)

The tin-silver-copper wave solder is the main lead-free solder of the survey participants in particular in Asia (75 %), but also in Europe (44 %) and in America (30 %).
The American participants have the highest share of lead solder use (40 %). The Europeans follow with 24 %, while the Asian participants do not use lead-solders.
The tin-copper-nickel wave solder alloy has the highest prevalence among the American participants (20 %), followed by the Asian (13 %) and the European companies (9 %). The Americans are the only ones that do not use the SnAg wave solder alloy, while the Asians are the main users with 13 %. The share of this alloy in Europe is only 8 %.
The Asian survey participants do not use the SnCu alloy in wave soldering. The main users are the Americans (10 %) and the Europeans (9 %).
Several of the alloys with low shares are only used by the Europeans. The SnAgCuBi solder (3 %), and the SnAgBi and the SnZn solders with around 2 % each. At first glance, this seems surprising, as bismuth is known to be a favored solder alloy constituent in Asia. As the earlier Soldertec survey from the year 2003 shows [4], the Japanese industry used 3 % of bismuth containing wave solders at that time. Assuming that this situation has not changed fundamentally, the seemingly non-use of bismuth containing solders in this survey simply would be the result of the low probability that one of the only 11 participants from Japan and Singapur is among the users of such a solder. The same may be true for America.

What does Figure 7 show is that European manufacturers use around 5 % of wave solders with bismuth.

2.1.3 Regional Use of Reflow Solders

Figure 8 illustrates the regional use patterns of reflow solder alloys in Europe, Asia and North America. It must be kept in mind that the Asian and American reflow solder use patterns are based on around 10 replies only and therefore should not be considered representative (see chapter 2.5.1 on page 27).

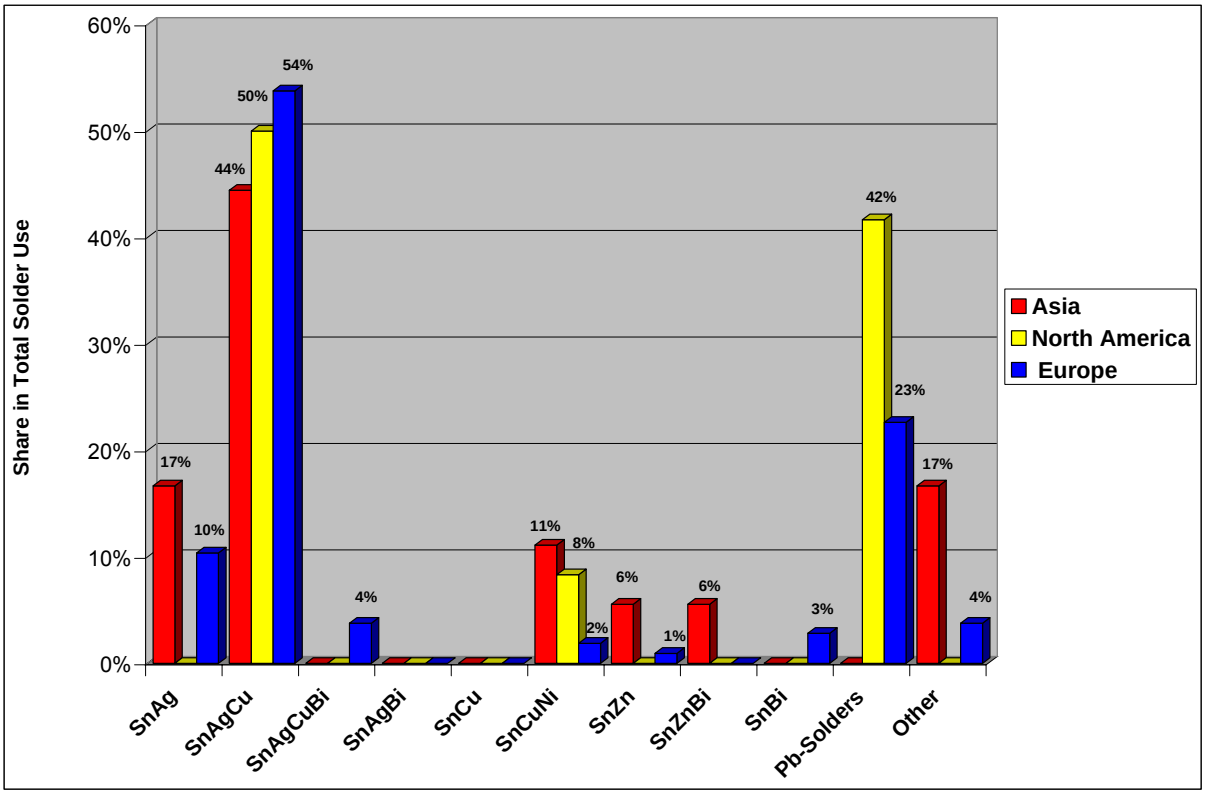

Figure 8: Regional use of reflow solders
(100 %: Wave solder nominations per region; all values rounded)

The main users of lead solders are located in North America (42 %), followed by the Europeans (23 %), while the Asian survey participants do not use lead-solders.

Like in wave soldering, the tin-silver-copper solder is the main lead-free reflow solder among the survey participants in particular in Europe (54 %), but also in North America (50 %) and in Asia (44 %).

The tin-copper-nickel reflow solder alloy has the highest prevalence among the Asian participants (11 %), followed by the American (8 %) and the European companies with 2 %.
The Americans are the only ones that do not use the SnAg reflow solder alloy, while the Asians are the main users with 17 %. The share of this alloy in Europe is only 10 %.

The Asian survey participants do not use the SnCu alloy in reflow soldering. The main users are the Americans (10 %) and the Europeans (9 %).
Several of the alloys with low shares are only used by the Europeans. The SnAgCuBi solder (3 %), and the SnAgBi and the SnZn solders with around 2 % each. At first glance, this seems surprising, as bismuth is known to be a favored solder alloy constituent in Asia. As the earlier Soldertec survey from the year 2003 shows [4], the Japanese industry used 3 % of bismuth containing reflow solders at that time. Assuming that this situation has not changed fundamentally, the seemingly non-use of bismuth containing solders in this survey simply would be the result of the low probability that one of the only 11 participants from Japan and Singapur is among the users of such a solder. The same may be true for America.
What does Figure 7 show is that European manufacturers use around 5 % of reflow solders with bismuth.

2.1.4 Development of Lead-free Wave Solder Preferences in Europe

Figure 9 shows how the lead-free wave solder preferences have developed in the ELFNET surveys from 2004 to 2006. As Asian and American companies had not participated in the previous surveys, the comparison is limited to Europe.

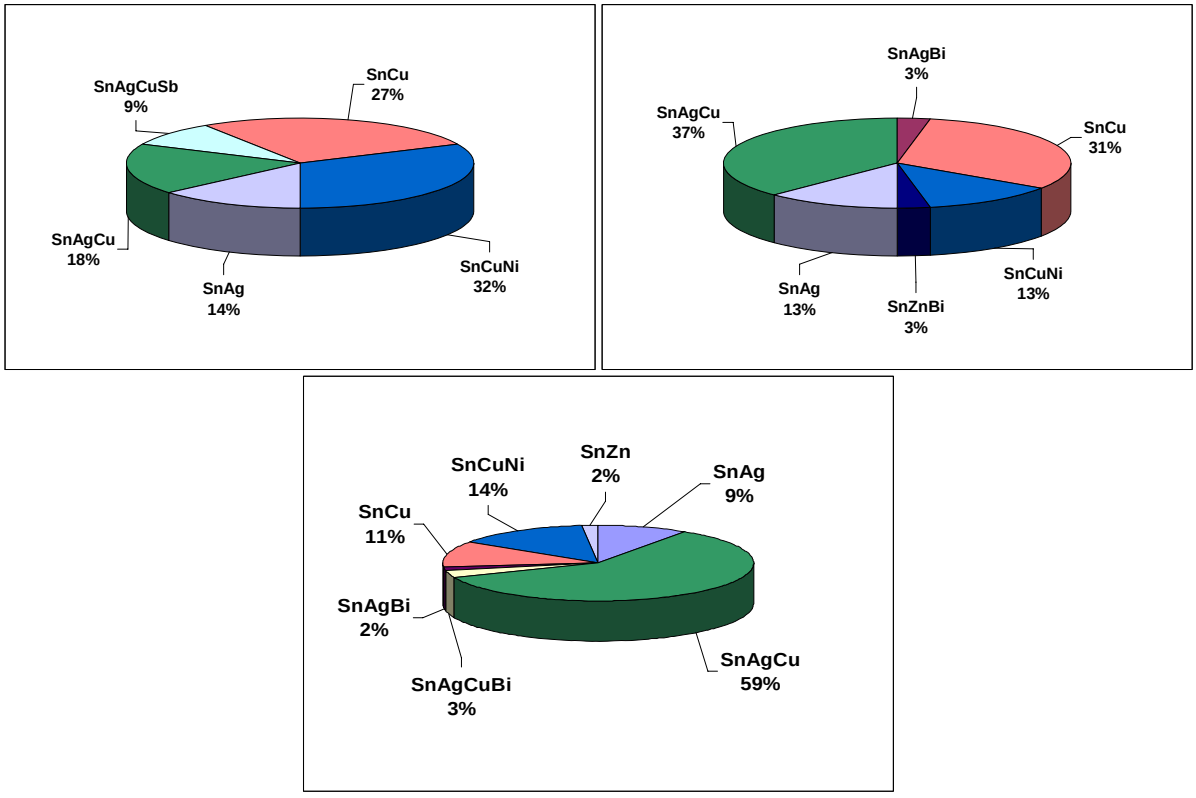

Figure 9: (Intended) use of wave solders in 2004 (top left), 2005 (top right) and 2006 (bottom) in Europe
(100 %: Total number of wave solder nominations in each year; all values rounded)

The comparison shows that in 2004, the favourite lead-free wave solder in Europe was not the SnAgCu alloy, but the SnCuNi alloy with 32 % and the SnCu alloy with 27 %. The SnCuNi alloy has lost its leading position in the following years for the

benefit of the SnAgCu alloy, whose share has increased from 18 % in 2004 to 59 % in 2006.
The SnCu alloy since 2005 has reduced its share from around 30 % in 2004 and 2005 down to 11 % in 2006, also to the benefit of the SnAgCu solder.
The SnAg solder as well dropped behind the original share of 14 % in 2004 to 9 % in 2006.
The SnZnBi (3 %) for the first time was intended to be used in 2005, and the SnZn (2 %) solder more or less replaced in 2006.
In 2004, around 9 % of survey participants had intended to use the SnAgCuSb solder, which, however, completely disappeared from the agenda in the following years. From 2005 on, the SnAgBi solder had a stable share of around 3 %.

As the general overall trend, the share of the SnAgCu solder has permanently increased in lead-free wave soldering, while the share of SnCu and SnCuNi has decreased. The material variety also has increased over the years from five to six to seven different materials. This effect, however, might simply be attributed to the growing participation (Figure 1on page 5). The probability to be nominated thus increased for the materials of minor importance.

2.1.5 Development of Lead-free Reflow Solder Preferences in Europe

Figure 10 shows how the lead-free reflow solder preferences have developed in the ELFNET surveys from 2004 to 2006. As Asian and American companies had not participated in the previous surveys, the comparison is limited to Europe.

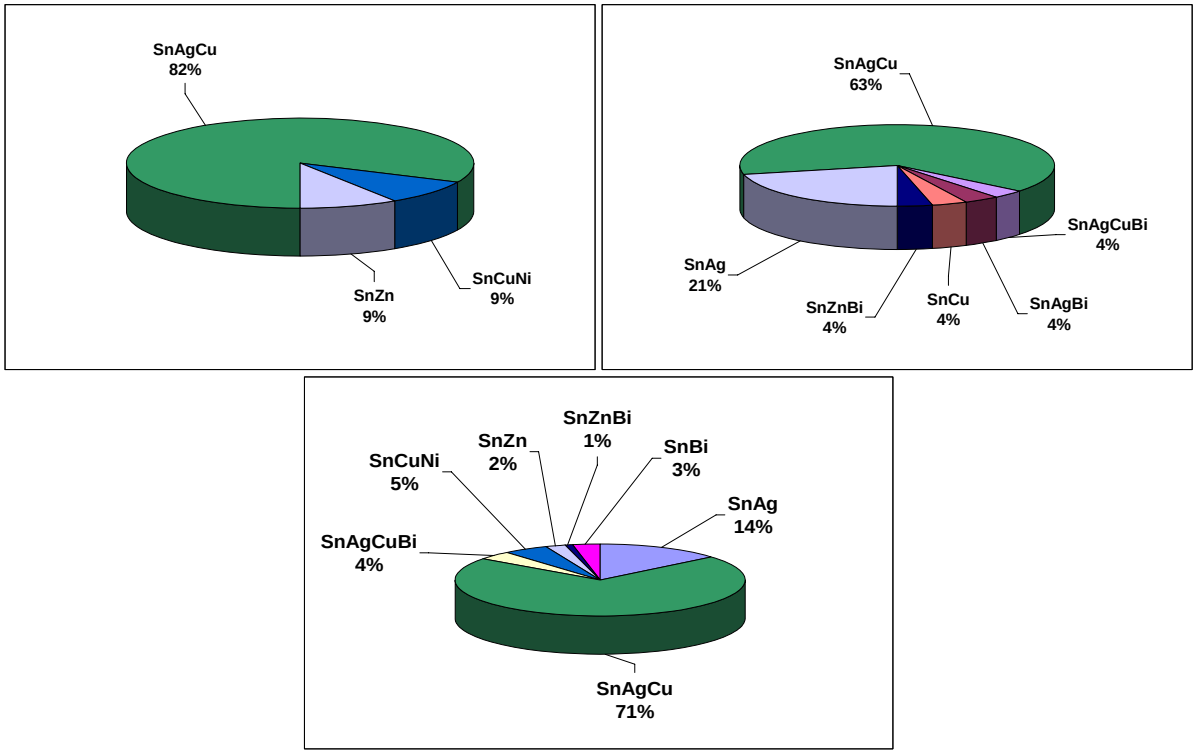

Figure 10: (Intended) use of reflow solders in 2004 (top left), 2005 (top right) and 2006 (bottom) in Europe
(100 %: Total number of reflow solder nominations in each year; all values rounded)

In 2004, the survey participants had intended the use of three different lead-free reflow solders the SnAgCu being the most popular with 82 %. The other two alloys were SnZn and SnCuNi with 9 % respectively. In the following years, the material variety has increased at the cost of the SnAgCu solder, whose share decreased from 82 % down to 71 % in 2006.
The SnAg reflow popped up in 2005 with a share of 21 %, which now is 14 %. The SnCuNi solder was not mentioned in 2005, but its use was indicated in 2006 again with around 5 %.
Around 4 % of participants for the first time had intended to use the SnCu alloy for reflow soldering, but the alloy disappeared in 2006.
In 2005, around 4 % of the participants had indicated the intended use of SnAgBi and SnAgCuBi solder. In 2006, only the SnAgCuBi solder could maintain a share of 4 %, while the SnAgBi solder was no longer mentioned.
The SnZnBi solder (4 %) appeared for the first time in 2005. In 2006, this alloy lost to the SnZn reflow solder (2 %) and could only maintain a share of 1 %. The SnBi reflow solder appeared for the first time in 2006 with a share of 3 %.
Finally, in 2005 and in 2006, the SnAgCuBi solder could stabilize its share at 4 %.
The high material variety has also stabilized in 2005 and 2006 with the intended or actual use of six and seven different reflow solders respectively in Europe.
The material variety has increased from three to six to seven different materials. This effect, however, might simply be attributed to the growing participation (Figure 1on page 5). The probability to be nominated thus increased for the materials of minor importance.

2.2 Use of Hand Solders

2.2.1 Total Use of Hand Solders

The use of hand solders is displayed in Figure 11.

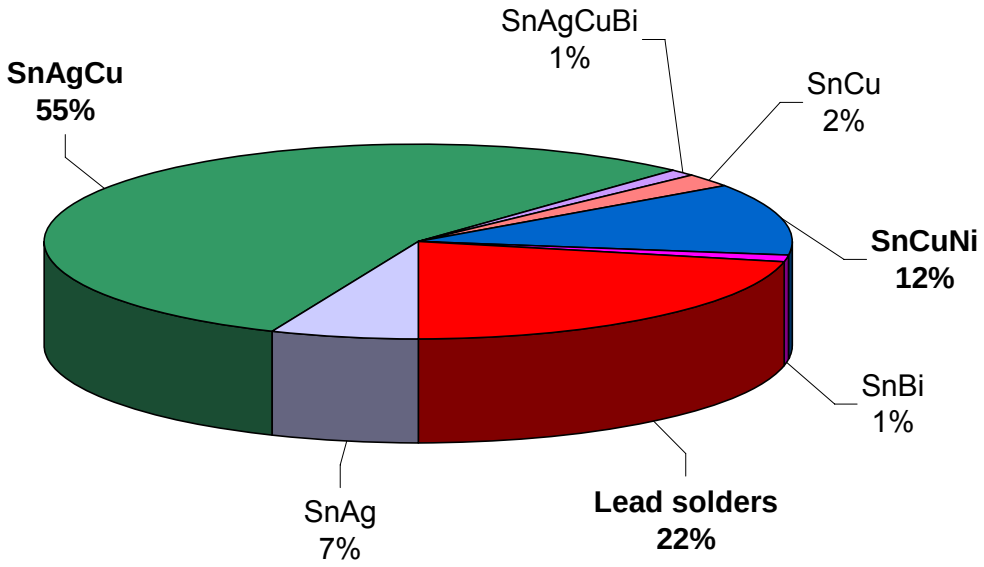

Figure 11: Use of hand solders in Europe, Asia and North America
(100 %: total number of hand solder nominations; all values rounded)

The lead-free SnAgCu solder by far is the most popular solder with 55 % of users, followed by the SnCuNi solder (12 %). The SnAg with 7 % is of some importance, while the SnCu solder on one hand and the SnAgCuBi and SnBi solder on the other hand only have a small share of 2 % and 1 % respectively.

2.2.2 Regional Use of Hand Solders

Figure 12 shows the regional differentiation of hand solder use.

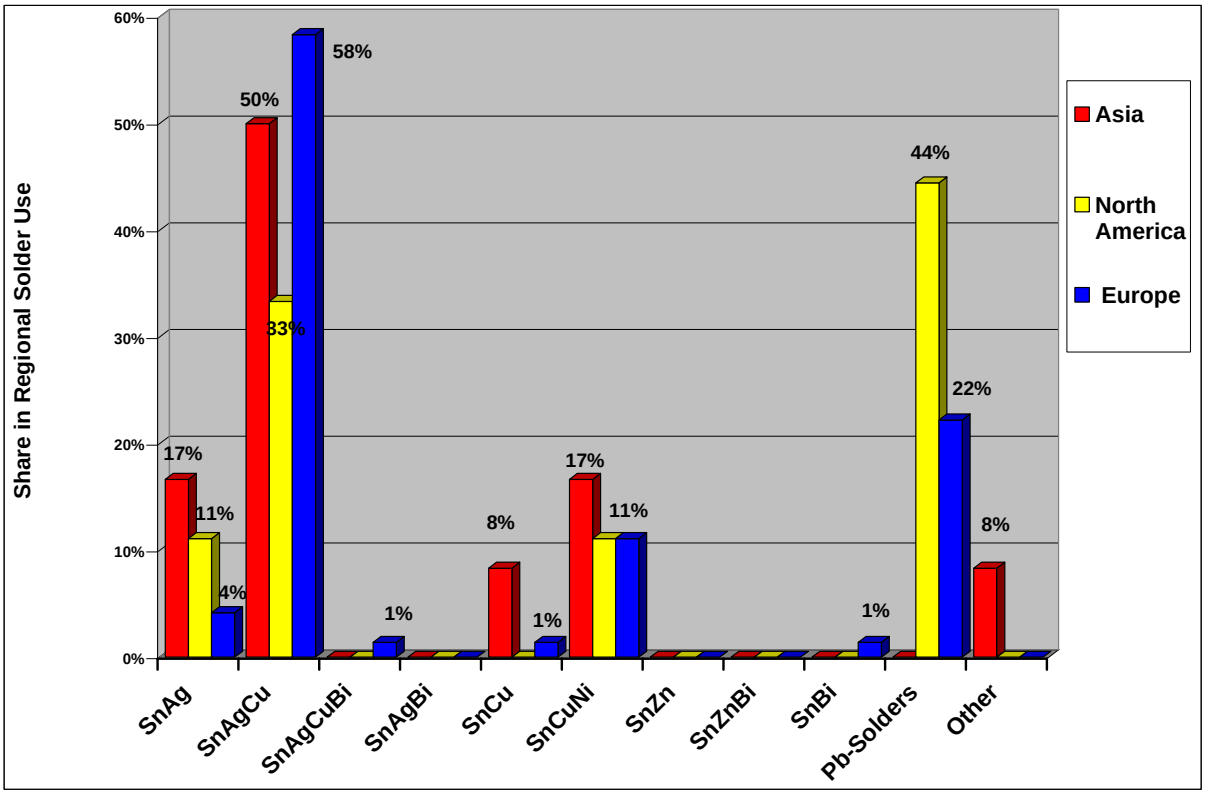

Figure 12: Regional use of hand solders in Europe, Asia and North America
(100 %: total number of hand solder nominations per region; all values rounded)

The use of SnAgCu solder is prevalent in particular in Europe (58 %). The Asian and North American users indicated a share of 50 % and 33 % respectively.
The North American survey participants are the main users of leaded hand solders, followed by the Europeans. The Asian participants did not indicate any use of lead-containing hand solders.

The SnCuNi hand solder is in particular popular among the Asian survey participants (17 %). The North American and European companies use this hand solders for around 11 % each.
The Asian participants also are the heaviest users of the SnAg hand solder (17 %), followed by the Europeans with 11 % and the North American participants with 4 %.
The same applies to the SnCu hand solder, with a share of 8 % among the Asian users and 1 % in Europe. The North American users did not indicate the use of this hand solder.
Only European companies use the SnAgCuBi hand solder and the SnBi hand solder with a share of 1 % respectively.

2.2.3 Development of Lead-free Hand Solder Preferences in Europe

Figure 13 shows how the lead-free hand solder preferences have developed in the ELFNET surveys from 2004 to 2006 in Europe.

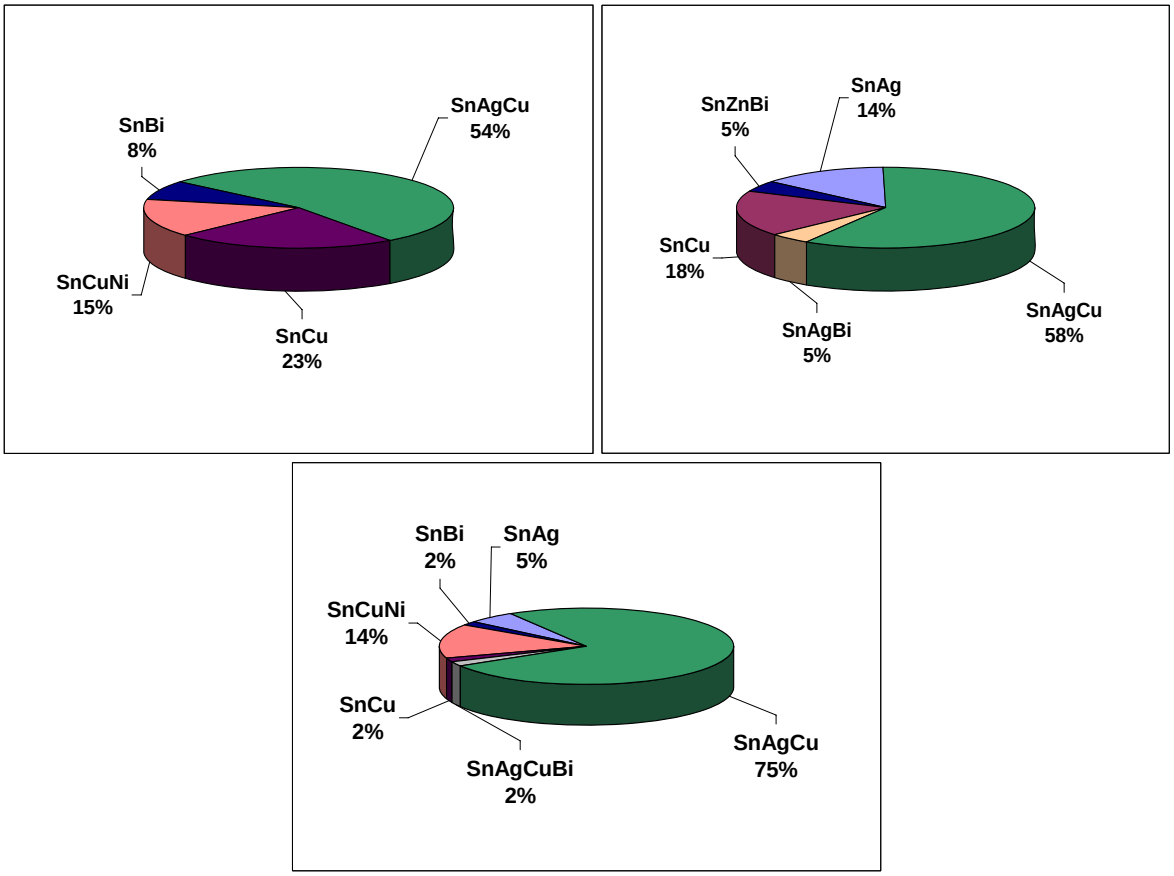

Figure 13: (Intended) use of lead-free hand solders in 2004 (top left), 2005 (top right) and 2006 (bottom) in Europe
(100 %: Total number of lead-free hand solder nominations in each year; all values rounded)

Figure 13 shows a clear trend towards the use of SnAgCu solder for hand soldering. Its share has increased from 54 % in 2004 to 58 % in 2005 and finally to 75 % in 2006.
The SnCu solder use permanently decreased from 23 % in 2004 to 18 % in 2005 and ended up at only 2 % in 2006. The SnCuNi solder stabilized its share to 14 % in 2006. In 2004, it held 15 %, but had disappeared in 2005.
SnBi had a share of 8 % in 2004, was not mentioned for use in the 2005 survey, but came back in 2006 with a small share of 2 %. Vice versa, the SnZnBi solder only popped up in 2005 with a share of 5 %. The same happened with the SnAgBi solder that had a preference of 5 % only in 2005.
The SnAgCuBi solder for the first time appeared in 2006 and conquered a share of 2 % of the total hand solder use.
In 2005, the SnAg solder had a strong start with a share of 14 %, but has lost in 2006 its share going down to 5 %.

The material variety increased permanently from four to six different hand solders and thus follows the trend of the wave and reflow solders and the finishes. This trend, however, might simply be attributed to the growing participation (Figure 1on page 5). The probability to be nominated thus increased for the materials of minor importance.

2.3 Use of Finishes on Printed Wiring Boards on Component Terminations

The focus in this chapter is on the total and the regional use of PWB and component finishes as well as on the development of the preferences for certain lead-free finishes throughout the three ELFNET surveys 2004, 2005 and 2006.

2.3.1 Total Use of Finishes on Printed Wiring Boards and Component Terminations

The next figure shows the use of finishes on printed wiring boards (PWBs) and on component terminations in Europe, Asia and North America.

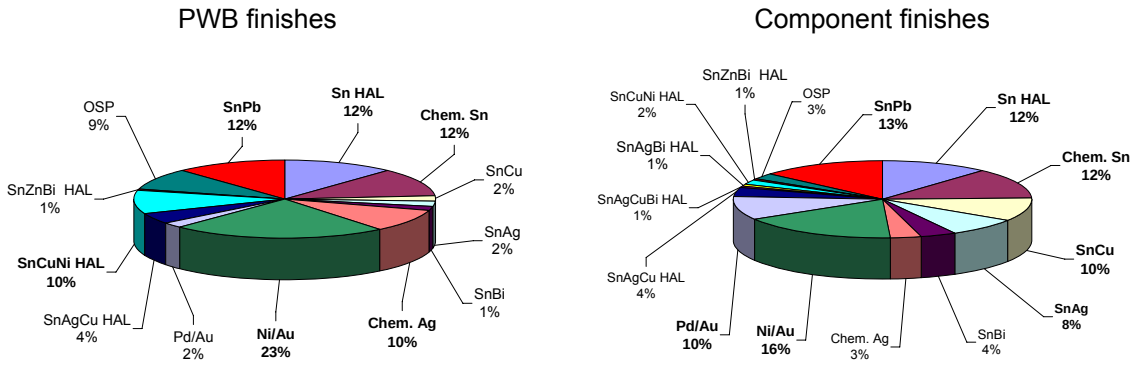

Figure 14: Use of finishes on PWB lands (left) and on component terminations
(100 %: total number of nominations of each finish; all values rounded)

With a share of 12 % on PWBs and 13 % on components, the use of the lead-finish is almost the same on PWBs and on component terminations. The numerous survey participants with out-of-scope products and exempted lead applications explain the use of lead-containing finishes on PWBs and components. Given the fact that at least 44 % of the participants fall under this category, the share of lead-containing finishes is low. Obviously, many of them use lead-free finishes as well or only.

Figure 15 shows the share of the different lead-free finishes in the total use of lead-free finishes, i. e. without consideration of the lead-finishes.

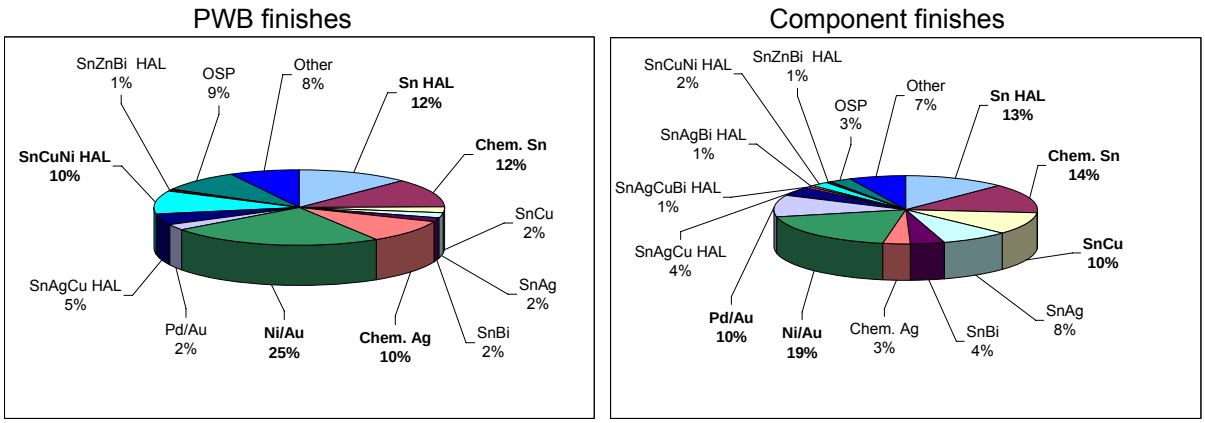

Figure 15: Use of lead-free finishes on PWBs (left) and on components
(100 %: total number of nominations of each finish without Pb-finish; all values rounded)

Nickel-gold (Ni/Au) both for PWB and for component finishes is the most commonly used lead-free finish. The tin hot air levelled (HAL) finish with 12 % on PWBs and 13 % on components keeps the second rank in both applications, followed by the chemical tin surface finish with 12 % on PWBs and14 % on components. The use of the other lead-free finishes on PWBs and on components differs.
Around 10 % of lead-free surface PWBs have chemical silver and SnCuNi terminations, followed by OSP and “Other” surfaces with 9 % and 8 % respectively. SnAgCu HAL finishes still have a share of around 5 %. The occurrence of the other lead-free finishes is between 2 % and 1 % on the PWBs.
On components, SnCu and Pd/Au finishes both have a share of 10 %, followed by the SnAg surface with 8 %. Around 4 % of components carry SnAgCu HAL or SnBi terminations, or chemical silver finishes or OSP (both 3 %). All other finishes have a share of 2 % down to 1 % only.
Both PWBs and components carry around 7 % to 8 % of “Other” finishes, which the survey participants had not further specified.

The application of OSP and HAL surfaces on components is not usual. Further details behind this unusual result are not known. Possibly, the participants had an unclear understanding of OSP and HAL and therefore indicated their finish under this term.

2.3.2 Regional Use of PWB Finishes

Figure 16 shows the regional use of PWB finishes.

The survey participants from Japan and Singapur only use SnCuNi HAL and OSP finishes. Only two of the 11 participants from Asia had indicated PWB finishes. As the result thus is based **on two answers only**, it is not representative.

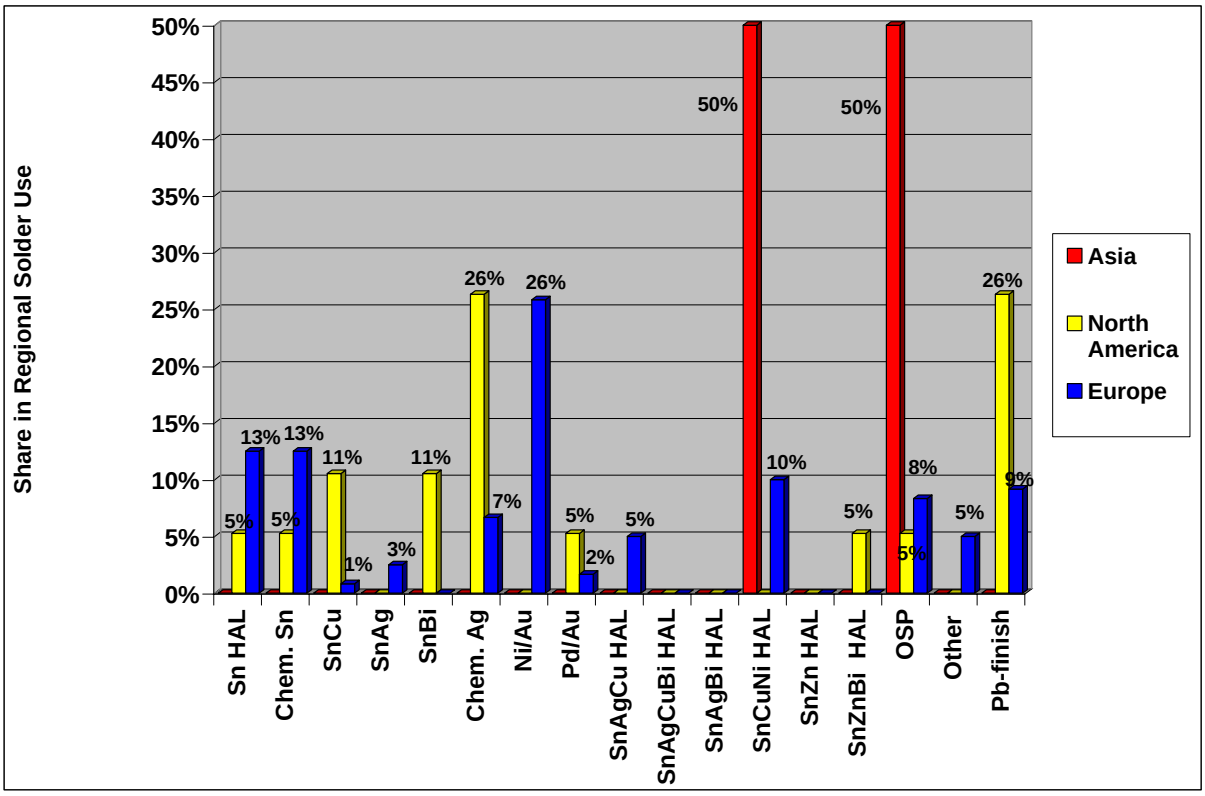

Figure 16: Regional use of finishes on PWBs
(100 %: total number of finish nominations per region; all values rounded)

In North America, chem. Ag and lead-finishes are the preferred surfaces with 26 % each. SnBi and SnCu finishes have a share of 11 %, SnCuNi finishes follow with a 10 % share on the PWBs in North America, and OSP, Sn HAL, chem. Sn, Pd/Au and SnZnBi HAL finishes with 5 %.

In Europe, the Ni/Au surface with 26 % by far is the most popular finish, followed by Sn HAL and chem. Sn (both 13 %) and SnCuNi HAL (10 %). The lead finish has a share of 9 %, which is low taking into account the high share of survey participants with lead applications out of scope or exempted from the RoHS Directive.

2.3.3 Regional Use of Component Finishes

Figure 17 displays the regional use of component finishes in Europe, Asia and North America.

The Asian survey participants prefer Ni/Au finishes on components (19 %), Pd/Au (15 %), as well as Sn HAL and SnBi (both 11 %). The SnAgCu finish has a share of 7 %, and the other finishes are around 4 % thus being of less importance. Other finishes, not mentioned in the above figure have are used for around 15 %. Unlike in the other materials, the Asian participants indicated the use of around 4 % of lead-containing finishes on the components.

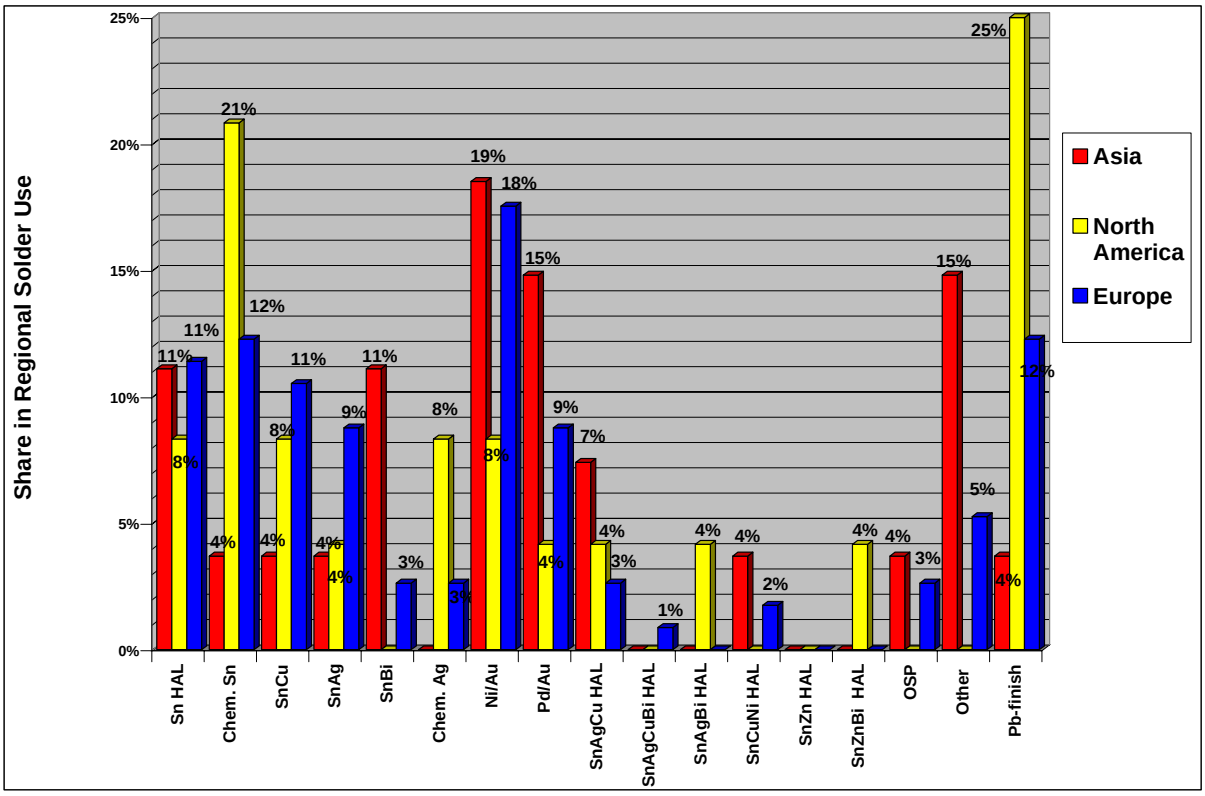

Figure 17: Regional use of component finishes
(100 %: total number of finish nominations per region; all values rounded)

The North American participants mainly use lead-containing finishes (25 %). Chemical tin is the most popular lead-free finish (21 %), followed by Sn HAL, SnCu and chemical tin with 8 % of users among the participants. The other finishes have shares of only around 4 %.

In Europe, the share of lead-containing finishes was reported with around 12 %. Given the high share of participants with products and lead applications, which the RoHS Directive does not apply to currently, this share is even low.
Ni/Au by far is the most popular component finish in Europe. With 18 % its share is higher than that of chem. Sn (12 %), Sn HAL and SnCu (11 %), SnAg and Pd/Au (9 %).
The North American participants do not use SnCuNi, SnBi and OSP-type surfaces on components, unlike the Asian and the European ones. Vice versa, only the North American companies indicated the use of SnZnBi finishes. Only the Europeans indicated the use of SnAgCuBi surfaces on components (1 %).

2.3.4 Development of Lead-free PWB Finish Preferences in Europe

Figure 18 shows how the lead-free PWB finish preferences developed in the ELFNET surveys from 2004 to 2006 in Europe.

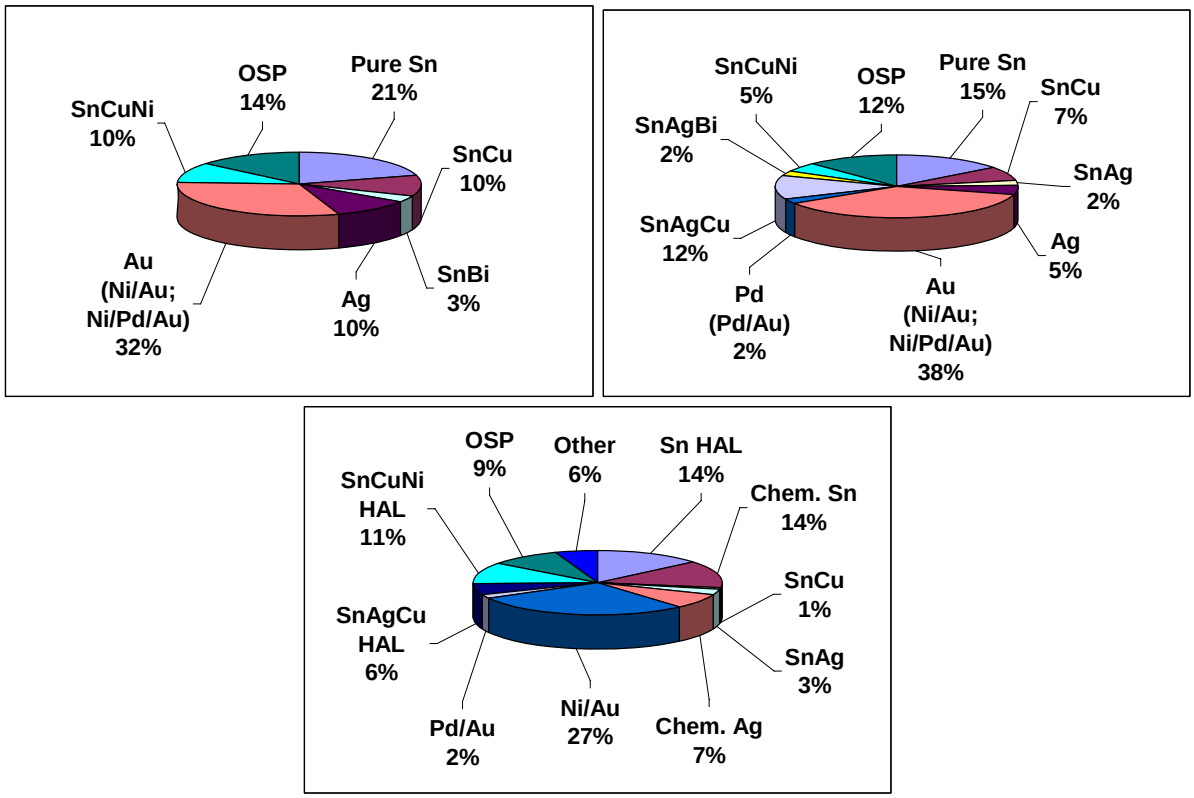

Figure 18: (Intended) use of lead-free PWB finishes in 2004 (top left), 2005 (top right) and 2006 (bottom) in Europe
(100 %: Total number of lead-free PWB finish nominations in each year; all values rounded)

The gold containing PWB finishes (Ni/Au, Ni/Pd/Au) in 2004 and 2006 had a share of 32 % in 2004 and even 38 % in 2005. In 2006, the share of Ni/Au is 27 %. The Ni/Pd/Au PWB finish was not mentioned explicitly, but none of the survey participants had indicated the use of this finish under “Others”.
Around 21 % of participants in 2004 had intended or actually used pure tin surfaces. This share had shrunk to 15 % in 2005. In 2006, 28 % of the European participants gave their preference for pure tin finishes as Sn HAL (14 %) and chem. tin (14 %). The share thus has increased.
The preference for OSP had been decreasing from 14 % in 2004 to 12 % in 2005 down to 9 % in 2006.
The SnCu finish had the strongest losses from 10 % in 2004 to 7 % in 2005 down to just 1 % in2006.
In 2004, around 10 % of the participants had indicated their intention to use the SnCuNi finish. Their number has gone down to 5 % in 2005 and up to 11 % in 2006.
The silver finish in Europe in 2004 had a preference of around 10 % and meanwhile has stabilized below 10 % with 5 % in 2005 and 7 % in 2006. Around 3 % of participants in 2004 wanted to use the SnBi finish. This surface has disappeared in the following years. Vice versa, the SnAgCu finish was not on the preference list in 2004, but had a 12 % share in 2005 and 6 % in 2006. The Pd/Au finish came up in 2005 for the first time with a share of 2 % and could maintain this share in the 2006 survey as well. This situation is similar for the SnAg finish, which was mentioned first time in the 2005 survey with a share of 2 % and with 3 % in the recent survey.

The material variety had increased over the years from only 7 finishes in 2004 up to 10 finishes in 2005. In the recent survey, the participants indicated the use of 10 concretely nominated different finishes. Additionally, the use of “Other” finishes had been indicated with 6 % without further specification. This trend, however, might simply be attributed to the growing participation (Figure 1on page 5). The probability to be nominated thus increased for the materials of minor importance.

2.3.5 Development of Lead-free Component Finish Preferences in Europe

Figure 19 shows how the lead-free component finish preferences have developed in the ELFNET surveys from 2004 to 2006 in Europe.

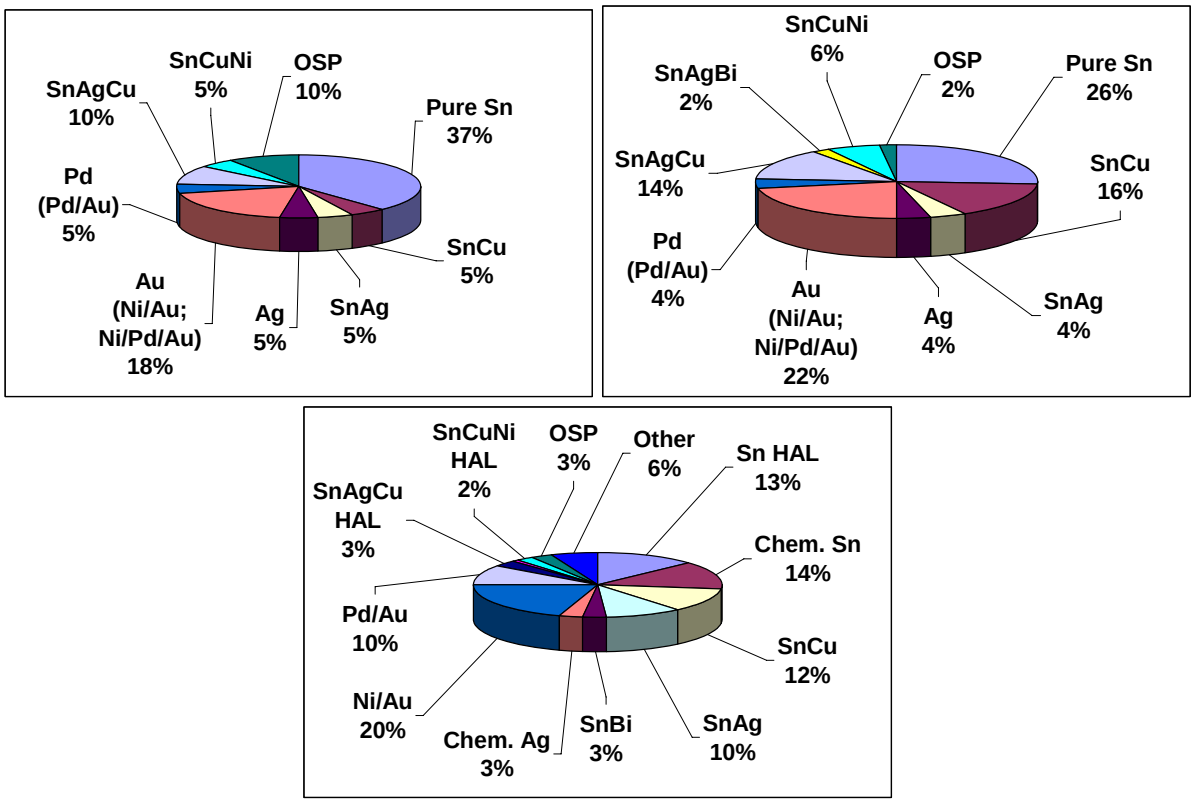

Figure 19: (Intended) use of lead-free component finishes in 2004 (top left), 2005 (top right) and 2006 (bottom) in Europe
(100 %: Total number of lead-free component finish nominations in each year; all values rounded)

On the component terminations, pure tin finishes were the favourites with a total of 37 %. This share has reduced to 26 % in 2005 and remained stable with 27 % in 2006 (14 % chem. Sn, 13 % Sn HAL).
The nickel/gold type finishes maintained a stable share of around 20 % in all three surveys. The preference for the OSP surface, however, decreased from 10 % in 2004 down to only 2 % in 2005, arrived at 3 % in 2006 and thus has stabilized at a low level in Europe.
The SnAgCu finish made a volatile career from 10 % in 2004 up to 14 % in 2005 and finally down to only 3 % in 2006.
In 2004, the SnCuNi finish on components held a share of 5 %, which increased to 6 % and finally went down to 2 % in the 2006 survey. The Pd/Au finish in opposite started with a share of 5 % in 2004, had around 6 % in 2005 and increased to 10 %

in 2006. Similarly, the SnAg surface preference increased from 5 % in 2004, only 4 % in 2005 up to 10 % in the 2006 survey. The silver finish vice versa permanently decreased from 5 % in 2004 to 4 % in 2005 down to 3 % in 2006. The SnBi component finish only appeared in the 2006 survey with a share of 3 %.

Similar to the trend for the PWB finishes, the material variety for lead-free component finishes had increased over the years from only 9 finishes in 2004 up to 10 finishes in 2005. In the recent survey, the participants indicated the use of 12 concretely nominated different finishes. Additionally, the use of “Other” finishes had been indicated with 6 % without further specification. The material variety for the lead-free component finishes is even slightly higher than that of the PWB finishes.

The effect of increasing material variety, however, might simply be attributed to the growing participation (Figure 1on page 5). The probability to be nominated thus increased for the materials of minor importance.

2.4 Solder Balls

2.4.1 Use of Materials for Solder Balls

Figure 20 shows which alloys the survey participants use for solder balls.

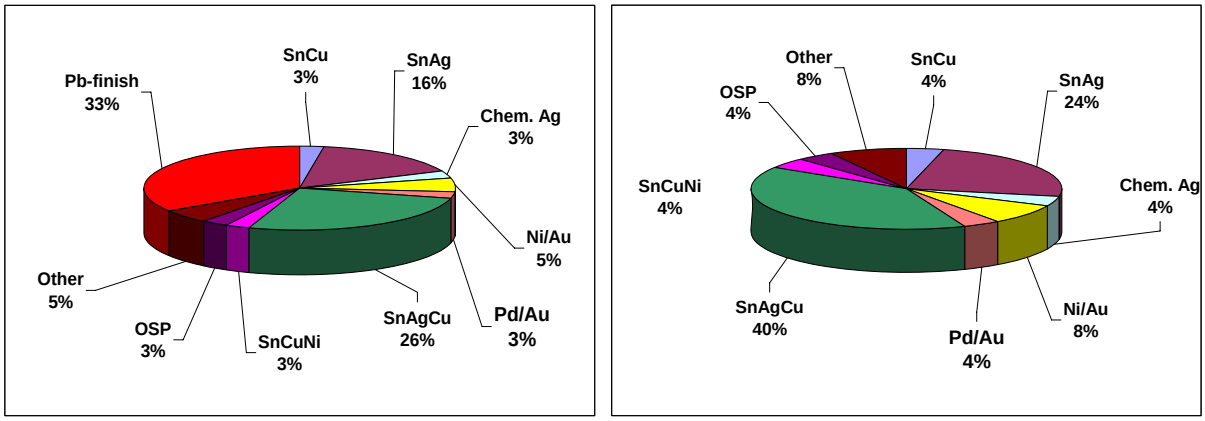

Figure 20: Use of alloys for solder balls in total (left) and lead-free alloys only
(100 %: Total number of finish nominations (left figure) and total number of lead-free finish nominations (right figure); all values rounded)

The preference for the lead-alloys is at 33 % of the total use for solder balls.
Among the lead-free solder balls, the SnAgCu alloy by far is the favourite with 43 % of use. With considerable distance, SnAg is following with a share of 25 % in the total use of lead-free alloys for solder balls.
Nickel/gold (Ni/Au) is not an alloy, but consists of a thin gold layer over a nickel layer. It is not used to form the solder balls, but as a finish over plastic balls. The share of use is around 8 %.
All other alloys or metal layer combinations have a low preference with around 4 % (SnCuNi, OSP, chem. Ag, SnCu and Pd/Au). “Other” lead-free materials have a share of 8 % in the total use of lead-free alloys.

2.4.2 Regional Use of Solder Ball Materials

Figure 21 displays the regional use of solder ball materials. It must be kept in mind that the results are based on two solder ball material nominations only from Asia and seven from North America and therefore certainly are not representative. European manufacturers made 29 solder ball material nominations.

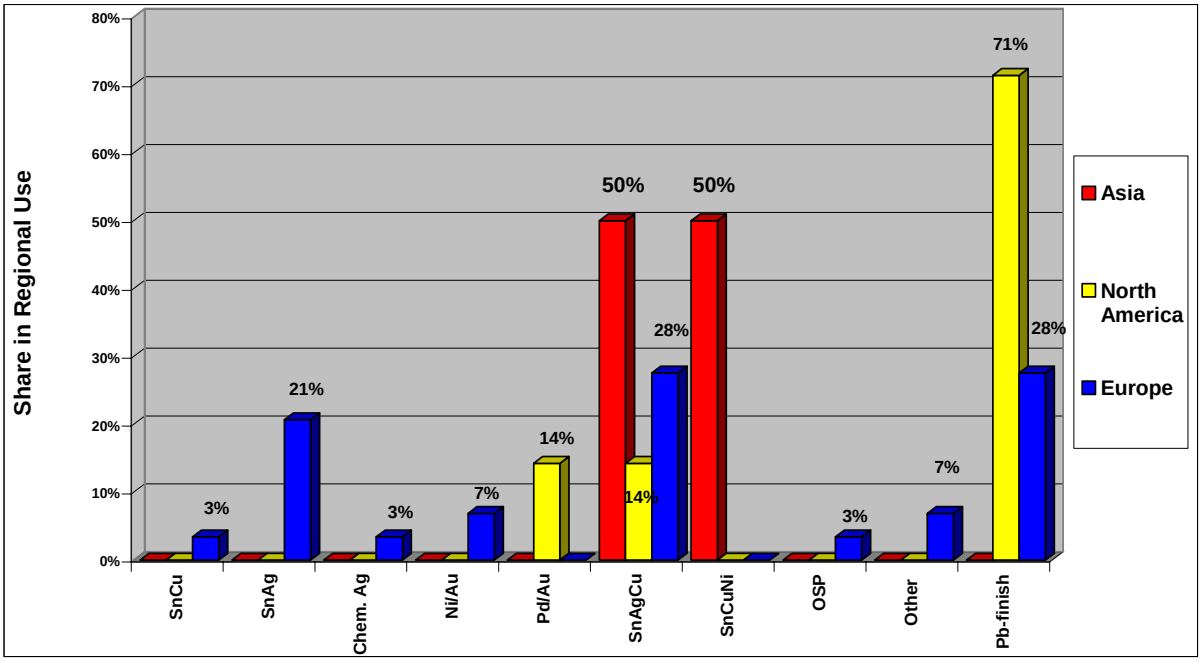

Figure 21: Regional use of solder ball materials
(100 %: Total number of material nominations per region; all values rounded)

The North American participants use around 71 % of leaded solder balls, the Europeans around 28 %, while the Asians do not use them. They prefer SnAgCu and SnCuNi solder balls with 50 % each.

Among the lead-free solder ball materials, the SnAgCu is prevalent in Europe (28 %), followed by the SnAg alloy with 21 %. The Northern American survey participants use SnAgCu and Pd/Au, which both have a share of 14 % each in the total use of solder ball materials in North America.
In Europe, Ni/Au with 7 % is a preferred material. SnCu, chem. Silver and OSP have a share of only 3 %. The Europeans additionally indicated the use of “Other” solder ball materials without further specification.

2.4.3 Development of Lead-free Solder Ball Material Preferences in Europe

Figure 22 shows how the lead-free solder ball material preferences have developed in the ELFNET surveys from 2004 to 2006 in Europe. For the interpretation of the results, the low number of participants in particular in the first ELFNET survey from 2004 must be taken into account (Figure 1on page 5).

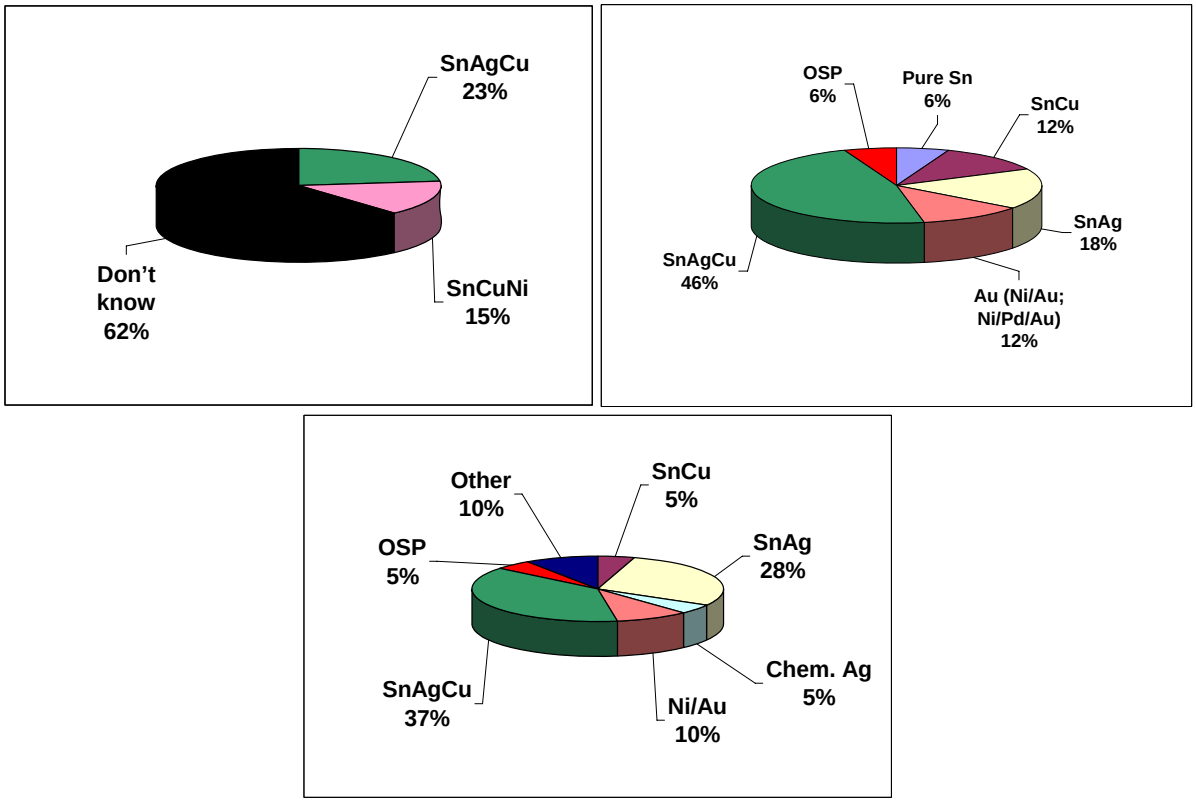

Figure 22: (Intended) use of lead-free solder ball materials in 2004 (top left), 2005 (top right) and 2006 (bottom) in Europe
(100 %: Total number of lead-free component finish nominations in each year; all values rounded)

In 2004, around 62 % of the 18 participants had indicated not to know which lead-free solder ball material to use. In 2005, none of the 32 participants had indicated not to have an answer to this question. SnAgCu had been indicated as the favourite with a share of 23 %, while 15 % wanted to use SnCuNi solder balls.
The importance of SnAgCu had increased to 46 % in the 2005 survey, but dropped to 37 % in the recent one.
The share of SnAg increased from 18 % in 2005 to 28 % in 2006 and thus became the most popular lead-free solder ball material in Europe after the SnAgCu alloy. Vice versa, SnCu dropped from 12 % in 2005 down to 5 % in 2006.
In both the 2005 and the 2006 survey, Ni/Au type materials had a similar share of 12 % and 10 % respectively. The same is true for OSP, whose share was stable with 6 % in 2005 and 5 % in 2006. Pure Sn was nominated with 6 % in 2005, but had disappeared in the 2006 survey.
Like for the solders and the finishes, the material variety has increased from survey to survey. This trend, however, might simply be attributed to the growing participation (Figure 1on page 5). The probability to be nominated thus increased for the materials of minor importance.

2.5 Use of Lead-free Solders in Out-of-Scope Products or Exempted Lead Applications

2.5.1 Out-of Scope and Exempted Uses of Lead According to the RoHS Directive

To allow a sound interpretation of the survey results, some clarifications are required concerning the use of lead in specific product categories and applications after the deadline of July 2006.
The RoHS Directive differentiates two cases for the continued use of lead:

1. The following products or product categories are **out of scope** of the RoHS Directive (article 2 (1) RoHS Directive)
   - medical devices
   - monitoring and control instruments
   - **large-scale stationary** industrial tools

According to article 2 (1) of the RoHS Directive, industrial tools are **within** the scope of the RoHS Directive. **Only** the large scale stationary industrial tools are out of scope and thus may continue using lead **and all the other substances** banned in the RoHS Directive.

2. **Exemptions** for the use of **certain** banned substances in **specific applications** in products **within the scope** of the RoHS Directive (Annex of the RoHS Directive). Such exemptions are
   - **lead** in solders for
     - servers,
     - storage and storage array systems,
     - network infrastructure equipment for switching, signalling, transmission as well as network management for telecommunications

Contrary to the out-of-scope product categories listed under point 1., the RoHS Directive applies to the products listed under point 2. Just the use of lead is allowed in these products, the use of the other substances banned in the RoHS Directive is not! Products or product categories, which are out of the scope of the RoHS Directive may continue using lead and the other substances banned in the RoHS Directive as long as other regulations do not restrict their use in these products.
Industry may submit exemption requests to the Commission for the further use of a substance banned in the RoHS Directive following the requirements as laid out in article 5 (1) (b) of the RoHS Directive (also see on the internet under http://ec.europa.eu/environment/waste/weee_index.htm).

2.5.2 Lead-free Solder Use in Out-of-Scope Products or Exempted Lead Applications

Some manufacturers among the survey participants **only** produce products or applications, for which the RoHS Directive would allow the use of lead (see chapter 2.5.1 on page 27), but nevertheless **only** use lead-free solders.

Table 1: Number of exclusive manufacturers of out-of-scope equipment and partially exempted lead applications

Servers, storage	Network infrastructure	Industry equipment	Power Electronics	Automotive	Aerospace/Defence	Medical
1	11	28	10	14	16	6

Figure 23 shows how many percentages of these users apply lead-free solders only. The out-of-scope product categories or exempted uses of lead are marked in green/dark gray. For power electronics it depends on where these products are used. The use of lead would be allowed in power electronics e. g. in trains, but not for the use in industry electronics as long as it is not a large scale stationary tool. This difference is also important for industry electronics. As it is not specified into large scale stationary and other tools, it is not clear whether the participants in this product category may use lead. Both power electronics and industry equipment is therefore marked in yellow/bright gray.
The use of lead-free finishes on PWBs and on components was not taken into account. Concerning the components, supply problems (see chapter 4 on page 33) might force producers to use components with lead-free finishes rather than they really want to use it. It cannot be excluded that the situation with leaded finishes on PWBs is similar.

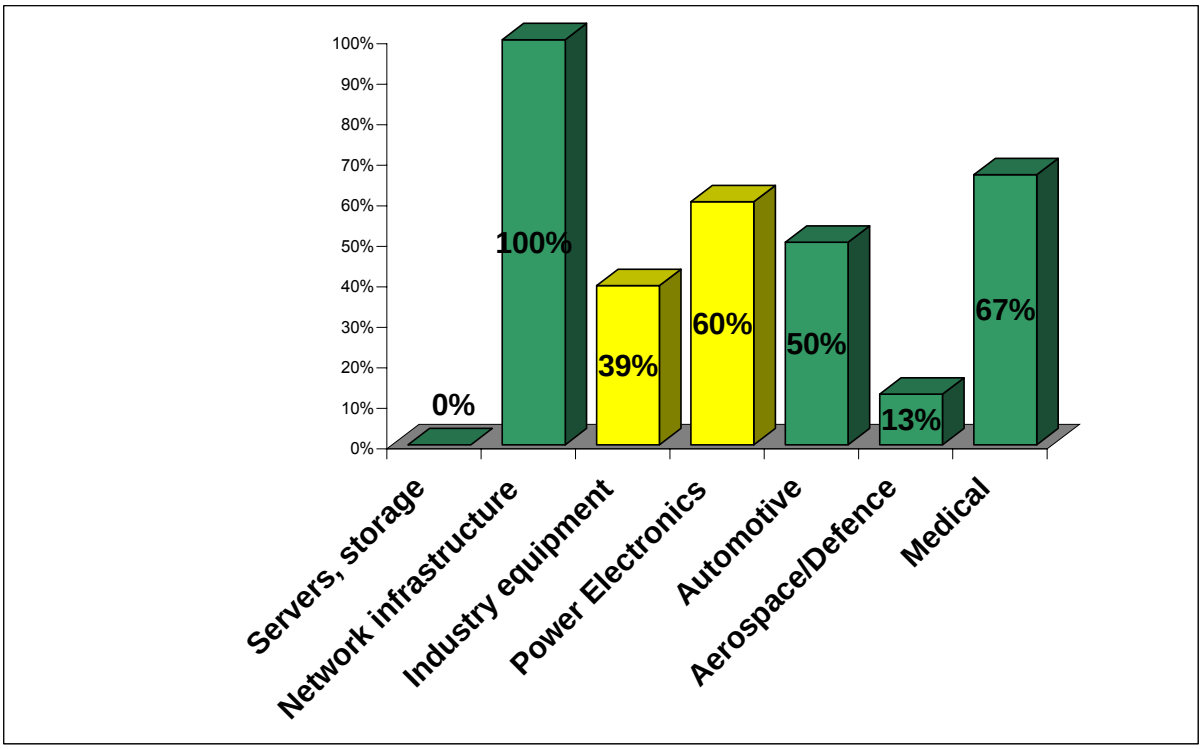

Figure 23: Use of lead-free solders only in out-of-scope products or partially exempted applications
(100 %: total number of survey participants per product category **only** active in the specified product category; all values rounded)

There is only one company exclusively manufacturing servers and storage equipment. This producer does not use lead-free solders. As it is just a single producer (see Table 1 on page 28), this result is not representative.
All companies in the survey producing only network infrastructure (11 in total) use lead-free solders exclusively, followed by the medical equipment manufacturers

(67 %) and automotive electronics producers (50 %). In aerospace and defence, only 13 % of the participating companies use lead-free solders exclusively. None of the survey participants manufacturing servers and storage devices is an exclusive user of lead-free solders only.
Around 60 % of power electronics manufacturers and 39 % of industry equipment producers apply lead-free solders only. However, as their RoHS status is not clear, the RoHS Directive might be the direct driver for the application of the lead-free solders.

2.6 Use of Lead-Solders in Out-of-Scope Products or Exempted Lead Applications

Some manufacturers among the survey participants **only** produce products or applications, for which the RoHS Directive would allow the use of lead (see chapter 2.5.1 on page 27).

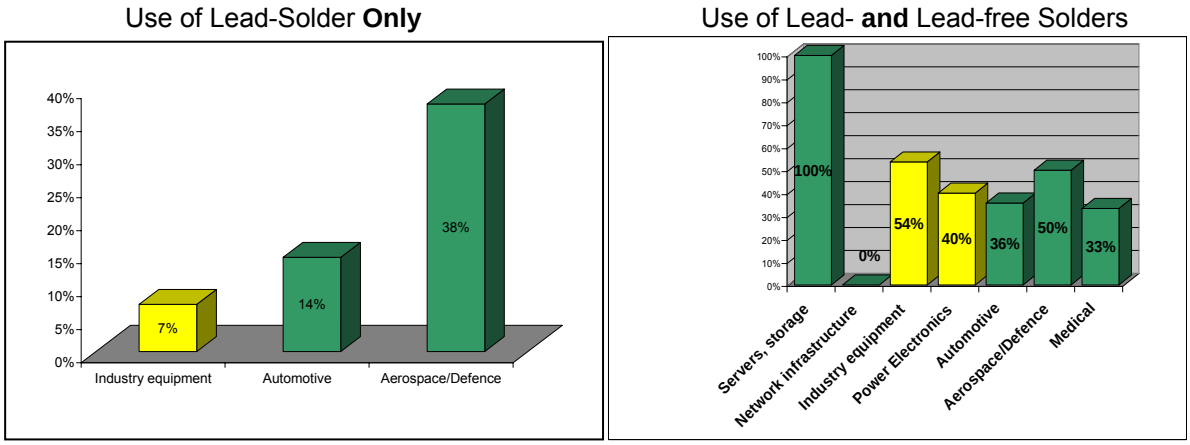

Figure 24: Exclusive use of lead- solders (left) and use of solder mix (right) in out-of-scope products or partially exempted applications
(100 %: total number of survey participants per product category **only** active in the specified product category; all values rounded)

As Figure 24 shows, only 7 % of industry equipment manufacturers only use lead-solders and no lead-free solders. In automotive, already 14 % exclusively apply lead-solders, while this share is up to 38 % for the manufacturers producing for aerospace and defence. The networking equipment manufacturers in this survey producing only in this product category do not use lead-solders any more (Figure 23 on page 28).

All of the participants exclusively manufacturing server and storage products use both lead-solders and lead-free solders. In automotive, 36% of exclusive automotive producers use lead- and lead-free solders, while this share in aerospace and defence is even up to 50 %. Around 33 % of medical equipment manufacturers also use both solder types.

In the industry equipment sector, around 54 % of exclusive producers apply lead- and lead-free solders, in power electronics this preference is at around 40 %.

2.7 Use of Lead-Solders in RoHS-Affected Products and Applications

In the 2006 survey, none of the 115 participants uses lead in products or applications, in which the RoHS Directive bans it use.

3 Equipment Upgrades and Exchanges

The next figure shows how many of the survey participants upgraded or exchanged their soldering equipment. As around 44 % of the participants manufacture products, for which the RoHS Directive allows the use of lead, the lead-solder users were excluded from the following considerations. Thus, the base for the following figures are those companies that only use lead-free solders in order to obtain information on how lead-free soldering has influenced the soldering equipment of companies.

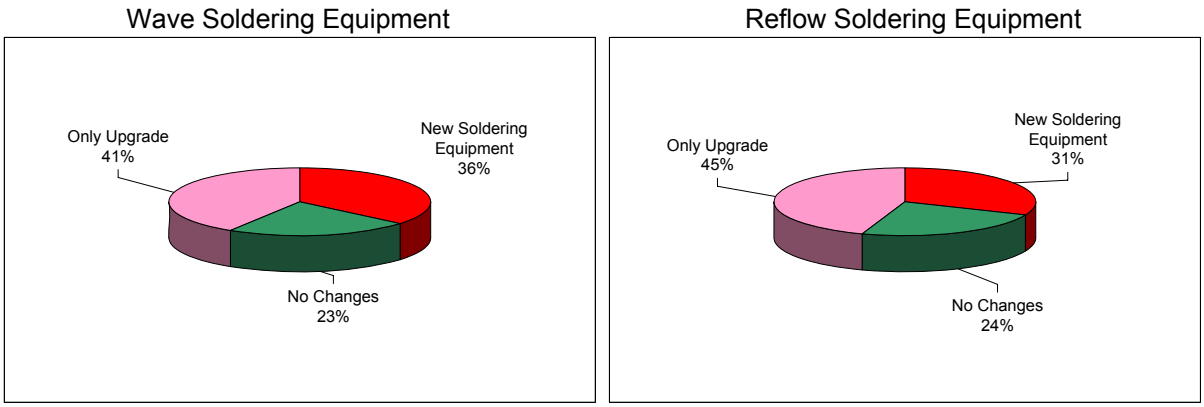

Figure 25: Upgrades and exchanges of wave (left) and reflow soldering equipment among pure lead-free solder users
(100 %: total number of survey participants using ONLY lead-free solders for wave and reflow soldering equipment respectively; all values rounded)

Around 36 % of the 61 participants that use ONLY lead-free solders had purchased new wave soldering equipment. Another 41 % had upgraded it. Around 23 % of the companies had not changed their wave soldering ovens at all.

For reflow soldering, around 31 % of the 67 pure lead-free solder users had purchased new reflow soldering equipment. Around 45 % considered an upgrade to be sufficient, and 24 % had not changed their reflow soldering equipment at all.

Most reflow ovens manufactured from 1996 on can meet the specific reflow soldering requirements of lead-free soldering [2]. For wave soldering ovens, the situation is different. Approximately from 2004 on, the wave soldering ovens on the market are constructed and adapted to the specific requirements of lead-free soldering [2]. Lead-free soldering can cause severe corrosion problems in the solder pot, the pump and all other metallic parts in direct contact with lead solders that have high tin contents. The higher melting points also require a stronger pre-heating of the PWBs and other changes enabling the transfer of the higher heat energy without exceeding the heating-up rates of sensitive components.

The share of 23 % of survey participants who had indicated that they had not changed their wave soldering equipment insofar are a surprising result. However, the use of e. g. SnCuNi solders and low soldering temperatures
below 260 °C combined with not too intensive use of the equipment allow using older wave soldering equipment at least for two or even more years before typical corrosion problems become obvious. Slower processing – resulting in lower throughputs - can solve the temperature problems. Thus, the result becomes plausible, but at least for some manufacturers might lead to severe problems with the wave soldering equipment later on.

4 Remaining Problems and Further Support

4.1 Remaining Technical and Non-Technical Issues

Around 17 % of the 115 survey participants had not reported any remaining issues, neither technical nor non-technical ones.
Figure 26 shows the remaining issues which the other 83 % of participants had indicated in the survey.

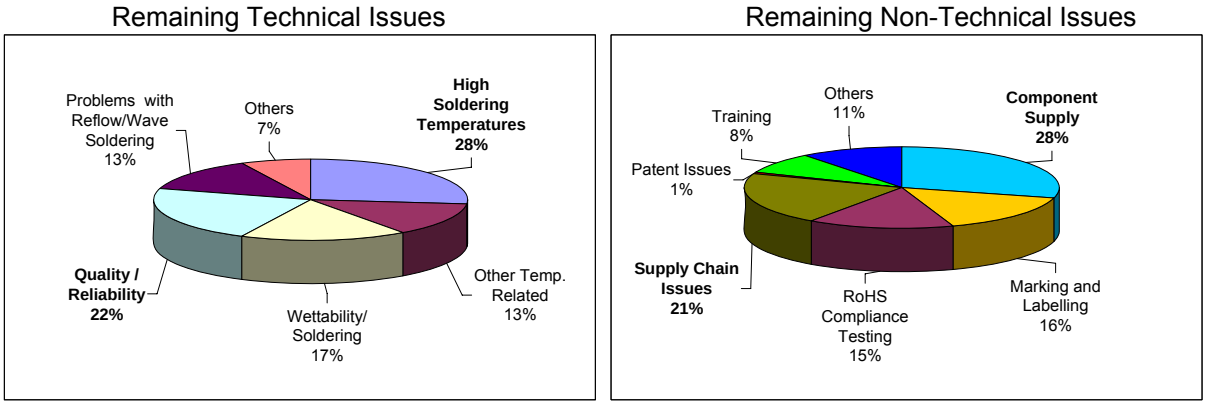

Figure 26: Remaining technical (left) and non-technical problems
(100 %: total number of survey participants that had indicated remaining technical and non-technical issues respectively; all values rounded)

On the technical side, the high soldering temperatures are the main remaining issue (28 %), as well as general quality and reliability problems (22 %). Around 17 % of the survey participants that had named remaining technical issues indicated wettability and soldering problems. Problems with reflow/wave soldering and other temperature related problems have a share of 13 % in the remaining technical issues. Thus, the high melting points of the lead-free solders are the main remaining driver for problems with a share of 41 %. As wettability at least in parts is related to the soldering temperatures, as well as quality and reliability problems, the high melting points are by far the most problematic technical issue in lead-free soldering. This result underpins the need for lead-free solders with lower melting points comparable to the tin-lead solders or even lower.
Component supply issues (28 %) and supply chain issues (21 %) are leading the non-technical issues companies are still fighting with after the deadline 1 July 2006 for the ban of lead. The general supply chain issues probably are related to the organization of RoHS compliant materials and the necessary certificates for RoHS compliance, which is a burdensome task in an industrial branch, which is globally organized to a higher degree than most other industries. As component supply issues are just a specific case of a supply chain issue, the supply chain issues cause almost 50 % of the non-technical persisting problems.

Marking and labelling (16 %) and RoHS compliance testing (15 %) follow. In the globalized electrical and electronics industry, international standards are required to solve the marking and labelling problem.
Also, there is still a lot of insecurity among companies how to properly test and prove compliance indicating a further need for testing standards (like e. g. IEC 62321) and for more information for companies in the member states, who are responsible for the monitoring of RoHS compliance.

4.2 Further Support

59 of the 115 survey participants (51 %) expressed the need for further support that would be most useful for them. The answer to the question about the most useful support companies would like to have had to be given in free text. The participants thus should have the possibility to freely express what they felt would help them to solve their remaining problems with the implementation of lead-free soldering.

Equivalently to the technical remaining issues (Figure 26 on page 33), research and development for reliability and repair is an important issue. Most participants (22 %) expressed that this kind of support would be most useful for them.

The absence of a standard alloy and the high variety of materials seem to create insecurities about process and material selections for lead-free soldering. Around 10 % of the participants wish technical support for the process and material selection.

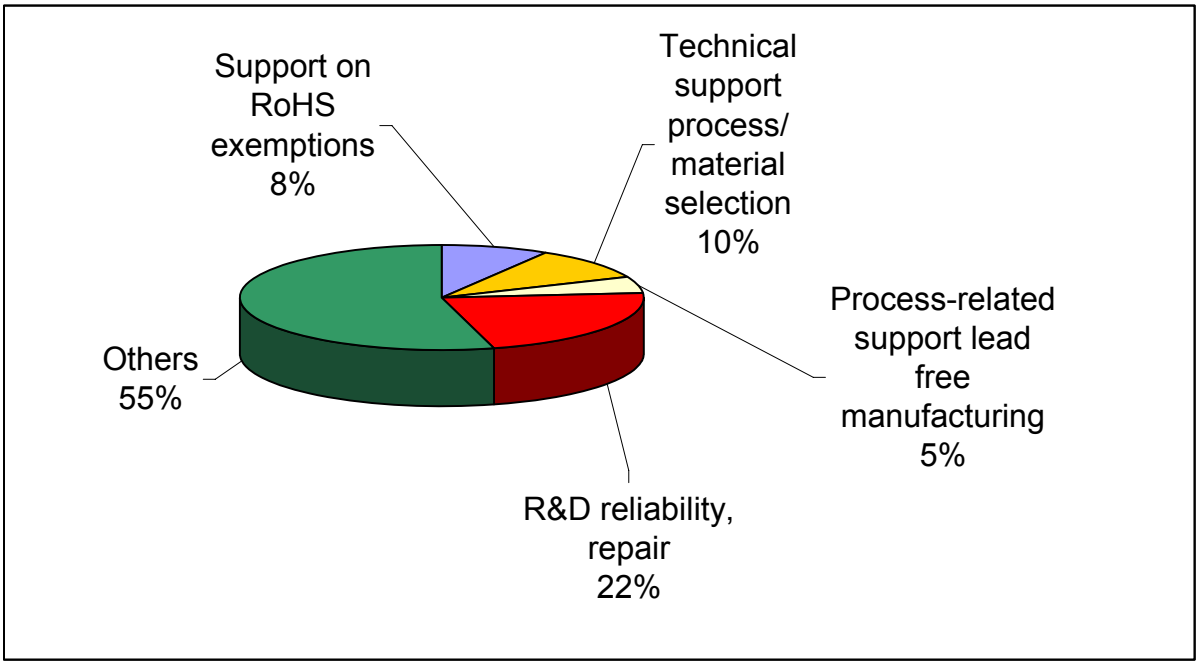

Figure 27: Desired, most useful support as expressed by the survey participants
(100 %: total number of support issues indicated by the survey participants; all values rounded)

Another 8 % would like to receive support on the RoHS exemptions. The participants did not specify what kind of problems they have with the RoHS exemptions. From the daily work experience, it can be assumed that the problems are related to the following questions:

- Does my product fall under the RoHS Directive?
  This question is not related to RoHS exemptions, but to the scope of the RoHS Directive. The daily experience in the work with companies is that most of them do not differentiate between the product categories out of scope and the exemptions of the RoHS Directive (see chapter 2.5.1 on page 27).

- Does any of the exemptions formulated in the Annex of the RoHS Directive cover the use of lead in my application?

- How and when will the exemption requests, which have been submitted to the Commission, be decided and will a future exemption thus cover my current application of the banned material?

The Commission's frequently-asked-question document might give some support to the companies with their questions on the scope and the exemptions of the RoHS Directive (http://ec.europa.eu/environment/waste/weee_index.htm).

Around 5 % of the survey participants wish process-related support for lead-free manufacturing without further specifying what kind of support they would like to have.

As the participants used free text to express their needs, the "Others" category has the highest share with 55 %. All the following nominations from just one or two participants were subsumed under this category.

- Employee training (2)
- Selection of cost effective soldering alloys and profile development (2)
- Research in wetting improvement (2)
- Study of the fatigue resistance of solder joints (2)
- Life time information overview on advantages /disadvantages materials and techniques (2)
- R&D in the compatibility of new components (2)
- Clear rules for applicability of RoHS regulations (2)
- Development of standard method for RoHS compliance testing (2)
- Investigation of intermetallic phases between solder and chip metallisation/substrate metallisation (2)
- Benchmark data as to how industry will use exemptions on solders (2)
- Development of a common definition of a solder alloy for high reliable products (1)
- Information on solders, plating, PCB materials, components, fluxes (1)
- BGA soldering (1)
- Technical information and more manuals on how to " for solving most common problems (1)
- RoHS guidelines be available on the internet (1)

- Reliability data for products with a long life time (1)
- Screening of PCBA suppliers (1)
- Information on RoHS audit (1)
- Clear marking of lead free assemblies (1)
- Exchange of information between companies (1)
- Information on choice of components (1)
- Collaborative studies by institutions (1)
- Technical support from solder suppliers and equipment manufacturers (1)

The ELFNET website (www.europeanleadfree.net) could be a valuable source of either direct information on these issues or at least be useful to find an expert for further support.

References

[1] DEUBZER, Otmar: Explorative Study into the Sustainable Use and Substitution of Soldering Metals in Electronics - Ecological and Economical Consequences of the Ban of Lead in Electronics and Lessons to Be Learned for the Future; PhD thesis TU Delft, The Netherlands, January 2006, ISBN 978-90-5155-031-3

[2] DIEHM, Rolf; Seho, Kreuzwertheim, Germany: Personal communication with Otmar Deubzer, 23 March 2007

[3] GEIBIG, Jack R.; Socolof, Maria Leet, University of Tennessee: Solders in Electronics – A Life Cycle Assessment Summary; US Environmental Protection Agency (EPA), EPA 744-S-05-001, August 2005; download from http://www.epa.gov/dfe/pubs/solder/lca/lca-summ2.pdf, last access June 10, 2006

[4] NIMMO, Kay: “Second European Lead-Free Soldering Technology Roadmap, Soldertec 2003

[5] NIMMO, Kay: "Results from Pb-free Marking Survey", Soldertec Global 2004

[6] WARBURG, Niels et al.: Lead free from different stakeholders point of view; IKP University of Stuttgart, Germany

Annex Third ELFNET Lead-Free Soldering Status Survey Questionnaire

RoHS Survey

2006 – 2007

Fill out and return this questionnaire and you will be entered into a prize draw to take place on January 27th 2007 to win a top of the range MP3 player.

'ELFNET – European Lead-Free Soldering Network', is a European network of technical experts and industry bodies in microelectronics. It provides the platform to coordinate lead-free soldering research, thereby enabling electronic producers in the EU to meet the RoHS Directive and face a lead-free future.

This is the **3rd annual ELFNET survey** to observe the progress of lead-free soldering technology in the European electronics industry. The results are published in annual status reports, available on http://www.europeanleadfree.net. This information is highlighting urgent research and technical support issues for companies. It will be of interest to industry bodies as well as to policymakers.
The company information you provide will be strictly confidential.

Thank you!

Please return it by e-mail or fax to

ELFNET Status Research
Technische Universität Berlin
Otmar Deubzer
Tel +49 (0) 30 464 03 - 157
Fax +49 (0) 30 464 03 - 131
E-mail: otmar.deubzer@izm.fraunhofer.de

1 MATERIALS

1.1 What are your preferred lead-free solder alloys?

Please indicate alloys you use and fill in composition, if possible. Otherwise just X; Please also indicate alloys you do not use.

Alloy	Reflow Soldering	Wave Soldering	Hand Soldering	Not Used
SnAg	☐ Sn___Ag___	☐ Sn___Ag___	☐ Sn___Ag___	☐
SnAgCu	☐ Sn___ Ag___Cu__	☐ Sn___ Ag___Cu__	☐ Sn___ Ag___Cu__	☐
SnAgCuBi	☐ Sn___ Ag___ Cu___Bi___	☐ Sn___ Ag___ Cu___Bi___	☐ Sn___ Ag___ Cu___Bi___	☐
SnAgCuSb	☐ Sn____ Ag____ Cu____Sb____	☐ Sn____ Ag____ Cu____Sb____	☐ Sn____ Ag____ Cu____Sb____	☐
SnAgBi	☐ Sn____ Ag_____ Bi_____	☐ Sn____ Ag_____ Bi_____	☐ Sn____ Ag_____ Bi_____	☐
SnCu	☐ Sn_____ Cu_____	☐ Sn_____Cu_____	☐ Sn_____Cu_____	☐
SnCuNi	☐ Sn___Cu_____ Ni_____	☐ Sn___ Cu_____ Ni_____	☐ Sn___ Cu_____ Ni_____	☐
SnZn	☐ Sn_____ Zn_____	☐ Sn_____ Zn_____	☐ Sn_____ Zn_____	☐
SnZnBi	☐ Sn_____ Zn_____ Bi_____	☐ Sn_____ Zn_____ Bi_____	☐ Sn_____ Zn_____ Bi_____	☐
SnBi	☐ Sn_____ Bi_____	☐ Sn_____ Bi_____	☐ Sn_____ Bi_____	☐
Other - Please specify *composition*	☐ _____	☐ _____	☐ _____	☐
Other - Please specify *composition*	☐ _____	☐ _____	☐ _____	☐ _____
I use lead solders *Composition*	☐ _____	☐ _____	☐ _____	☐ _____

1.2 What are your preferred lead-free surface finish materials?

Please tick the material type. Please also indicate alloys you do not use.

	Component Plating	PWB Land Finish	Solder Ball	Not Used
Sn HAL	☐	☐	☐	☐
Chem. Sn	☐	☐	☐	☐
SnCu	☐ Sn Cu	☐ Sn Cu	☐ Sn Cu	☐
SnAg	☐ Sn Ag	☐ Sn Ag	☐ Sn Ag	☐
SnBi	☐ Sn Bi	☐ Sn Bi	☐ Sn Bi	☐
Chem. Ag	☐	☐	☐	☐
Ni/Au	☐	☐	☐	☐
Pd/Au	☐	☐	☐	☐
SnAgCu HAL	☐ Sn Ag Cu	☐ Sn Ag Cu	☐ Sn Ag Cu	☐
SnAgCuBi HAL	☐ Sn Ag Cu Bi	☐ Sn Ag Cu Bi	☐ Sn Ag Cu Bi	☐
SnAgBi HAL	☐ Sn Ag Bi	☐ Sn Ag Bi	☐ Sn Ag Bi	☐
SnCuNi HAL	☐ Sn Cu Ni	☐ Sn Cu Ni	☐ Sn Cu Ni	☐
SnZn HAL	☐ Sn Zn	☐ Sn Zn	☐ Sn Zn	☐
SnZnBi HAL	☐ Sn Zn Bi	☐ Sn Zn Bi	☐ Sn Zn Bi	☐
OSP	☐	☐	☐	☐
Other – Please specify composition	☐	☐	☐	☐
Other – Please specify composition	☐	☐	☐	☐
I use lead finish	☐	☐	☐	

2 Remaining Problems with Lead-free Implementation

Please indicate the main problems resulting from implementation in your company

2.1 Remaining Technical Issues

☐ Component problems due to high soldering temperatures:

☐ Other temperature related problems (PWB warpage, no appropriate PWB substrates available, please specify):

☐ Wettability/soldering problems:

☐ Quality / Reliability problems:

☐ Problems with reflow/wave soldering:

☐ Other, please specify:

.

2.2 Other Problems

☐ Component supply:

☐ Component marking and labelling:

☐ RoHS compliance testing and assessment:

☐ Organization of supply chain (RoHS compliance certificates etc.):

☐ Patent issues:

☐ Training:

☐ Other, please specify :

☐ No remaining problems

3 Support from R&D and others

3.1 What kind of support do you consider most useful:

.....
.....
.....
.....
.....

4 Exchange of equipment for lead-free soldering

4.1 Did you exchange or technically upgrade your reflow oven?

☐ Yes ☐ No exchange

☐ Yes ☐ No upgrade

4.2 Did you exchange your wave solder oven?

☐ Yes ☐ No exchange

☐ Yes ☐ No upgrade

5 COMPANY INFORMATION

Please provide a contact and some additional information about your company.
Your company information will be strictly confidential within ELFNET Status Research. The evaluation of your answers will be anonymous.

Country :

Company name :

Website :

Your name:
(necessary for the prize draw!)

E-Mail :

Telephone :

5.1 Company size

☐ <50 employees
☐ 50-250 employees
☐ 250-500 employees
☐ 500-1,000 employees
☐ >1,000 employees

5.2 Operating regions

☐ Global company operation

☐ Pan-European operations

☐ Individual European Member State operations, please specify : …….

☐ Other, please specify : ……

5.3 Which products / services do you offer?

Mark all groups that apply to your business on the list.

Core business	Other business		
Equipment (products for end users)			
☐	☐	1.	Household appliances (air conditioner, refrigerator, etc.)
☐	☐	2.	Home entertainment and telecommunications
☐	☐	3.	Office equipment (excluding PC's)
☐	☐	4.	PCs and similar
☐	☐	5.	Mobile / handheld devices (cellular phone, PDA, Laptop, etc.)
☐	☐	6.	Servers, storage systems and similar
☐	☐	7.	Network infrastructure equipment for telecommunication (e.g. for use in base stations)
☐	☐	8.	Industry equipment
☐	☐	9.	Power Electronics
☐	☐	10.	Electrical equipment for vehicles
☐	☐	11.	Aerospace and defence
☐	☐	12.	Medical
☐	☐	13.	Others, please specify : ……..
Material and components			
☐	☐	14.	Solder and related material
☐	☐	15.	Printed wiring board and related material
☐	☐	16.	Semiconductors
☐	☐	17.	Passive components
☐	☐	18.	Connection components (connector, socket, switch, etc.)
☐	☐	19.	Power supply and transformer components
☐	☐	20.	Module components (hybrid IC's, PA, VCO, etc.)
☐	☐	21.	Others, please specify : ……
Production equipment			
☐	☐	22.	Production equipment for soldering
☐	☐	23.	Others, please specify : ……

Core business	Other business	
Recycling business		
☐	☐	24. Collection and dismantling
☐	☐	25. Material treatment
☐	☐	26. Others, please specify : …….
Other business sectors		
☐	☐	27. EMS, Contract manufacturer
☐	☐	28. Others, please specify : …….

Thank you for completing this questionnaire