



# Low Cost Lead-Free Soldering Technology to Improve Competitiveness of European SMEs

## Project Overview Presentation



*Project Overview Presentation*

**LEADOUT INFODAY**

**09.09.2005**



**HORIZONTAL ACTIVITIES  
INVOLVING SMEs**



***EUROPEAN DIRECTIVE***  
*Hazardous Products - RoHS (2002/95/EC)*



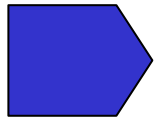
July  
2006

- ➔ SME LACK OF KNOWLEDGE AND LOW LEVEL OF LFS IMPLEMENTATION
- ➔ LACK OF RESEARCH WORK REGARDING LOW VOLUME PRODUCTION, REWORK AND MANUAL SOLDERING
- ➔ EUROPEAN BENCHMARKING OF LFS PROCESS

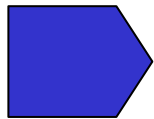


# Strategic Objectives

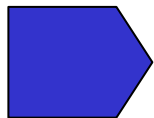
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Development/implementation of low cost lead-free soldering processes to support SMEs in complying with RoHS



Establishment of process quality standards, reduction of defect rates, improvement of reliability to increase competitiveness of SMEs



Increasing awareness of health and safety and pollution prevention



# The Consortium

Electronics  
Associations

- ANIMEE (P)
- APEMETA (P)
- SMART (UK)
- AETIC (E)
- MEISZ (HU)
- JEMI (F)
- DVS (D)
- ITEK (DK)
- CCIAA (I)
- EFW (EU)

Industrial Associations

External SMEs

Environmental  
Associations

SMEs

RTDS

*Assemblers*

- SILGAL (P)
- CROSSLINE(P)
- TELCA (P)
- ALCAD (E)
- IDK (E)
- ZUBELZU (E)
- CANFORD (UK)
- BLUNDELL (UK)
- DKL (UK)
- BETA (IRL)
- SZEM (HU)
- ELSZETRON (HU)
- AMTECH (UK)
- IMMG (EL)
- ISELQUI (I)
- MESATRONIC (F)

- ISQ (P)
- TWI (UK)
- INASMET (E)
- BUTE (HU)

*PCB manufacturers*



*Solder/Equipment  
suppliers*



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## WORK PACKAGES

### WP 1 – SME INFORMATION EXCHANGE

T1  
SME Core Group

T2  
Benchmarking Review

T3  
SME Survey

T4  
Website

T5  
Virtual Institute

T6- Awareness Promotion  
Newsletters  
Information Seminars

### WP 2 – TECHNOLOGY DEVELOPMENT

T1 – Technology Review

T2 – Process and Reliability  
Programme

T3 – Reability Testing

T4 – Environmental  
Assessment

T5 – Environmental  
Life-Cycle Impact

### WP 3 – LEAD FREE TECHNOLOGY, INDUSTRIAL IMPLEMENTATION

T1 – Evaluation of Equipment  
and Materials

T2 – Soldering  
Trials at Industrial Sites

T3 – Quality Evaluation of Solder Joints

T4 – Environmental  
Health & Safety Assessment

T5 – Recommendations for SMEs

T6 – Benchmarking Data  
Reporting

### WP 4 – DISSEMINATION & TRAINING

T1 – Seminars

T2- Training Courses

### WP 5 – EVALUATION OF THE PROJECT PERFORMANCE

T1 - Process Improvement

T2 - Technology Improvement

T3 - Environmental Improvement

### WP 6 - Management



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# Key Deliverables

- Benchmarking Summary Report - March 2007
- Report on Soldering Trials - Sept 2005
- Report on Reliability Testing - February 2006
- Photo Library for Joint Inspection - February 2006
- Recommendations for Lead-free Implementation at SMEs - April 2006
- Seminars and Workshops - 5 per country
- Virtual and Conventional Training Courses - 5 to be delivered before July 2006
- Health and Safety Report on Lead-Free Soldering - April 2006
- Environmental Impact Report on the Industrial Use of Lead-Free Solders - Sept 2007



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**HORIZONTAL ACTIVITIES  
INVOLVING SMEs**

- 1) BENCHMARKING**
- 2) TECHNOLOGY DEVELOPMENT AND INDUSTRIAL IMPLEMENTATION**
- 3) AWARENESS, DISSEMINATION AND TRAINING**
- 4) ENVIRONMENTAL IMPACTS**



What is the average defect level in the industry,  
Does anyone know?

PPM - Part Per Million Opportunities

Total Defects x 1,000,000 = PPM

Baseline

$$\frac{5}{10,000} \times 1,000,000 = 500 \text{ PPM}$$



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ppm-monitoring.com



Click Here for

### AUGUST PPM AVERAGES

Solder Paste Printing: 1430  
 Component Placement: 1229  
 Reflow Soldering: 108  
 Wave Soldering: 4314

- [Home](#)
- [Members Area](#)
- [About the Project](#)
- [Monthly Averages](#)
- [PPM Workshops](#)
- [Process Defect Guides](#)
- [smart-e-link](#)
- [Downloads](#)
- [Contact Us](#)
- [Press Cuttings](#)
- [Link to Us](#)

## MONTHLY AVERAGES

Month	Screen Printing	Component Placement	Reflow Soldering	Wave
May	730	15020	448	
June	589	7103	678	
July	3977	2098	1227	3738
August	1430	1229	108	4314



[top](#)

For further information on PPM Monitoring and this SMART Group initiative, contact:  
 Bob Willis - [info@ppm-monitoring.com](mailto:info@ppm-monitoring.com)

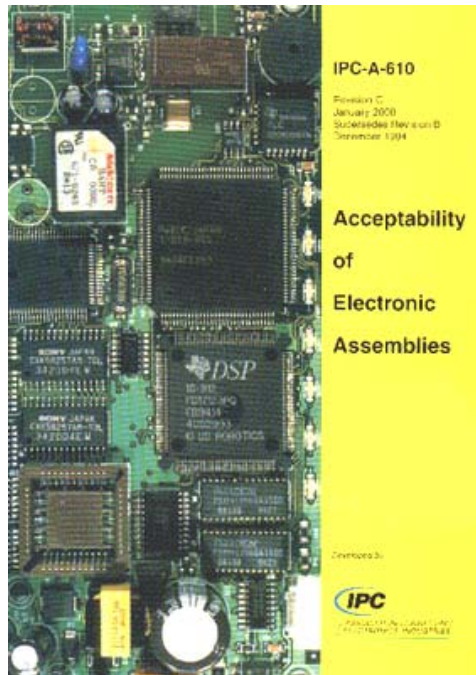


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# Inspection Criteria



Printing: Number of apertures

Placement: Number of components

Reflow: Number of joints

Wave: Number of joints

Monitoring occurs through the lead-free implementation period

- To compare leaded and lead-free processes
- Assessment of equipment suitability



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- Aim is to qualify specific assembly processes at core group SMEs using actual product
  - based on inspection and reliability testing, with assistance from RTD partners
  - less controlled, more realistic than pure test board development
  - reflow, wave, hand, mixed and rework
  - materials:
    - tin/lead for baseline
    - tin/silver/copper all processes
    - ‘tin/copper’ for wave and hand
  - boards and components as supplied, not all components may be lead-free, but automatically get a range of finishes and lead types



- Recording procedure for all assemblies
  - pcb finish, materials, process details
  - rework method, location, materials
  - temperature, solderability issues, defects?
- Inspection according to IPC-A-610D
- All assembled product function tested at SME
  - joints inspected and digitally recorded for quality standards report
- Reliability regimes agreed with assemblers
  - to best match in-house and standard tests for each assembly
  - ageing, temperature cycling, vibration, impact
  - parallel testing to compare tin/lead and lead-free assemblies





**1 0 18 8 0 50**  
years month days hours min sec  
*Still to go...*

User Name:    
 Password:   
[User Registration](#) - [Forgot password?](#)

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**About this Project**

The electronics industry in Europe is about to experience one of the biggest single changes since it started. The Restriction of the use of certain of Hazardous Substances (ROHS) Directive, due to be effective in July 2006, will mean that many parts of the Industry will have to change from tin/lead solder used to join the electronic components to the printed circuit boards (PCB) to a lead-free solder (LFS).

Due to these restrictions, it is quite important to make aware and prepare SMEs for the replacement of the existing soldering technology by other using LFS.




Fig. 1. Leadout European Team during the kick-off meeting at ISQ, Lisbon, Portugal

**LEADOUT, LowCost Lead-Free Soldering Technology to Improve the Competitiveness of European SMEs**, is one of the largest European funded Projects, on lead-free technologies under the scope of 6th Framework SME oriented activities. It is a three year project and the consortium, comprising 31 partners from 10 European Countries, (11 Industrial Associations, 16 SME's and 4 Research Institutes), had its kick-off meeting in October 2004.

The main objective of the project is to provide technical support to a wide range of SMEs spread all over Europe in the development of technological solutions for the problems resulting from the replacement of tin-lead solders in the electronics industry. The project also covers environmental impact and life cycle evaluation as well as lead free process benchmarking.

**Coordinators:**



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**TWI ( United Kingdom )**  
Dr. Simon Mason - [simon.mason@twi.co.uk](mailto:simon.mason@twi.co.uk)

**NEWS:**

- **ENDIEL 2005**  
14th Meeting for the Development of the Electric and Electronic Sector International Fair
- **Annual lead free event in the UK**  
February 2005
- **Monitoring and Benchmarking Training at TWI**  
November 2004

Project funded by the European Commission.

**Project Contacts:**

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## **Training - Sept 2005 - Sept 2007**

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Appropriate material, style and level for SMEs

- \* Standard courses
- \* Practical workshops
- \* e-learning/virtual institute

## **Dissemination - May 2005 - Sept 2007**

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Information and best practice

- \* LEADOUT Newsletters, papers
- \* LEADOUT Web Site (Information & Help Desk)
- \* LEADOUT Seminars
- \* Industrial Trade Association Events



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Workplace and wider environmental considerations

Deliverables:

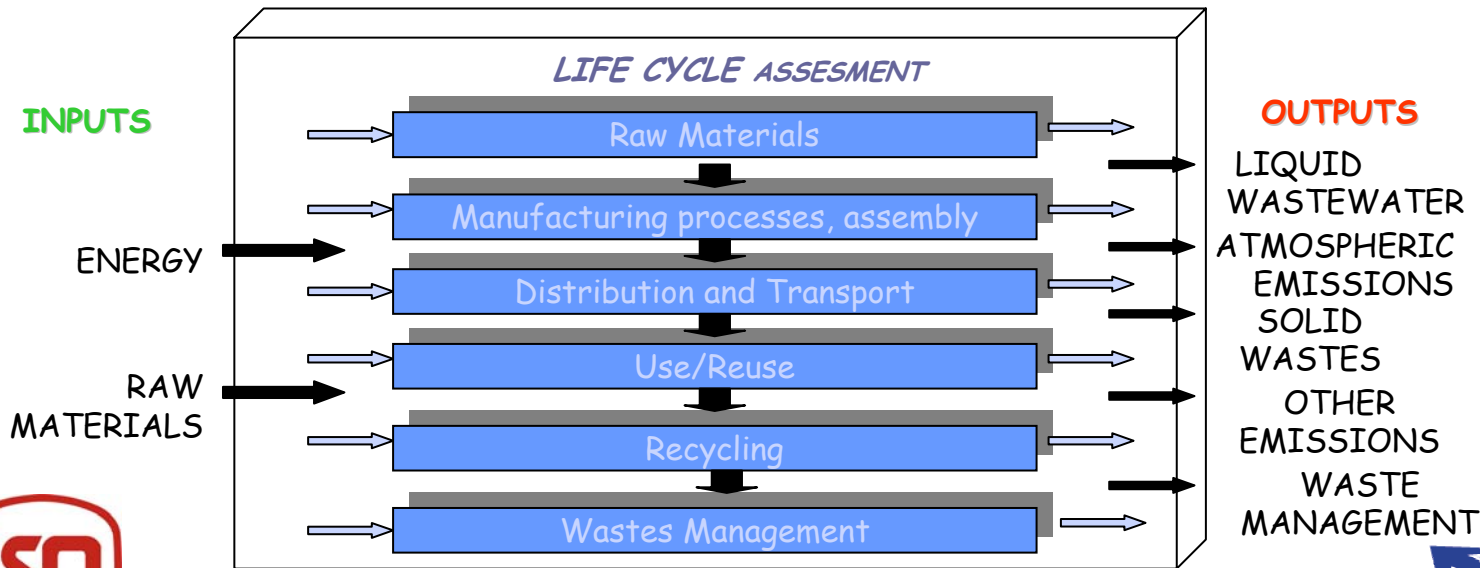
- Health and Safety Report on Lead-Free Soldering - April 2006
- Life-Cycle Assessment of Lead-Free Soldering Technology - April 2006
- H&S Impact Report on the use of Lead-Free Solders at SMEs - Jan 2006
- Environmental Impact Report on the Industrial Use of Lead-Free Solders - Sept 2007





# Life Cycle Analysis

- ✓ *Life-cycle analysis (LCA)* measures and combines the energy and raw material consumption, emissions and other factors related to a specific product over its entire life cycle from an environmental point of view.
- ✓ The ISO 14040-14043 is considered to be the LCA standard.





# LCA for LEADOUT project

## 1. Goal and scope

- ✓ To quantify the environmental impacts of the two different solder employed in two processes

	Solder Sn-Pb	Solder lead-free
Wave technology	✓	✓
Reflow process	✓	✓

## 2. Possible waste treatment scenarios:

- ✓ Reuse of parts and components
- ✓ Recycling of metals
- ✓ Incineration



- ✓ Controlled landfill disposal



## Proposed Environmental Impacts to be Analyzed

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✓ Greenhouse effect	✓ Heavy metals emissions (to water and air)	✓ Summer smog (NO <sub>x</sub> & VOCs)	✓ Industrial wastes generation
✓ Depletion of energetic resources	✓ Depletion of natural resources (mining, water,...)	✓ Ecotoxicity (to water, land,...)	



# Fume Emissions from Sn-Pb Soldering Processes

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# Fume Emissions

- **TRIALS AT WAVE SOLDERING PROCESS**
- CIRCUIT: 170 x 240 mm, WEIGHT: 199 g
  - 22 CIRCUITS PROCESSED, TIME: 35 min
  - PREHEAT 300 °C, 350 °C, BATH: 250 °C
  - NO CLEAN FLUX, SOLDER 63 Sn - 37 Pb
  - TOTAL FUME EXTRACTION FOR SOLDER AND FLUX.
  - 1 MEASUREMENT TRIAL: 30 min.
  - AVERAGE PCB WEIGHT INCREASE (SOLDER): 13.4 g



# Fume Emissions

## TRIALS AT REFLOW PROCESS:

- CIRCUIT: 175 x 240 mm (12 CIRCUITS TOGETHER), WEIGHT: 125 g
- 17 CIRCUITS PROCESSED, TIME: 70 min
  - PASTE: 62 Sn - 36 Pb - 2 Ag, NO-CLEAN
  - TOTAL FUME EXTRACTION
  - 2 MEASUREMENT TRIALS: 30 min each.
  - AVERAGE PCB WEIGHT DECREASE IN REFLOW OVEN (FLUX EVAPORATION): 0.3 g



# Summary

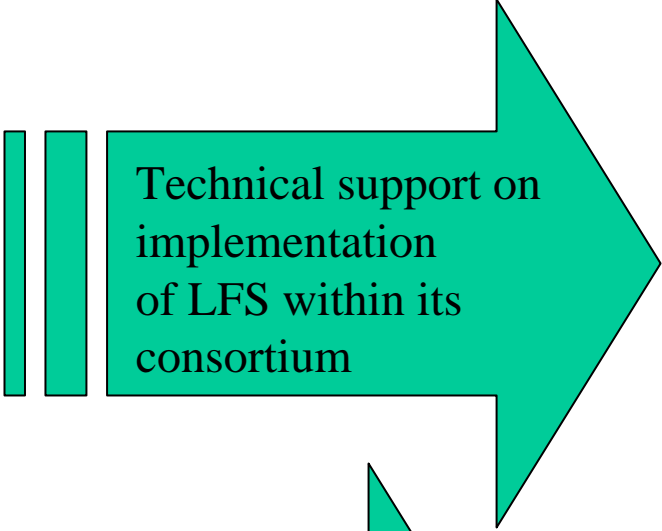
## LEADOUT will provide



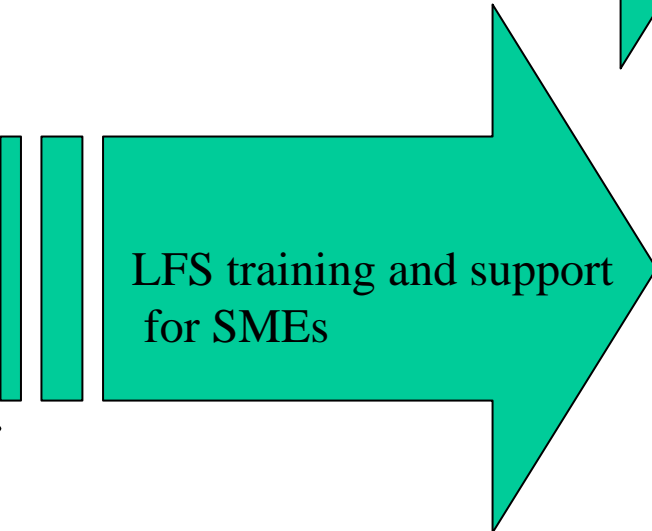
European Benchmarking



Environmental  
Impacts



Technical support on  
implementation  
of LFS within its  
consortium



LFS training and support  
for SMEs



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*European working team to support SMEs in  
Lead-Free Soldering Implementation*

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# OBRIGADO!

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*More information available at  
[www.leadoutproject.com](http://www.leadoutproject.com)*



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