

D5.1 Analysis of the Current Status of European Lead-Free Soldering 2004

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1st ELFNET Lead-Free Soldering Status Survey Questionnaire	

Survey questionnaire

The results discussed in this report are based on a questionnaire distributed from September to December 2004 via the Internet, on congresses and fairs (Electronics Goes Green 2004+, Berlin/Germany, MSQ Nordic Days Lillestrom/Norway, Lead-Free Seminar Jachranka / Poland, Electronica 2004, Munich/Germany) and by direct contact to Enterprises. The analyzed answers of this first survey can not yet be seen as totally representative.

SME (small and medium sized enterprises) make 67% of the participating enterprises, so that some of the findings may be specific to smaller companies. The result could not yet be differentiated according to company size. The represented enterprises are categorized in table 1.

Producers	Suppliers	Equipment and others
Household appliances	Solder and related	Equipment for soldering
Home entertainment	Printed wiring board	Pick and place
Office equipment	Semiconductors	Testing
PCs and similar	Passive components	
Mobile / handheld devices	Connection components	Material treatment for Recycling
Network infrastructure	Power supply	
Industry equipment	Module components	
Power Electronics		
Equipment for vehicles		
Aerospace and defence		
Medical		
EMS		

Table 1: Represented part of the electronics industry.

Figure 1 shows the sectors covered in the survey. In particular, end producers (56% of the answers), components suppliers (6%), solder producers (7%), board manufacturers (7%) and electronics manufacturing services (EMS, 8%) have participated in the survey. The included end product types are shown in figure 2. The analyzed answers come from Finland, Norway, Italy, The Netherlands, Germany, The United Kingdom and Poland.

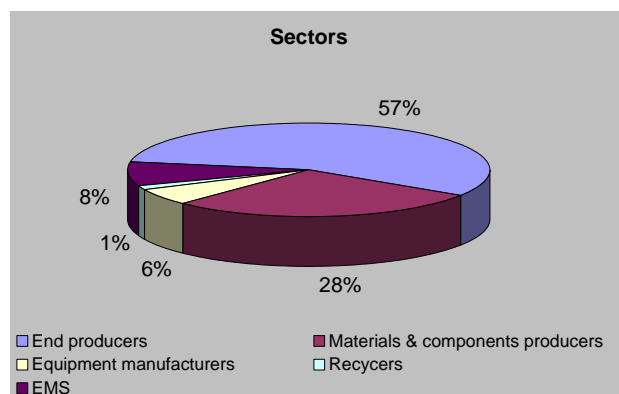


Fig. 1: Covered sectors.

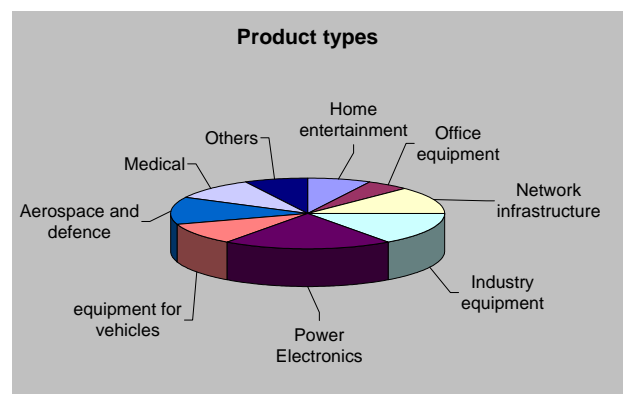


Fig. 2: Covered product types.

1 General situation

1.1 Recognized benefits of lead-free soldering implementation.

Some **environmental benefit** of the change to lead-free soldering is recognized by 44% of the replies to the questionnaire, 28% see benefits for recycling & EOL (end of life). Advantages for the enterprises are almost only seen in the field of marketing (See figure 3). 6% expect no positive effects from the regulations.

Technical improvements by lead-free soldering are not recognized, as they were seen by 5% in the 2003 soldertec roadmap. This may result from differences in the polled group of enterprises. Cost benefits are also not expected.

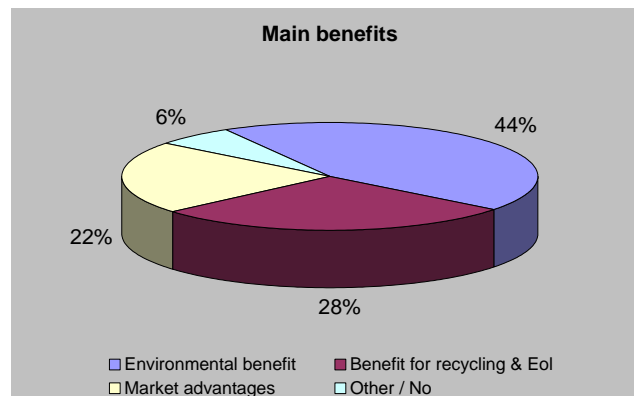


Fig. 3: Benefits expected from the change to lead-free technology.

1.2 Expected main problems from the enterprise point of view.

The main problems of lead-free soldering implementation that the enterprises currently are aware of, are increasing costs, technical requirements and organisational changes. The importance of the topics is rate nearly equally (figure 4).

The cost increase is expected / observed mainly for **investment and processing**, not for material costs (figure 5). The main technological problem is the provision of sufficient **quality / reliability** in the product (figure 6). The supply of suitable **components** for lead free soldering (temperature resistant, lead-free plating) is considered a major issue (figure 7). The need for appropriate **training in the enterprises** is also clearly recognized.

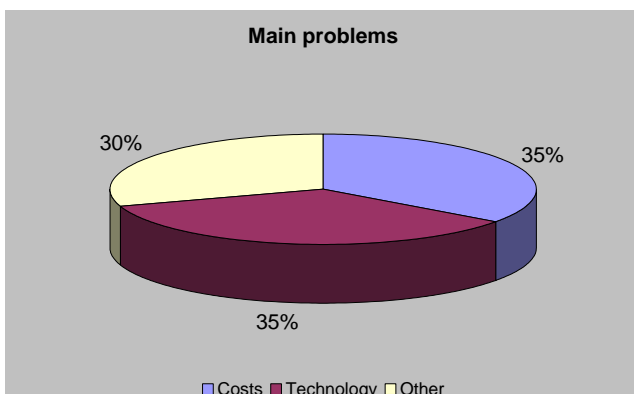


Fig. 4: Expected problems of lead-free implementation.

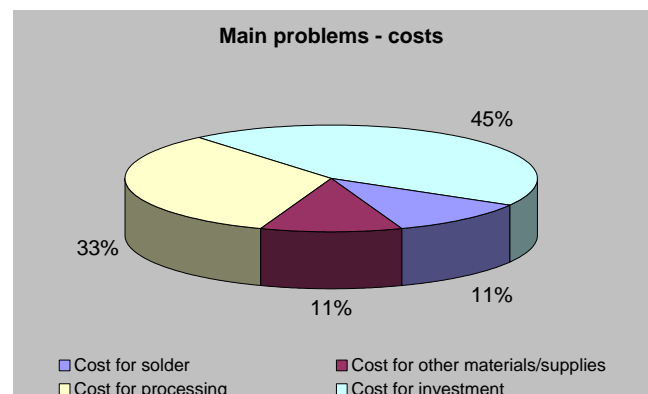


Fig. 5: Cost issues.

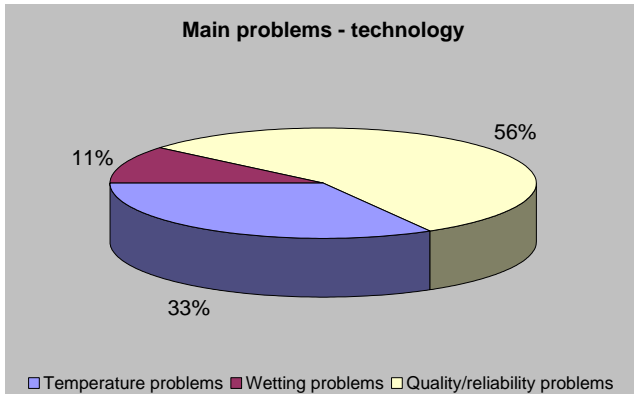


Fig. 6: Technical issues.

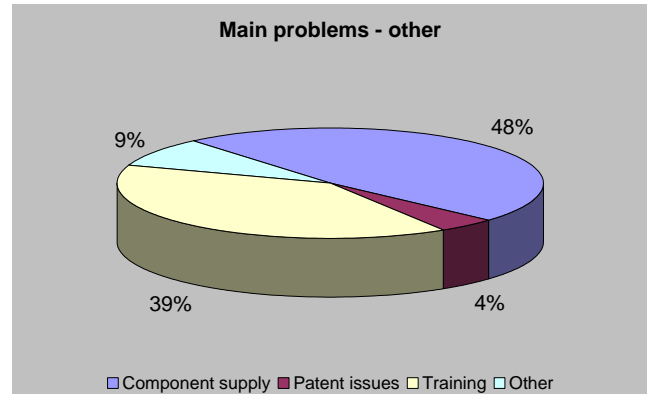


Fig. 7: Other issues.

1.3 Status of lead free products / processes in the enterprises.

Still 30 % of the answers indicate that the enterprises are not actively preparing for lead-free soldering (figure 8). However, 45 % already have experiences from own tests and about 20 % have first experience or an established commercial production. Compared to results from the 2003 soldertec survey, which showed that 40 % of the enterprises had no plans for lead-free implementation at that time, the result is a clear, but still insufficient, **improvement**.

The enterprises which state no own activity at the present time, will urgently have to concentrate in practical implementation during 2005, using the available information and published experiences as well as direct assistance from specialised consultants.

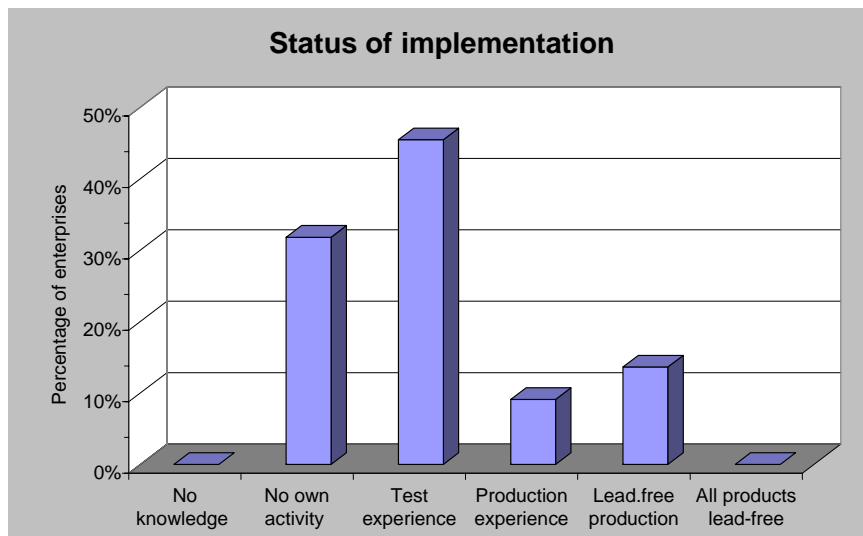


Fig. 8: Lead-free soldering – implementation in the enterprises.

1.4 Continued production of lead containing products.

Almost half of the answers indicate that **lead soldered products will be continued** according to the exemptions of the RoHS directive, but also for export (figure 9). Lead containing materials will also be used for repair by 20 % of the enterprises. This means that lead-free and conventional production will be co-existing in many enterprises for a significant time.

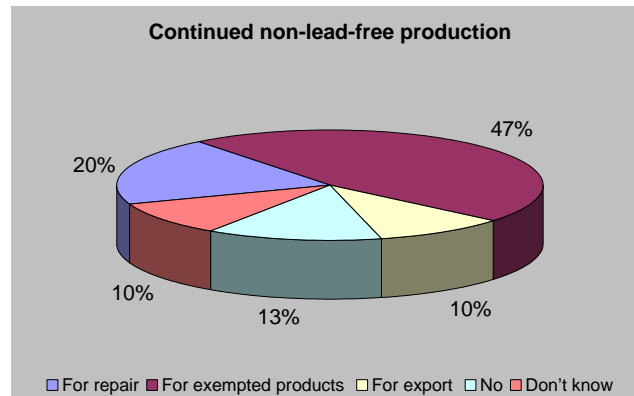


Fig. 9: Continued lead solder use

1.5 Progress towards lead-free implementation in the enterprises.

Compared to results from the 2003 soldertec survey, the number of enterprises that attempt to take leadership of the market decreased slightly. This may have been discouraged by a lack of clear decisions and guidance, for example on the question of concentration limits. Most prefer to match the **mainstream development**. As a positive result, it can be stated that none of the answering enterprises was undecided about their progress. In 2003, 5 % did not know yet.

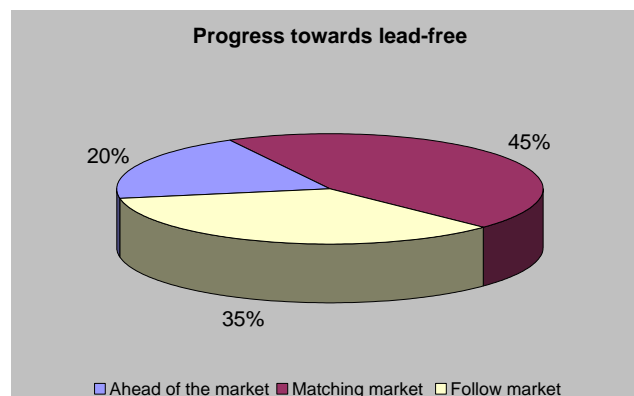


Fig. 10: Pace of implementation in the enterprises

1.6 Information level on technical details and legal requirements

According to figure 11, the recent research and information activities about lead-free soldering were to some extent successful, although this first ELFNET survey can not assure a totally unbiased result. Only 10 % of the enterprises that took part in the survey need, according to their own estimation, more basic information on the topic. On the other hand, **detailed technical and legal information** is still needed. This should be considered in the preparation of additional materials, workshops etc, avoiding unnecessary generalized, unspecific information.

Some need for information about the interference of the change to lead-free soldering with exempted products or sectors (namely aerospace & defence) was expressed during the survey.

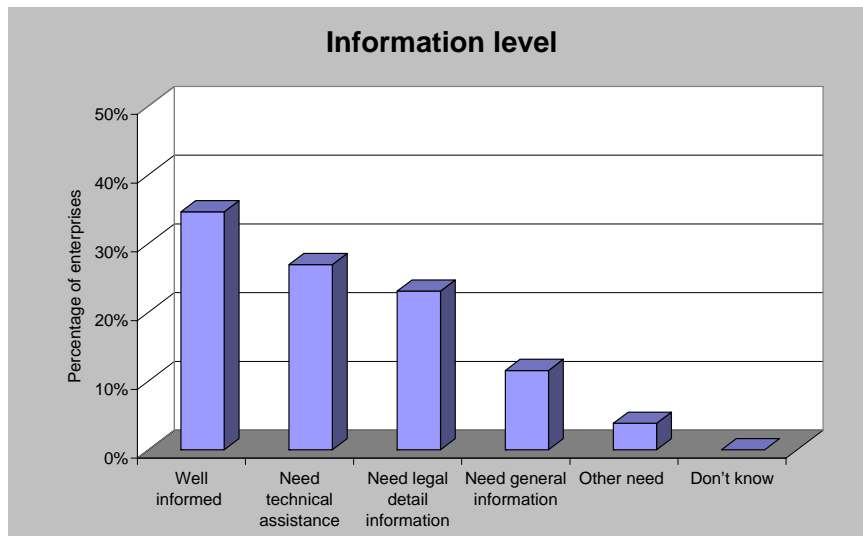


Fig. 11: Information level of the enterprises.

2 Materials

2.1 Preferred lead-free solder alloys.

The most widely used lead-free reflow solder type is **SnAgCu** (preferred by 59%), as it was in the 2003 soldertec survey. The material choices for wave and manual soldering are less clear (see table 2). For wave soldering, SnCu resp. the relatively new **SnCuNi** solders are preferred, for manual soldering SnAgCu.

The changes compared to the 2003 study, where SnAgCu was seen as the best choice both for wave and hand soldering, seems to be caused mainly by the introduction of **SnCuNi** solders with lower raw material costs than SnAgCu and less whisker formation than SnCu binary alloys.

The number of **undecided users** is still relatively high especially for hand soldering applications and (surprisingly) for reflow.

“Exotic” alloys like SnZn (for reflow), SnAgCuSb (for wave soldering) and SnBi are used by some enterprises.

	Reflow	Wave	Manual
SnAg		12%	
SnAgCu	60%	16%	39%
SnAgCuBi			
SnAgCuSb		8%	
SnAgBi			
SnCu		24%	17%
SnCuNi	7%	28%	11%
SnZn	7%		
SnZnBi			
SnBi			6%
Don't know	27%	12%	28%

Table 2: Preferred lead-free solder alloys.

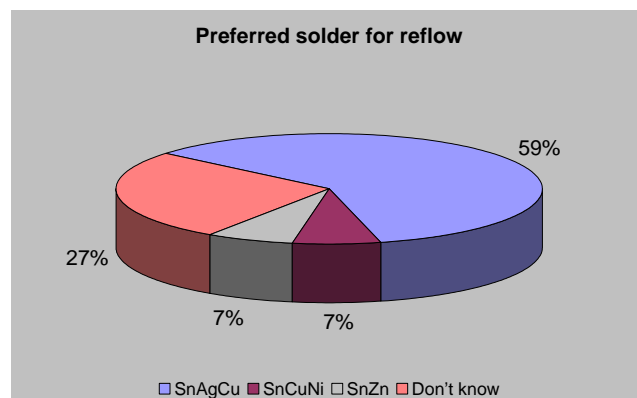


Fig. 12: Reflow solders.

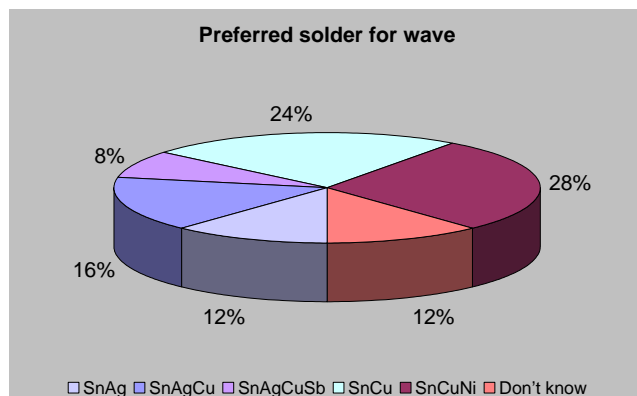


Fig. 13: Wave solders.

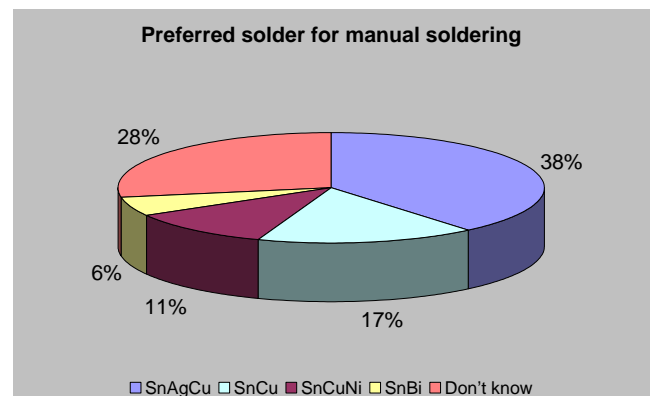


Fig. 14: Solders for hand soldering.

2.2 Preferred SnAgCu alloy composition.

During the last years, SnAgCu (SAC) alloys have been chosen as a de-facto “drop-in-solution” to replace SnPb solders (at least in reflow soldering). However, there are several alloy compositions available, and up to now, **no generally applied SAC solder** composition is established. The most commonly applied alloy among the enterprises participating in the survey is **SnAg3,0Cu0,5**, but SnAg4Cu0,5, SnAg3,8Cu0,7 and SnAg3,5Cu0,7 are also used and more than half of the enterprises don't know which SnAgCu alloy they should chose (figure 15).

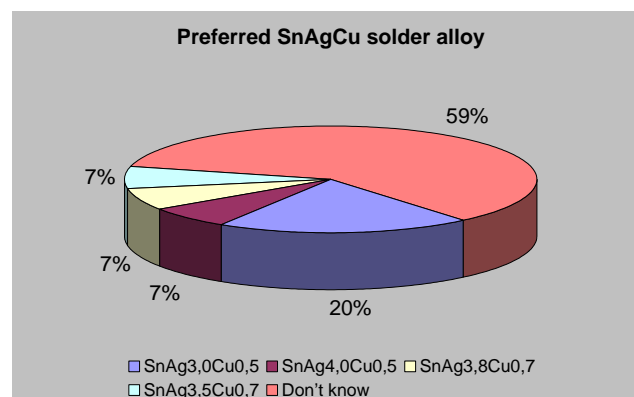


Fig. 15: Choice of SnAgCu alloys.

2.3 Preferred lead-free surface finish materials.

The diversity of lead free surface finishes is even higher than for solder alloys. No clear favourites can be seen in the analyzed answers (table 3). **Pure tin** for component terminations and **gold** surfaces for board land finishes are slightly preferred. Compared to the 2003 survey, the trend to Ni/Au (or alternatively pure Sn) board finishes remains. For low-value mass products, this trend should be regarded critically, because other (less expensive) finishes could be favourable. Lead-free HAL surfaces are currently in discussion.

Especially the preferable **materials for BGA** solder balls interconnections are not clear; 62 % of the answers are undecided (see table 3). For board land finish, the level of indecision sank from 30 % to 12 % since 2003.

	Termination	Land	Solder Ball
Pure Sn	30%	18%	
SnCu	4%	9%	
SnAg	4%		
SnBi		3%	
Ag	4%	9%	
Au (Ni/Au; Ni/Pd/Au)	15%	27%	
Pd (Pd/Au)	4%		
SnAgCu	7%		23%
SnAgCuBi			
SnAgCuSb			
SnAgBi			
SnCuNi	4%	9%	15%
SnZn			
SnZnBi			
OSP	7%	12%	
Don't know	22%	12%	62%

Table 3: Lead-free surface finish materials.

2.4 Amount of lead-free solder used in production at the present time.

From the available survey results, it can at this time only be stated that 70 % of the enterprises participating in the survey still use conventional lead containing solders at more than 90 % of their total solder consumption. Only 15 % of the enterprises use 50 % or more lead free solder.

3 Processes

3.1 Required equipment changes for lead-free.

The vast majority (74 %) of the polled enterprises see a **need to change** production equipment for lead free technology (figure 16). This is a clear increase compared to 35 % in the soldertec 2003 study. The uncertainty about this need is now low (5 %) compared to 2003 (22 %). The required degree of change (figure 17) is roughly estimated around 30 % by most of the enterprises, although some expect a larger change up to 80 %.

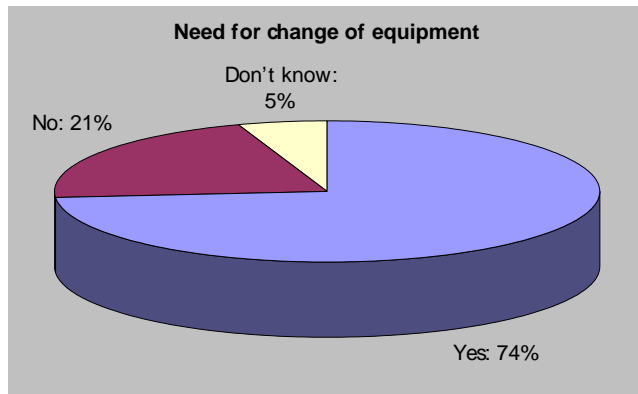


Fig. 16: Need for equipment change.

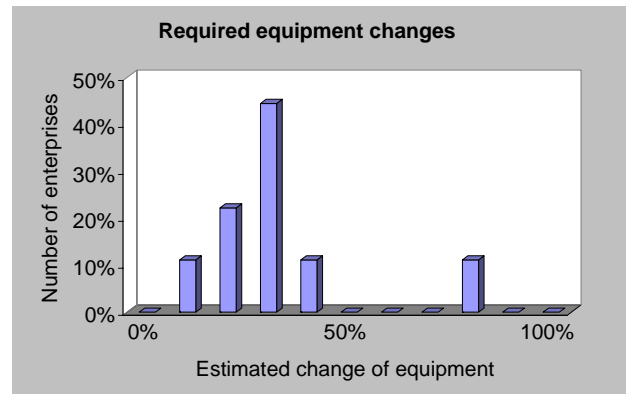


Fig. 17: Expected degree of equipment change.

3.2 Required assembly or component design changes for lead-free.

A **design change is needed** for lead-free assemblies or components in the opinion of 65 % of the enterprises (figure 18). Like for the expected equipment changes, this is an increase compared to the results from 2003 (40%). As for equipment changes, the uncertainty is much lower than in the 2003 study.

The required changes are expected to be around 20 – 30 % by most enterprises, up to 80 % by some (see figure 19).

The requirement of design changes for the switch-over to lead-free soldering is widely recognized, especially for sophisticated designs that require careful optimization even for tin-lead soldering. More simple designs may often not need such changes.

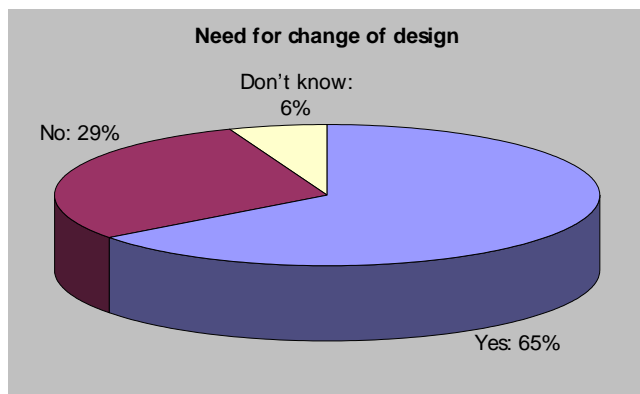


Fig. 18: Need for design change.

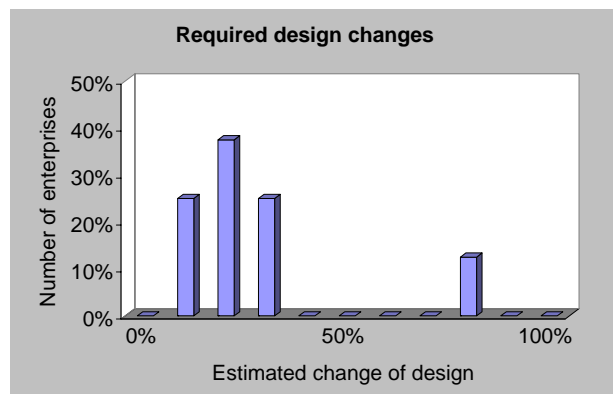


Fig. 19: Expected degree of design change.

4 Marking / Labelling

4.1 Application of labelling of lead-free products or components.

Labelling of lead-free products or parts can be applied on different levels: Components / board, end product, end product transport packing. More than half of the answers indicate that some kind of labelling is necessary (standardized or non-standardized) or already applied (see figures 20 – 23). However, the level of **uncertainty about labelling** is still high (20 – 30 % on the different levels).

The need for **standardized labelling** is expressed especially for components. About 10 % of the units on each level are already labelled, according to the survey (only 6% of transport packages).

Compared to the soldertec 2003 study, the results show a decrease of undecided answers and an increase of already labelled units (see table 4). Standardization of labelling obviously remains an important issue.

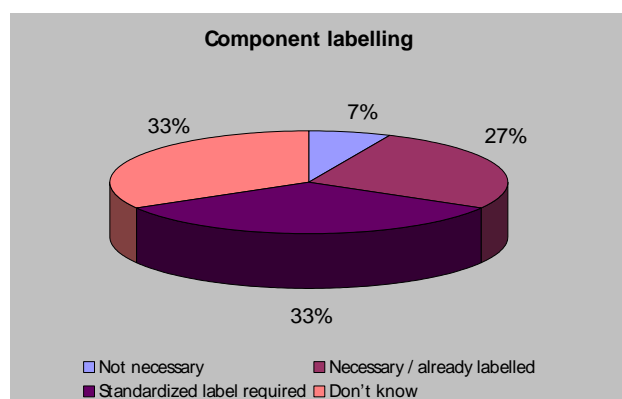


Fig. 20: Component labelling.

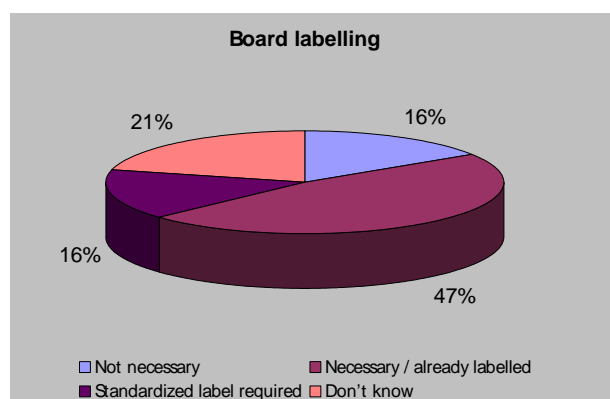


Fig. 21: Board labelling.

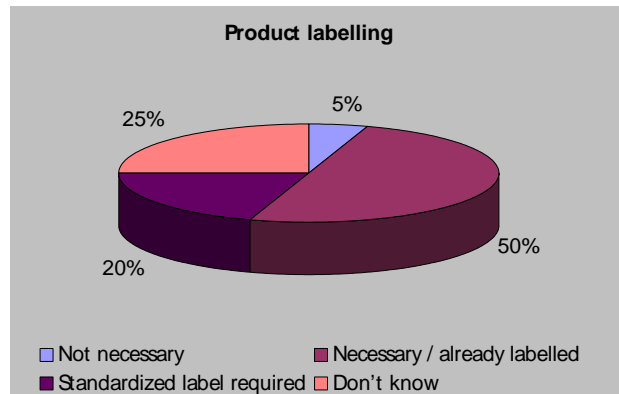


Fig. 22: Product labelling.

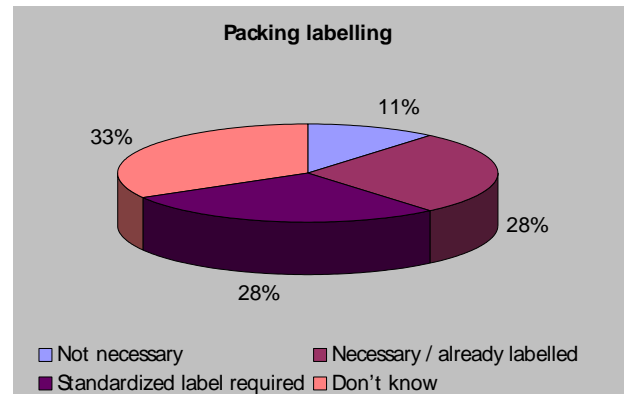


Fig. 23: Transport packing labelling.

	Component	Board	Product	Transport packing
Labelling not necessary	7%	16%	5%	11%
Labelling necessary	13%	37%	40%	22%
Standardized label required	33%	16%	20%	28%
Already labelled	13%	11%	10%	6%
Don't know	33%	21%	25%	33%

Table 4: Required lead-free labelling.

Agenda

For the next status reports within the ELFNET project, several adjustments of the procedure are desirable. At the same time, sufficient continuity with this report and the earlier studies of soldertec should be provided to allow comparisons and the identification of trends. The following adjustments are intended:

- **Harmonization** with similar studies; especially in contact with the LEADOUT project.
- Broadening of the basis of the study and provision of a **representative group** of inquired enterprises.
- Dissemination of the survey results and **feedback** of the relevant addressed groups to adjust questionnaire and evaluation.
- Detailed review of **marking requirements** for lead-free products, assemblies or components and the proposed solutions.

Reference

- Nimmo, Kay: "Second European Lead-Free Soldering Technology Roadmap, Soldertec 2003
- Nimmo, Kay: "Results from Pb-free Marking Survey", Soldertec Global 2004

Available via Soldertec at Tin Technology,

www.tintechnology.com

– registration required –

Annex

1st ELFNET Lead-Free Soldering Status Survey Questionnaire

1st ELFNET Lead-Free Soldering Status Survey

ELFNET – European Lead-Free Soldering Network’, is a new European network of technical experts and industry bodies in microelectronics. It provides a 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.

Within ELFNET, yearly surveys will be carried out to observe the progress of lead-free soldering technology in the European electronics industry. The results will be published in annual status reports. This information will be important for highlighting urgent research and technical support issues. It will be of interest to industry bodies as well as to policymakers.

You are invited to take part in the ELFNET lead-free soldering status survey through completing this questionnaire. **The company information you provide will be strictly confidential.**

We appreciate the time that you take to complete this survey.

Thank you !

Please return by e-mail or fax to	ELFNET Status Research Technische Universität Berlin Karl Heinz Zuber Tel +49 (0) 30 464 03 - 138 Fax +49 (0) 30 464 03 - 131 E-mail zuber@izm.fhg.de
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ELFNET - European Lead-Free Soldering Network is partially funded by The European Commission

09/07/2004	Please return to e-mail zuber@izm.fhg.de of fax +49 (0) 30 464 03 – 131	Page 14 of 22
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1st ELFNET Lead-Free Soldering Status Survey

5 General situation

What do you consider to be the main benefits of lead-free soldering implementation ?

Please indicate the main advantages of lead-free soldering that you see.

- Environmental benefit
- Benefit for recycling and end-of-life treatment
- Cost benefit
- Technical benefit
- Market advantages
- Other
- Please specify: _____
- Don't know

What do you consider to be the main problems for lead-free soldering implementation ?

Please indicate the main effective or expected disadvantages.

Costs

- Costs for solder
- Costs for other materials / supplies
- Costs for processing
- Costs for Investment

Technology

- Temperature problems
- Wetting problems
- Quality / Reliability problems

Other

- Component supply
- Patent issues
- Training
- Other
- Please specify: _____
- Don't know

1st ELFNET Lead-Free Soldering Status Survey

What is the status of lead free products / processes in your company ?

- No knowledge about lead-free soldering
- No own activity on lead-free implementation yet
- Own experiences from Tests
- Own experiences from production
- Lead free production fully operating
- All products leadfree
- Don't know

Will you continue to supply lead containing products ?

Will you continue to supply lead containing products during a transition phase or because they are not falling under the legal regulations or are exempted (like Automotive, Aerospace) ?

- Yes, for repair
- Yes, for exempted products
- Yes, for export
Please specify for how long: _____
- No
- Don't know

How do you feel progress towards lead-free implementation in your company compares with others ?

- Ahead of the market and competitors
- Matching market progress in your product sector
- Follow the market developments in your product sector
- Don't know

How do you rate your information level on technical details and legal requirements of lead-free soldering ?

Please indicate if and which type of additional information you need to implement lead-free soldering and comply with the legislation.

<input type="checkbox"/>	Well informed and technically capable
<input type="checkbox"/>	Need technical assistance
<input type="checkbox"/>	Need legal detail information
<input type="checkbox"/>	Need general information
<input type="checkbox"/>	Other need for information or assistance
	Please specify: _____
<input type="checkbox"/>	Don't know

1st ELFNET Lead-Free Soldering Status Survey

6 Materials

What are your preferred lead-free solder alloys ?

Please tick the alloy type. Please also indicate alloys that you will not use.

	Reflow soldering	Wave soldering	Hand soldering	Not Used
SnAg	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnAgCu	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnAgCuBi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnAgCuSb	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnAgBi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnCu	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnCuNi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnZn	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnZnBi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnBi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other - Please name	<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
Don't know	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

What is your favoured SnAgCu alloy composition ?

- SnAg3,0Cu0,5
- SnAg4,0Cu0,5
- Other
- Please specify: _____
- Don't know

1st ELFNET Lead-Free Soldering Status Survey

What are your preferred lead-free surface finish materials ?

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

	Termination Plating	Board Land Finish	Solder Ball	Not Used
Pure Sn	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnCu	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnAg	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnBi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ag	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Au (Au/Ni)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pd (Pd/Au)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnAgCu	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnAgCuBi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnAgCuSb	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnAgBi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnCuNi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnZn	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SnZnBi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
OSP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other - Please name	<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
Don't know	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

What amount of lead-free solder do you use in production at the present time ?

Please state the approximate percentage of the consumed solder which is already lead-free, or the percentage of other lead-free interconnection techniques you apply (e. g. adhesive joining, pressfit technology), based on the total production.

Percentage of lead-containing solder used	_____
Percentage of lead-free solder used	_____
Percentage of other interconnection techniques used	_____
Type other interconnection techniques used:	_____

1st ELFNET Lead-Free Soldering Status Survey

7 Processes

Do you believe that your assembly equipment will need to be changed due to lead-free introduction ?

- Yes
Please specify approximate percentage of change: _____
- No
- Don't know

Do you believe that your assembly or component design will need to be changed specifically for lead-free introduction ?

- Yes
Please specify approximate percentage of change: _____
- No
- Don't know

8 Marking / Labelling

Do you apply or intend any kind of labelling of lead-free products or components?

When lead-free is introduced it may be necessary to indicate this either to the consumer, industry customer, or to assist in the recycling and material recovery process. Please indicate your company intentions by ticking the boxes in the table below.

	Component	Board	Product	Transport packing
Labelling not necessary	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Labelling necessary	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Standardized label required	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Already labelled	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Don't know	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

1st ELFNET Lead-Free Soldering Status Survey

9 Remarks

Please use this space for your additional remarks or questions on lead-free technology, special problems or the questionnaire.

10 COMPANY INFORMATION

Please provide a contact and some additional information about your company.

Your company information will be strictly confidential within ELFNET Status Research and the evaluation of your answers will be anonymous.

Country	<input style="width: 95%;" type="text"/>
Company name	<input style="width: 95%;" type="text"/>
Website	<input style="width: 95%;" type="text"/>
Contact person	<input style="width: 95%;" type="text"/>
E-Mail	<input style="width: 95%;" type="text"/>

Company size

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

Operating regions

- Global company operation
- Pan-European operations
- Individual European Member State operations

Please name: _____

- Other

Please name: _____

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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)

- | | | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | 1. Household appliances (air conditioner, refrigerator, etc.) |
| <input type="checkbox"/> | <input type="checkbox"/> | 2. Home entertainment and telecommunications |
| <input type="checkbox"/> | <input type="checkbox"/> | 3. Office equipment (excluding PC's) |
| <input type="checkbox"/> | <input type="checkbox"/> | 4. PCs and similar |
| <input type="checkbox"/> | <input type="checkbox"/> | 5. Mobile / handheld devices (cellular phone, PDA, Laptop, etc.) |
| <input type="checkbox"/> | <input type="checkbox"/> | 6. Servers, storage systems and similar |
| <input type="checkbox"/> | <input type="checkbox"/> | 7. Network infrastructure equipment for telecommunication (e.g. for use in base stations) |
| <input type="checkbox"/> | <input type="checkbox"/> | 8. Industry equipment |
| <input type="checkbox"/> | <input type="checkbox"/> | 9. Power Electronics |
| <input type="checkbox"/> | <input type="checkbox"/> | 10. Electrical equipment for vehicles |
| <input type="checkbox"/> | <input type="checkbox"/> | 11. Aerospace and defence |
| <input type="checkbox"/> | <input type="checkbox"/> | 12. Medical |
| <input type="checkbox"/> | <input type="checkbox"/> | 13. Others |

Please name: _____

Material and components

- | | | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | 14. Solder and related material |
| <input type="checkbox"/> | <input type="checkbox"/> | 15. Printed wiring board and related material |
| <input type="checkbox"/> | <input type="checkbox"/> | 16. Semiconductors |
| <input type="checkbox"/> | <input type="checkbox"/> | 17. Passive components |
| <input type="checkbox"/> | <input type="checkbox"/> | 18. Connection components (connector, socket, switch, etc.) |
| <input type="checkbox"/> | <input type="checkbox"/> | 19. Power supply and transformer components |
| <input type="checkbox"/> | <input type="checkbox"/> | 20. Module components (hybrid IC's, PA, VCO, etc.) |
| <input type="checkbox"/> | <input type="checkbox"/> | 21. Others |

Please name: _____

Production equipment

- | | | |
|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | 22. Production equipment for soldering |
| <input type="checkbox"/> | <input type="checkbox"/> | 23. Others |

Please name: _____

Recycling business

- | | | |
|--------------------------|--------------------------|--------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | 24. Collection and dismantling |
| <input type="checkbox"/> | <input type="checkbox"/> | 25. Material treatment |
| <input type="checkbox"/> | <input type="checkbox"/> | 26. Others |

Please name: _____

1st ELFNET Lead-Free Soldering Status Survey

Core Other
business business

Other business sectors

- | | | |
|--------------------------|--------------------------|--------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | 27. EMS, Contract manufacturer |
| <input type="checkbox"/> | <input type="checkbox"/> | 28. Others |
| Please name: _____ | | |

Thank you for completing this questionnaire !