COMPETITIVE ELECTRONICS ASSEMBLY NEARBY

GEERT WILLEMS – IMEC-ELECTRONIC ASSEMBLY

CENTER FOR ELECTRONICS DESIGN AND MANUFACTURING

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EDM
Electronics Design & Manufacturing

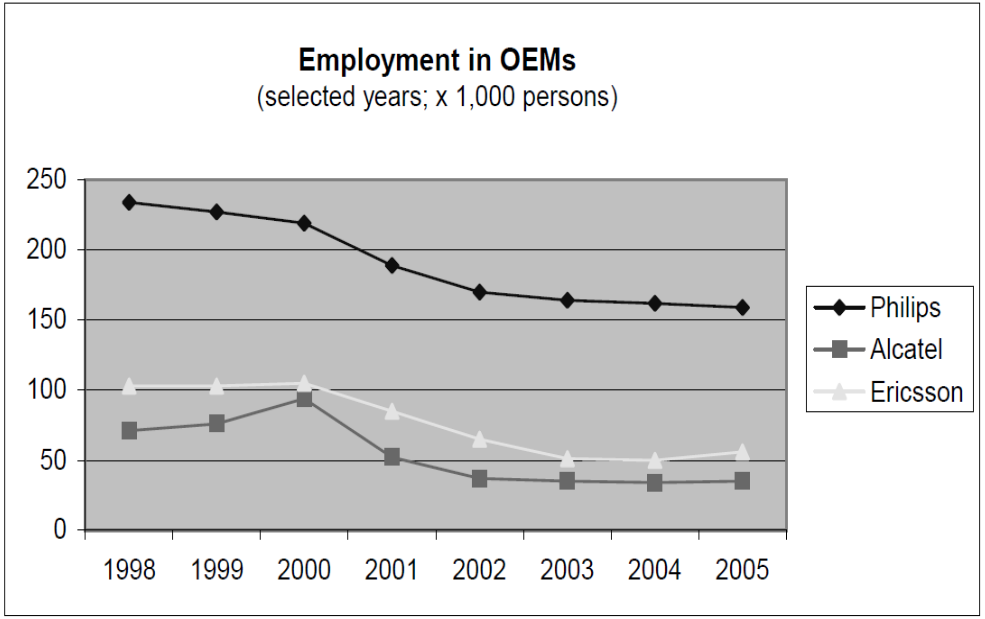
ASPIRE
INVENT
ACHIEVE

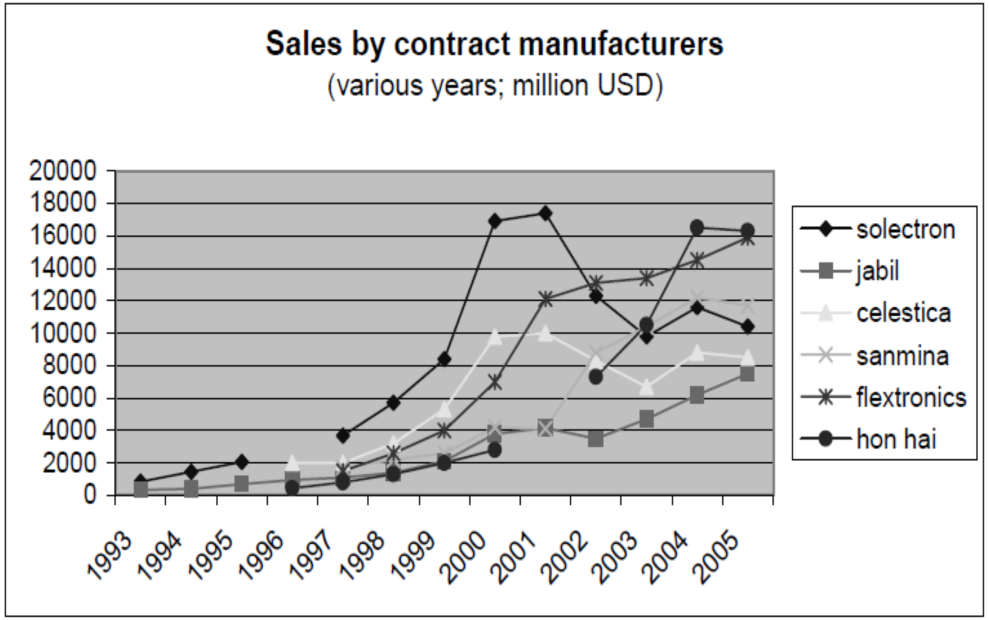
OUTLINE

- 20th Century Manufacturing Outsourcing
- Outlook 2015
- Re-shoring: bring manufacturing back
- What is needed?
- Quantification of Product Life Cycle Risks
- cEDM Tool Box

THE 20TH CENTURY MANUFACTURING OUTSOURCING

THE TREND





- Focus on the core business
- Low cost electronics manufacturing by EMS:

US → Mexico
West → East Europe
} → **China**

THE 20TH CENTURY MANUFACTURING OUTSOURCING

20 YEARS OF ELECTRONICS OUTSOURCING

The result

- Electronics is everywhere
- China: The world's factory
- US-Europe: major decline in manufacturing activity and know-how ...
  ... that is needed for cost effective, qualitative product development
- Highly complex and fragmented supply chain
- Declining quality and reliability
- Counterfeit: >10% of electronic components
- Copyright → "The right to copy"
- Slow response speed to customer driven changes.
- A lot of hidden costs: non-quality, communication, engineering changes, design iterations,...
- Transport: cost, environment

OUTLOOK 2015 - INDUSTRY

"THE TIMES THEY ARE A-CHANGIN' "?

EPS ELECTRONICS PURCHASING STRATEGIES NEWS+Plus

INFORMING, EMPOWERING & CONNECTING SUPPLY CHAIN DECISION MAKERS

Foxconn Is Coming to America: Has Offshoring Peaked?

Bolaji Ojo | January 28, 2014 | 1 Comment

Manufacturing Comes Back to United States *Terry Costlow, IPC online editor* *September 2, 2013*

Is Nearshoring Right for Your Product? JULY 2012

As China matures, a host of factors could rebalance the geographical supply chain.

Is Reshoring A Viable Option?

Tue, 01/21/2014 - 9:58am

by Tia Nowack, Associate Editor, Industrial Maintenance & Plant Operation

More: http://reshoringmfg.com/

HOW RESHORING DRIVES PROFITABILITY

This paper was originally published in the IPC APEX EXPO 2015 technical conference program.

Domestic Versus Offshore PCB Manufacturing

SUNSTONE "Made in USA" ©2013

The Trend Away From Offshore PCB Manufacturing

Must manufacturing leave Europe?

Electronic Engineering Times Europe November 2013

"Raspberry Pi has shown that with the right product addressing a global market European manufacturing not only makes sense, but can show a lead to the world."

A NEW PARADIGM FOR DESIGN THROUGH MANUFACTURE

Presented at IPC Apex 2012

Why Printed Circuit Board Design Matters to the Executive:

How PCBs Are a Strategic Asset for Cost Reduction and Faster Time-to-Market

February 2010

OUTLOOK 2015 - GOVERNEMENT

"THE TIMES THEY ARE A-CHANGIN' "?

EPRS
European Parliamentary Research Service

Briefing
21/03/2014

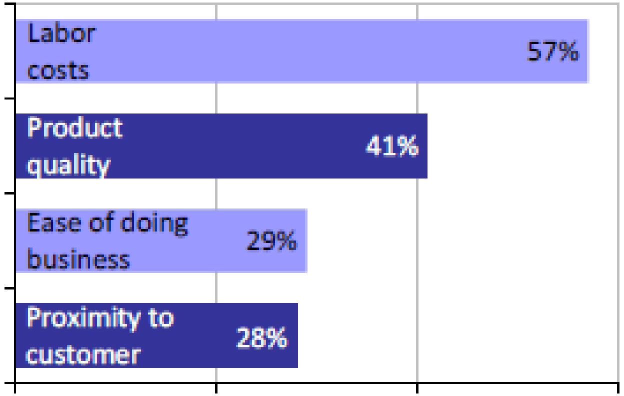
Reshoring of EU manufacturing

DRIVERS FOR RE-SHORING

Industry

- Rising total landed cost
  - Increasing labour cost
    China: +10%/y ('00-'05) +19%/y ('06-'10)
  - Increasing transport costs: oil x3 since '00
  - Cost of (larger) inventory
- Product quality
- Intellectual Property
- Ease of doing business
- Proximity to customers
- Mitigate supply risk

Main production location reasons



Source: Graebel paper 2012

Governements

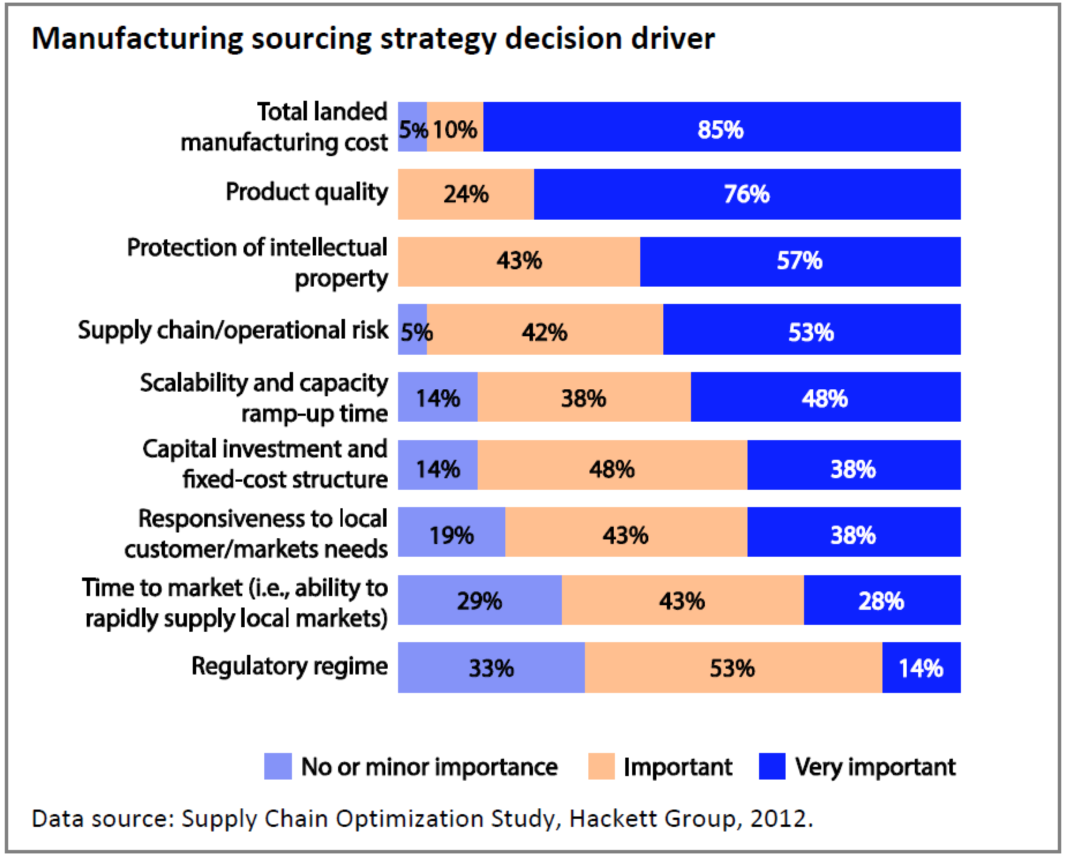
- Jobs: 1 manufacturing job + 2.5 support
- Higher pay than service sector
- More R&D → innovation, IP
- More export, less import

Ref: EPRS-study – Reshoring of EU manufacturing – 21/03/2014

MOST LIKELY PRODUCTS TO BE RE-SHORED

- Expensive to transport:
  ex. Heavy machinery
- "Dynamic" goods subject to frequent changes in consumer demand and short product life-cycles
- Products where safety concerns are important

Not everything will come back!



WHAT IS NEEDED?

Product:

- Dynamical
- High value
- Quality
- Safety → reliable

Trustworthy PREDICTION of all Product Life Cycle aspects

(without costly, long duration prototyping & testing)

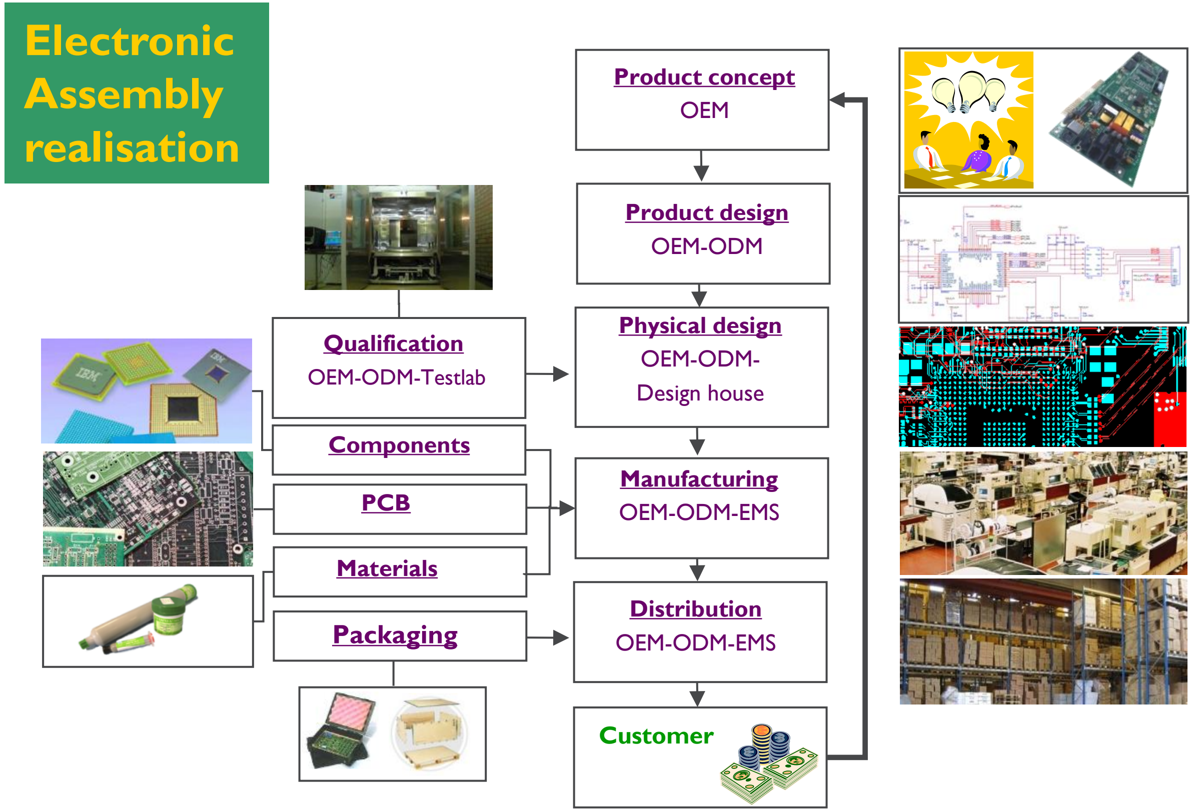
Design-for-eXcellence

Manufacturing, Reliability, Logistics, Cost,...

Challenge:

In the US – and in parts of Europe – there is difficulty in finding suitably skilled labour, reflecting the education system and a loss of specific manufacturing know-how, which has passed to new countries.

WHAT IS NEEDED?
PRODUCT LIFE CYCLE & SUPPLY CHAIN



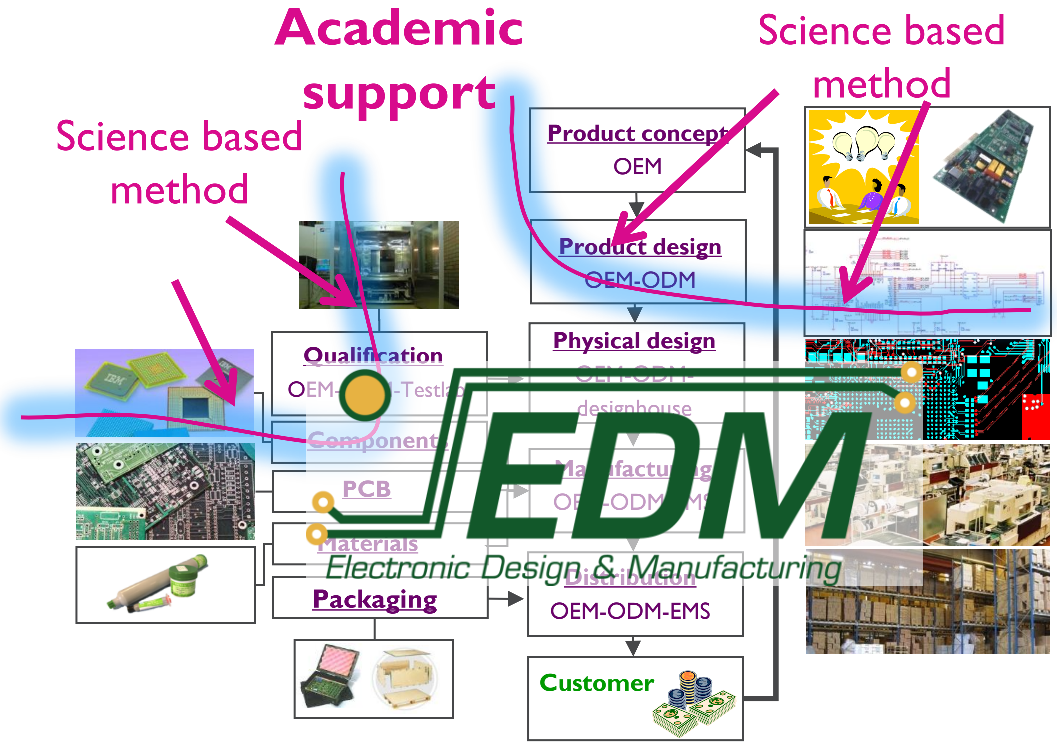
Status

- Many players.
- International.
- Very complex.
- Fragmented responsibility.
- Little academic support and education (esp. at master level)

Consequence

- Poor electronic product specification.
- Poor control of product and supply chain quality and performance.
- Development of design guidelines has stopped.

WHAT IS NEEDED?
SCIENTIFIC/ACADEMIC SUPPORT



Experience-based industrial approach

Insufficient scientific basis and possibilities for education :

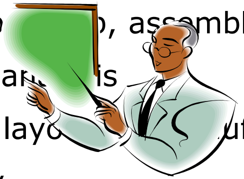
- PCB/PBA technology
- Substrate manufacturing
- Electronics assembly
- Test coverage
- Failure-mechanisms
- Design-for-X
- Reliability tests
- etc.

to handle challenges of complexity, quality and reliability

WHAT IS NEEDED

- From experience to science based product development and manufacturing
- IC realisation as a source of inspiration:
  Each realisation element of an IC has a EA 'sibling'.

IC realisation	EA realisation
• Materials semiconductors, metals, insulators, interfaces • Process-steps oxidation, implantation, deposition, lithography,… • Production-flow IC process flow • Test and analysis • Design – layout - TAD • Reliability	• Materials polymers, metals, solder, interfaces • Process-steps lamination, drilling, plating, lithography, printing, assembly, soldering,… • Production-flow substrate b[illegible], assembly flow • Test and an[illegible]is • Design – layo[illegible]ufacturing • Reliability


CEDM MISSION

To support industry

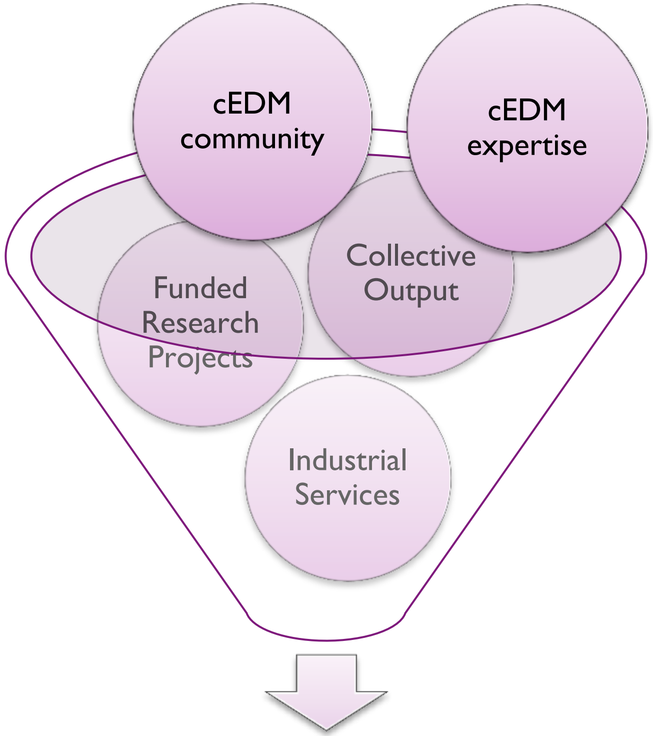
in the development and manufacturing of high quality, reliable and cost-effective electronic modules (PBA)

by means of

knowledge creation and sharing,

scientifically sound methodologies,

collaboration throughout the electronic supply chain.



Better electronics at reduced cost through science based design & production methodologies

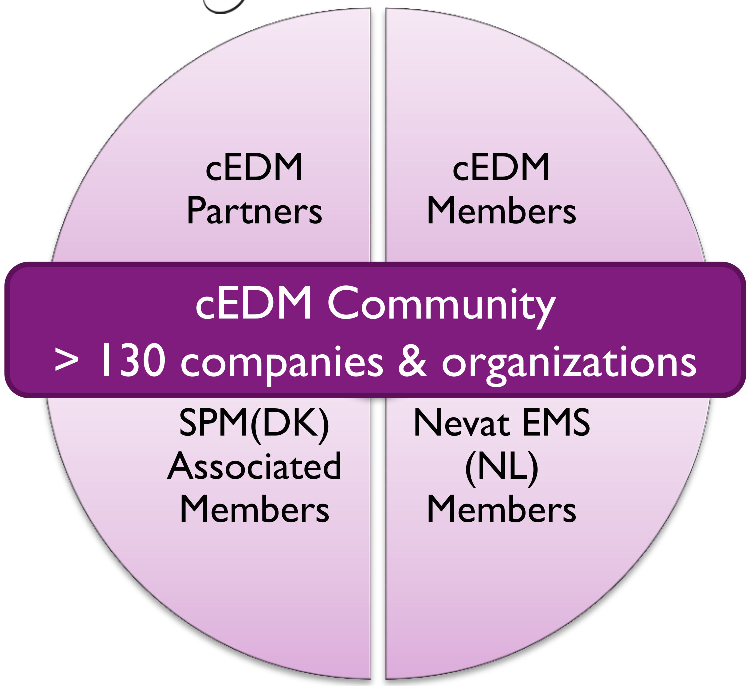
THE CEDM COMMUNITY

Industrial Sectors

- Electronics OEM
- Non-Electronics OEM
- Design
- EMS Manufacturing
- PCB manufacturing
- Component Suppliers
- Supply Chain

Founding Partners

imec sirris



QUANTIFIED ASSESSMENT OF PLC RISKS

Product Life Cycle of electronics

Development

Concept | Design | Prototyp... | ...ication

Manufacturing

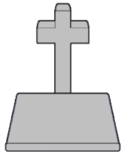
Industriali... | ...duction

U...

Operation | Maintenance

End-of-Life

Decommissioning | Reuse – Recycle – Waste



Science based Quantification

cEDM
Guidelines
&
Tools

QUANTIFIED ASSESSMENT OF PLC RISKS

Development: critical aspects

- Engineering cost
- Time-to-market

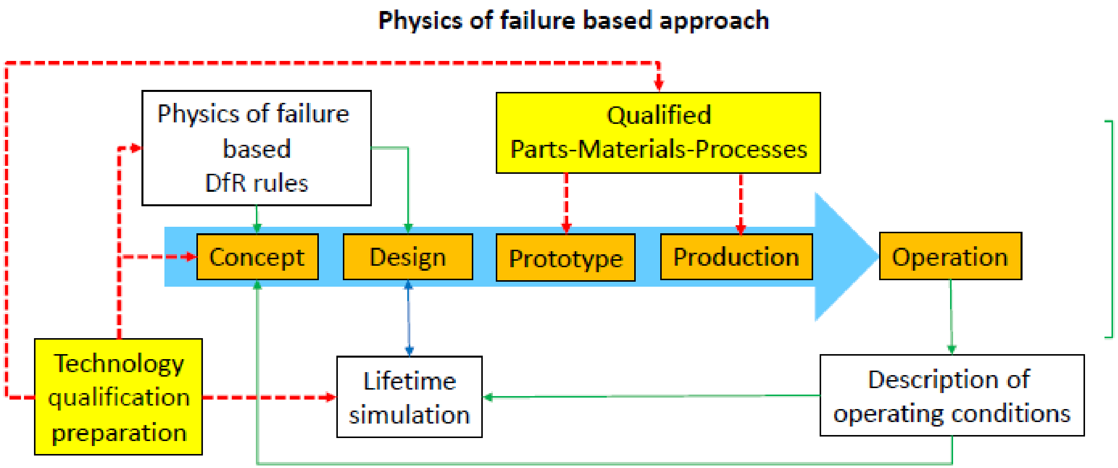
Minimize:

- Redesign
- Prototyping iterations: right first time
- Qualification failures

Maximize: PREDICTABILITY

Design-for-X guidelines & tools:

Manufacturing, test, reliability/robustness, logistics



QUANTIFIED ASSESSMENT OF PLC RISKS

Pred-X

Manufacturing: critical aspects

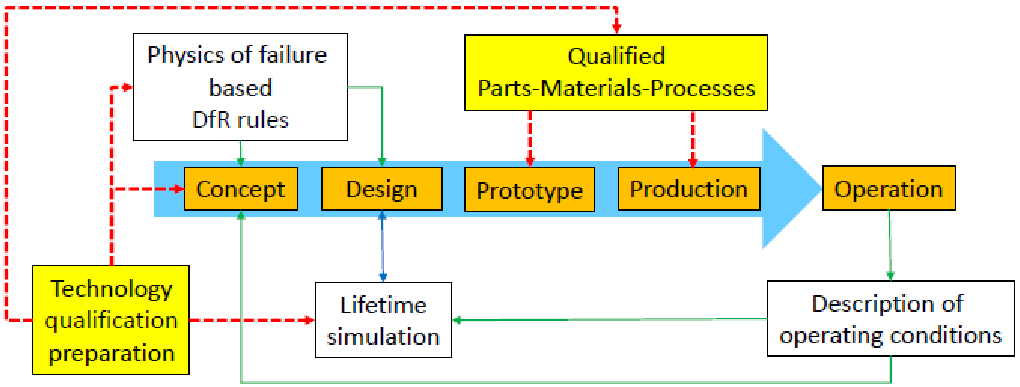
- Cost
- Volume ramp-up
- Delivery performance

Maximize yield

Minimize labour

Minimize Work-in-Progress (test & repair)

Design-for-Manufacturing, Test, Cost, Logistics,...



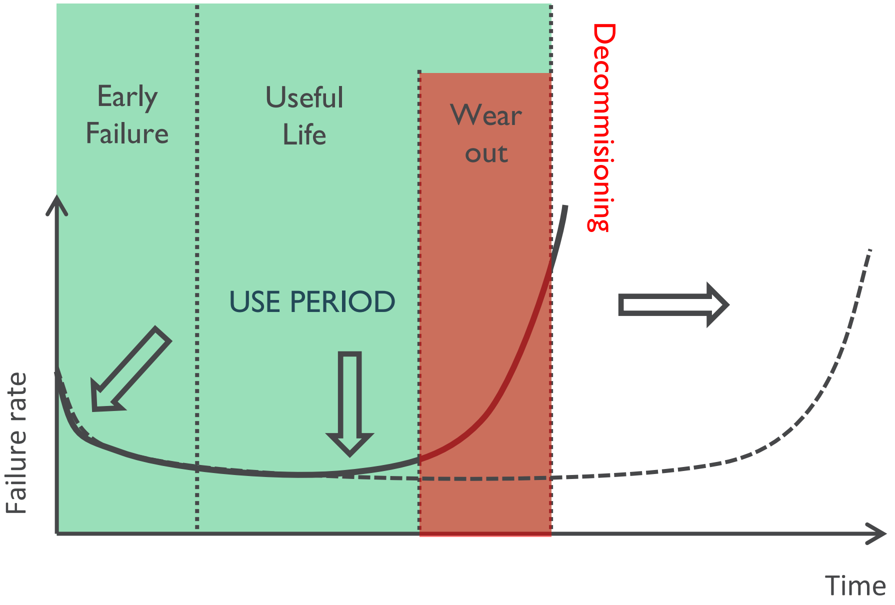
QUANTIFIED ASSESSMENT OF PLC RISKS

Use: critical aspects

- Quality
- Reliability
- Performance
- Availability
- Low maintenance cost

Design-for-Quality and Reliability

Quality and Reliability quantification



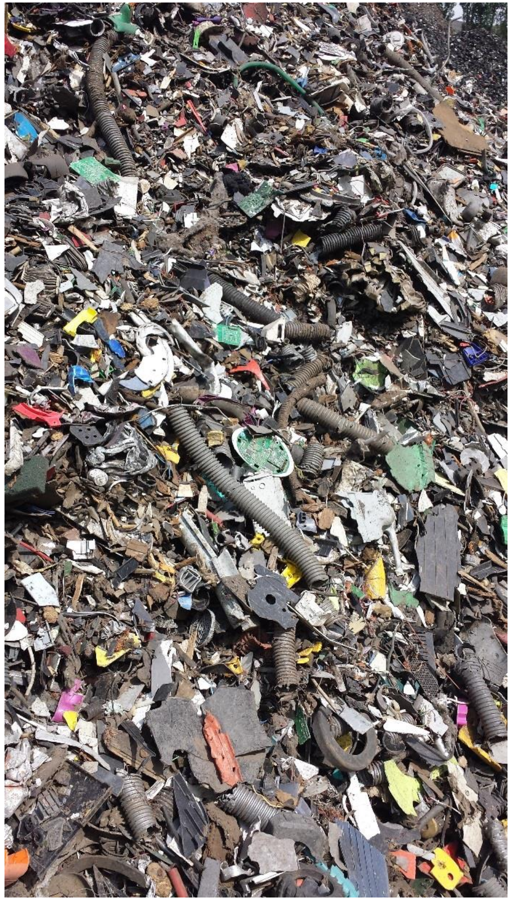
QUANTIFIED ASSESSMENT OF PLC RISKS

End-of-Life: critical aspects

- Replacement
- RoHS/WEEE
- Toxicity
- Waste treatment cost
- Recycling revenue

Design-for-RoHS/WEEE, disassembly, recycling

BOM based material identification



CEDM TOOL BOX

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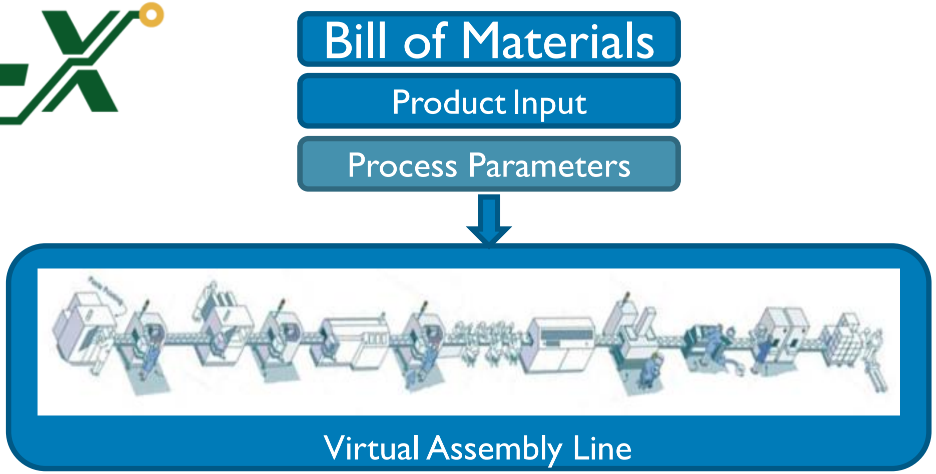
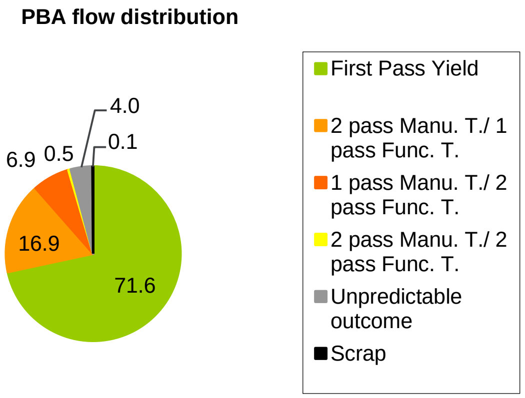
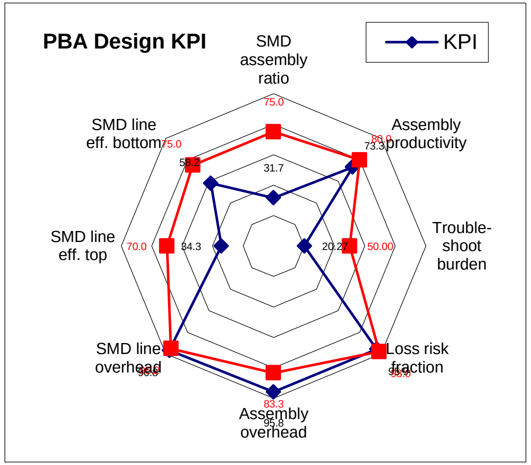
Pred-X

- Design-for-Assembly: BOM based
- Quantified Quality
  - DPMO/yield
  - Test coverage
  - Assembly flow & time
- Assembly model and DfA evaluator
  - Design impact on assembly flow and efficiency



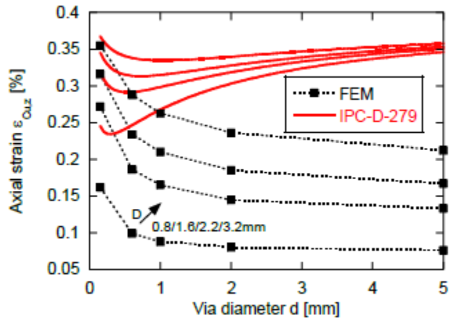


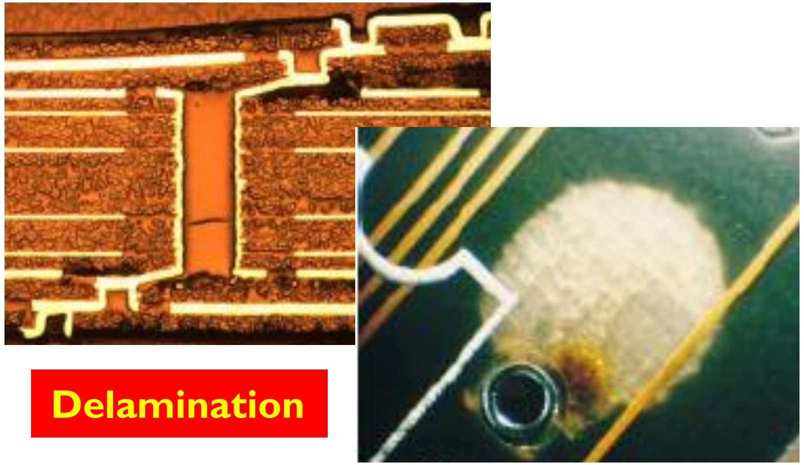


CEDM TOOL BOX

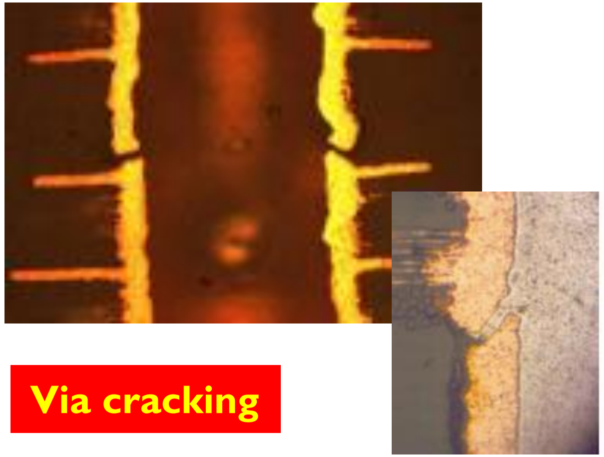
PCB laminate specification: specify FR4 type

- (Cohesive) delamination
- **Via failure: new analytical model**
- Prediction of failure probability: production & operation
- >200 laminates: ***PCB Laminate Overview*** on www.cedm.be

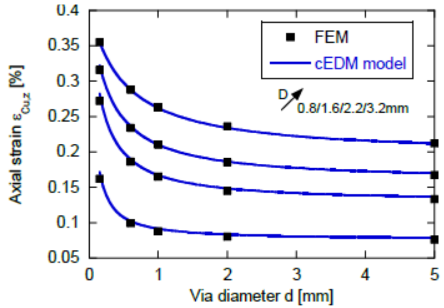




Delamination



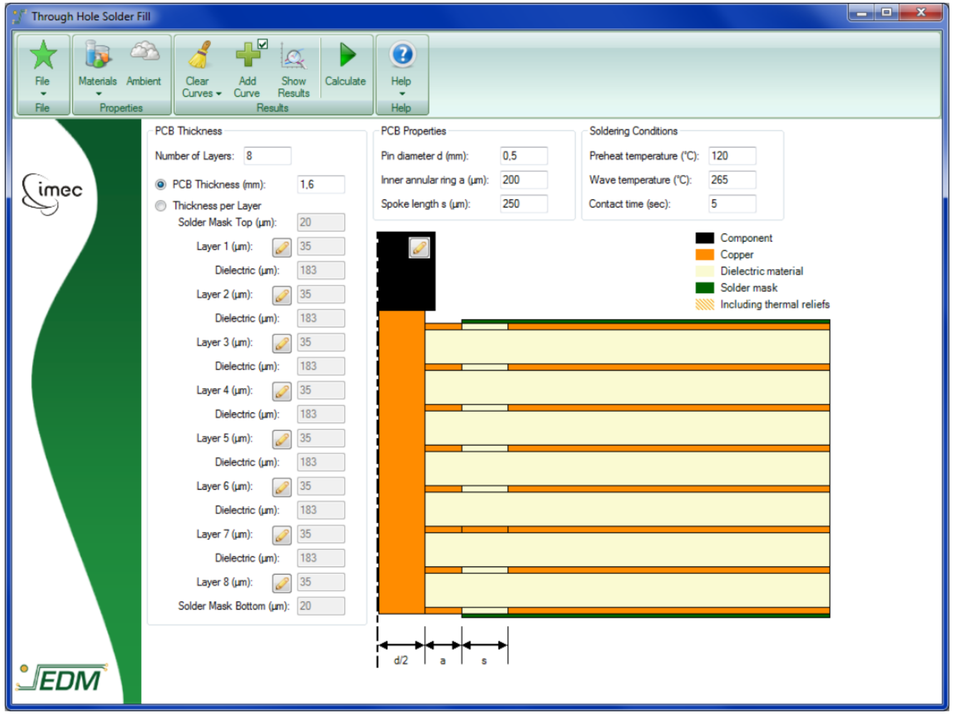
Via cracking

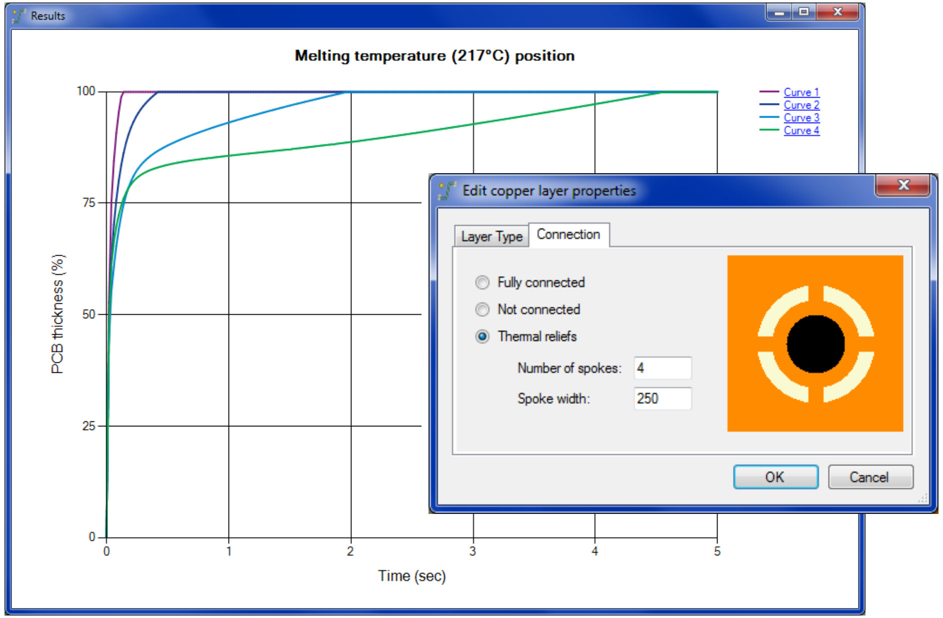


3. CEDM TOOL BOX

Assembly:
wave soldering

NEW:
% through hole fill

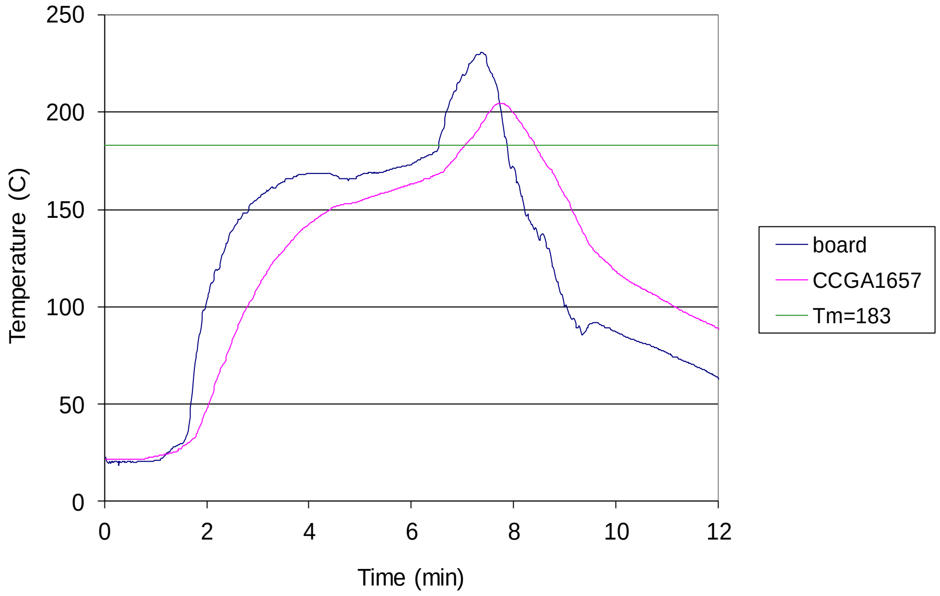


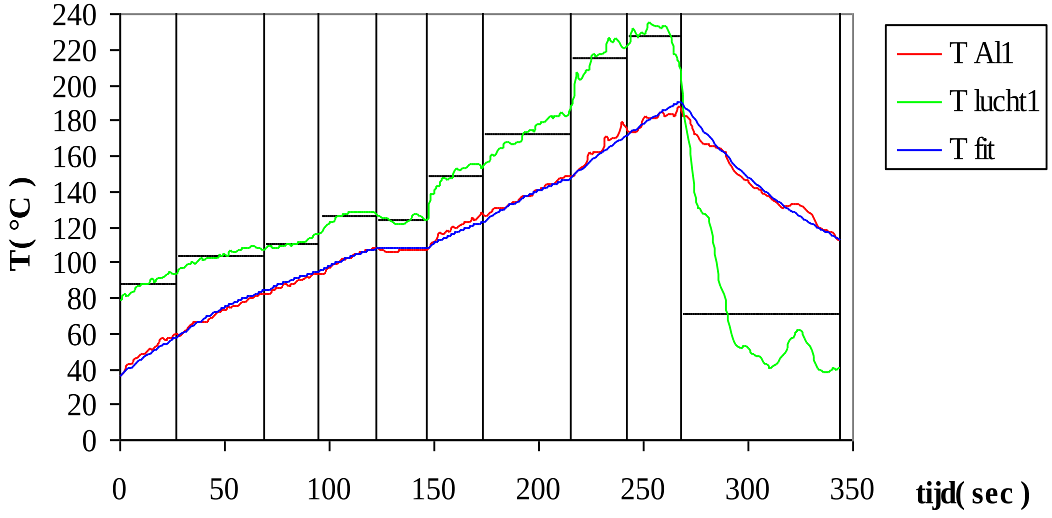


CEDM TOOL BOX

Assembly:
reflow soldering

Soon:
BOM based prediction reflow soldering temperature differences across the PBA





CEDM TOOL BOX

PCB layout:
DfA & thermal design

NEW:
Thermal via for bottom terminated SMD

CEDM TOOLBOX

Under development

PBA design:
D-f-Reliability

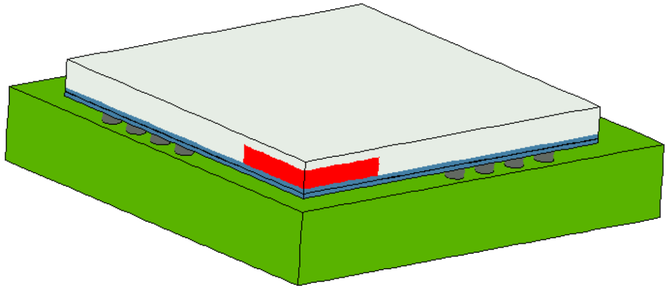
- Reliability extension to Pred-X
- Analytical solder joint lifetime model
  - 2 & 3D models for assemblies with flexible component on flexible substrates calculating forces and moments on solder joints
  - PCB and package flexibility taken into account

To replace IPC-D-279's:

The cyclic fatigue damage term for leadless SM solder attachments, for which the stresses in the solder joints exceed the solder yield strength and cause plastic yielding of the solder, is

$$\Delta D(\text{leadless}) = \left[\frac{F L_D \, \Delta(\alpha \Delta T)}{h}\right]$$

[Eq. A-3]



CEDM TOOL BOX

PBA design:
D-f-Reliability

Guidelines | Tools | Calculators | Projects | Agenda | Library | Membership | RoHS Service

TOOLS

- IPC Standards Guide
- PCB Laminate Overview
- NPI Questionnaire
- PBA Checklist
- BOM DfM Checklist
- Failure Risk Assessment FMEA
- IPC Class 2 vs IPC Class 3 - Assembly View

Enter your keywords

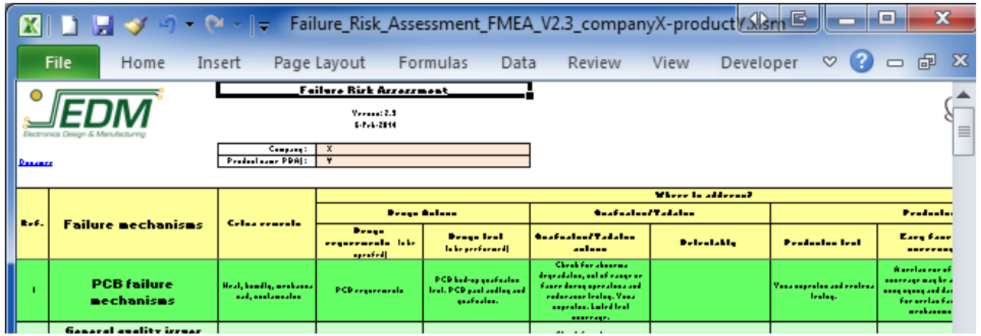
Search

Failure Risk Assessment FMEA

The PBA Failure Risk Assessment FMEA provides a comprehensive overview of potential Printed Board Assembly quality and reliability issues together with the major risk factors. Where and how to address these issues in the product development cycle is indicated. This tool can be used as a pro-active FMEA tool in PBA development. FMEA: Failure Mode and Effects Analysis

Failure Risk Assessment (Members / Partners only)
Version 2.3
Revision date 6-feb-2013

More information on membership / partnership



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Through Hole Solder Fill Calculator
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New guideline
Signal Integrity
More

New calculator
Thermal Via Design Calculator
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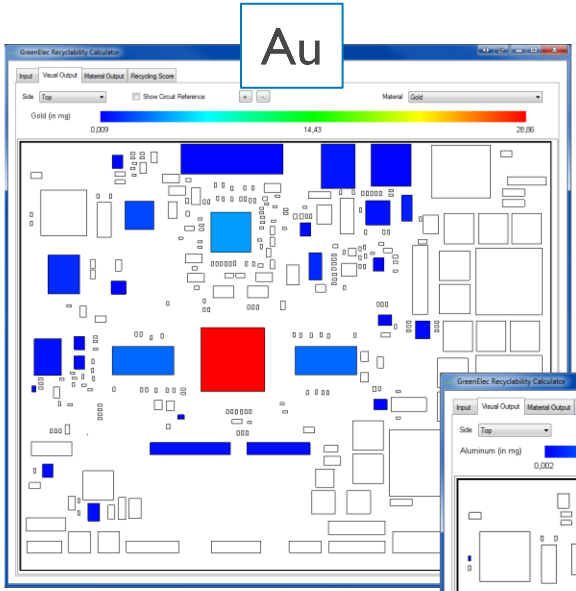
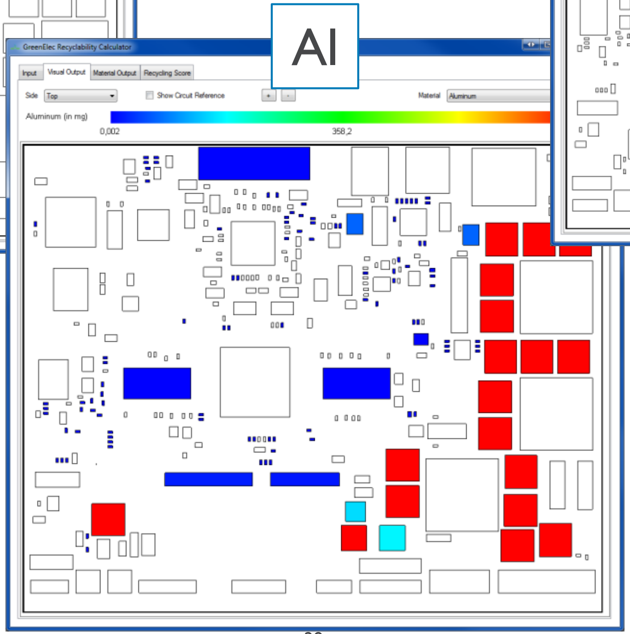
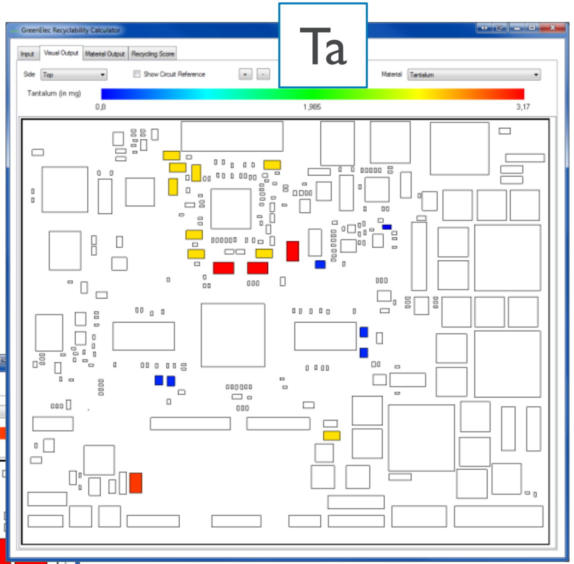


BOM based identification of materials





PBA design:
Green Design
D-f-Environment
D-f-Recycling

PBA certification:
Material declaration
RoHS – Reach
Conflict materials

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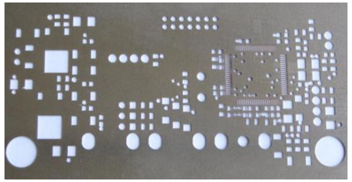
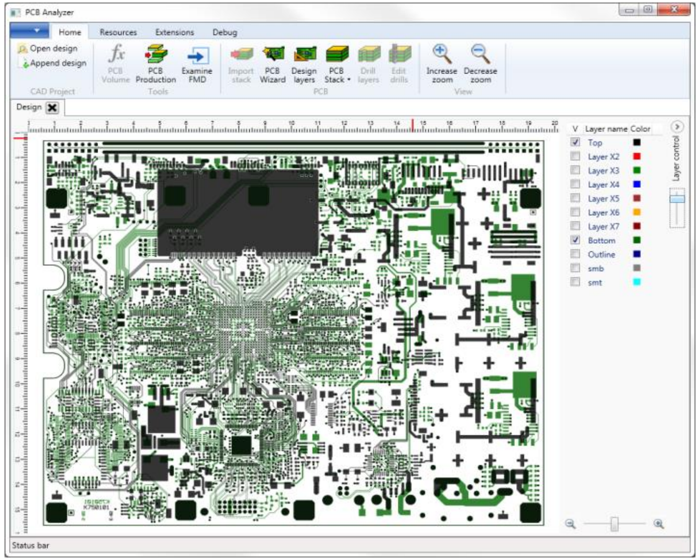
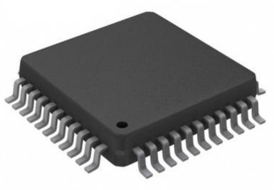
Full Material Declaration
Material Composition Models

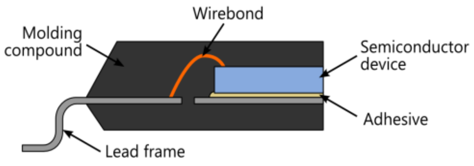
Solder: pad & stencil data

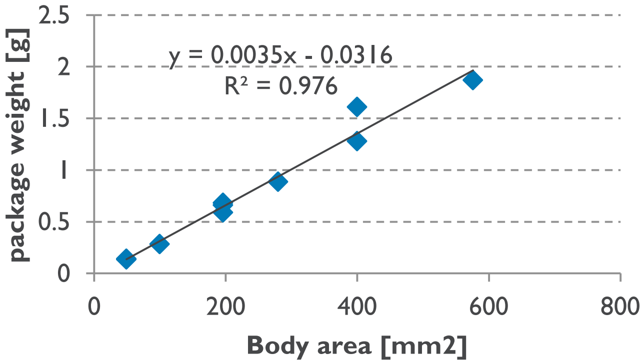




Component







Estimate material content based on the physical characteristics and build-up

PCB

8 LAYER STACKUP
Basic material

	PLATING	17 um
Cu_top	COPPER	18 um
	PREPREG	2x63 um
Cu_lay2	COPPER	35 um
	INNER	300 um
Cu_lay3	COPPER	35 um
	PREPREG	2x63 um
Cu_lay4	COPPER	35 um
	INNER	300 um
Cu_lay5	COPPER	35 um
	PREPREG	2x63 um
Cu_lay6	COPPER	35 um
	INNER	300 um
Cu_lay7	COPPER	35 um
	PREPREG	2x63 um
Cu_bot	COPPER	18 um
	PLATING	17 um
	TOTAL	1684 um

FUNDED PROJECTS

Cooperative projects

IWT O&O Rev-Up

- Reliability testing
- Physics-of-Failure based
- Interconnection
- Surface Insulation Resistance
- "health monitoring"

ICON Compact

- Physics-of-Failure based reliability modeling
- Interconnection
- Selected components
- Time-dependent failure in product development.

Collective project

Start: 1/10/2015

VIS-traject InProVoL

- DfR Guidelines
- DfR Tools
- Industrial implementation
- Consultancy

You can join the consortium and get early access to the results!

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THANK YOU

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