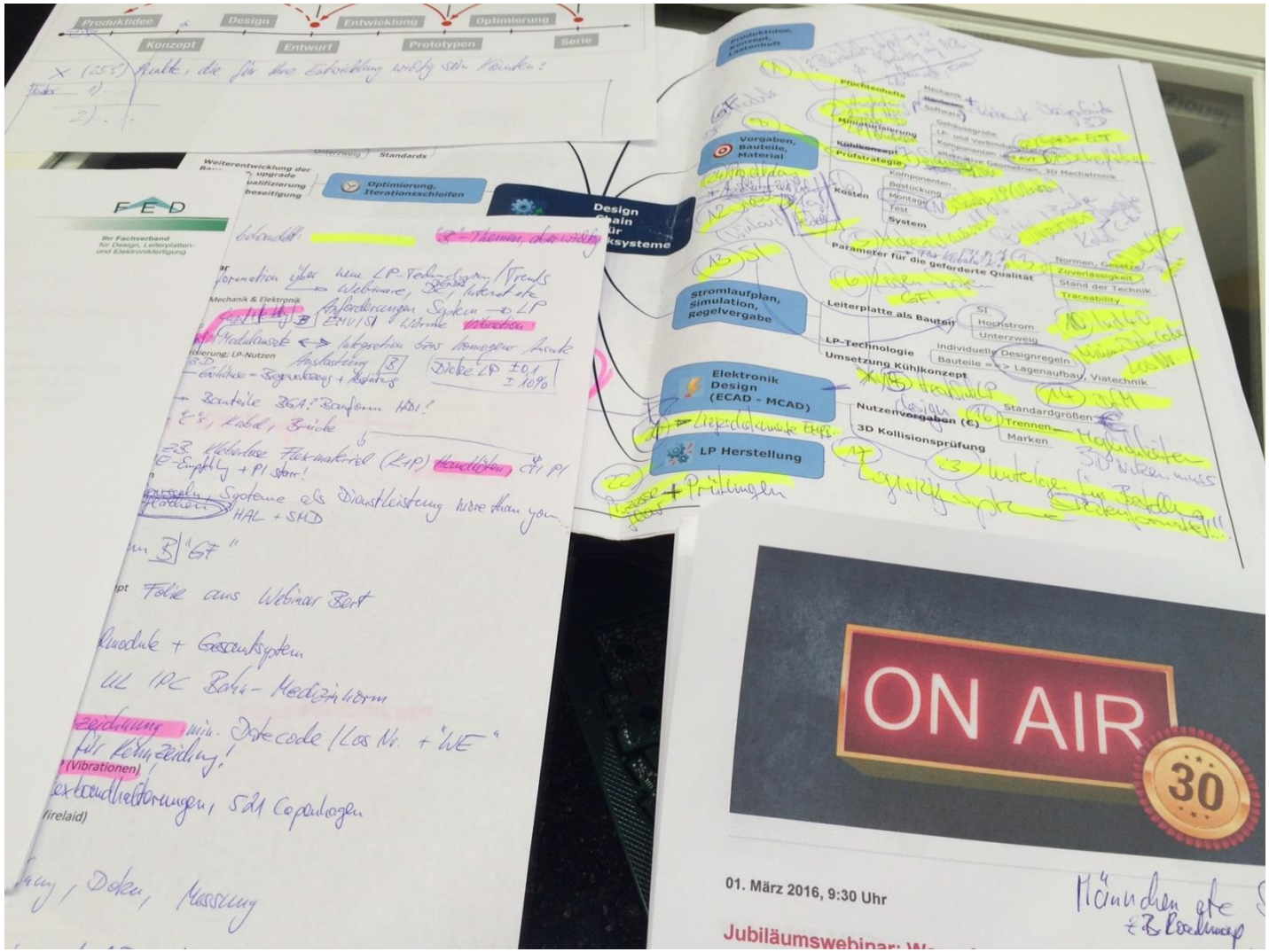
Anniversary webinar: what counts

Webinar March 01, 2016, 11:00 a.m. CET

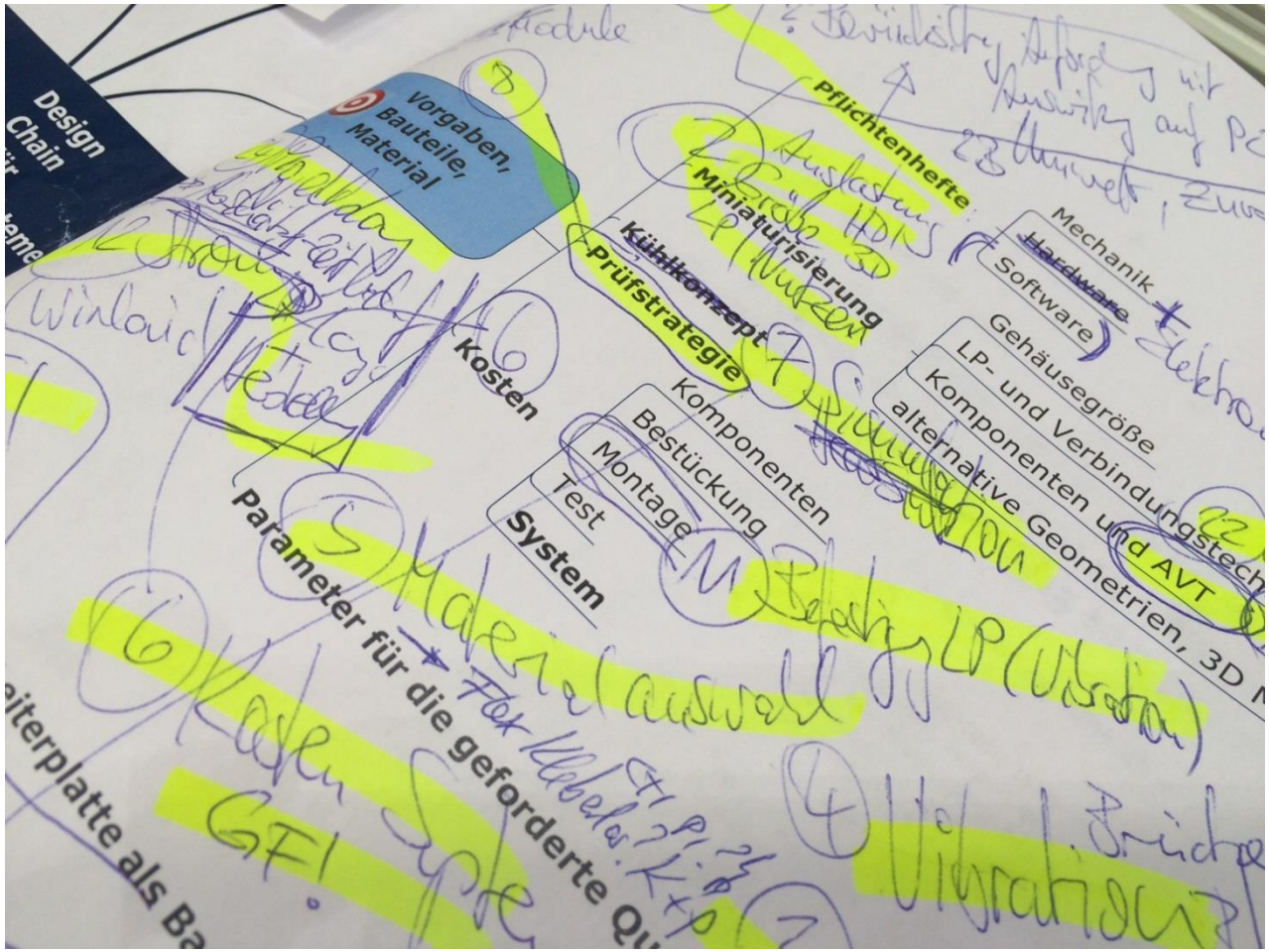
Speaker: Andreas Schilpp

Approach to the topic



Approach to the topic

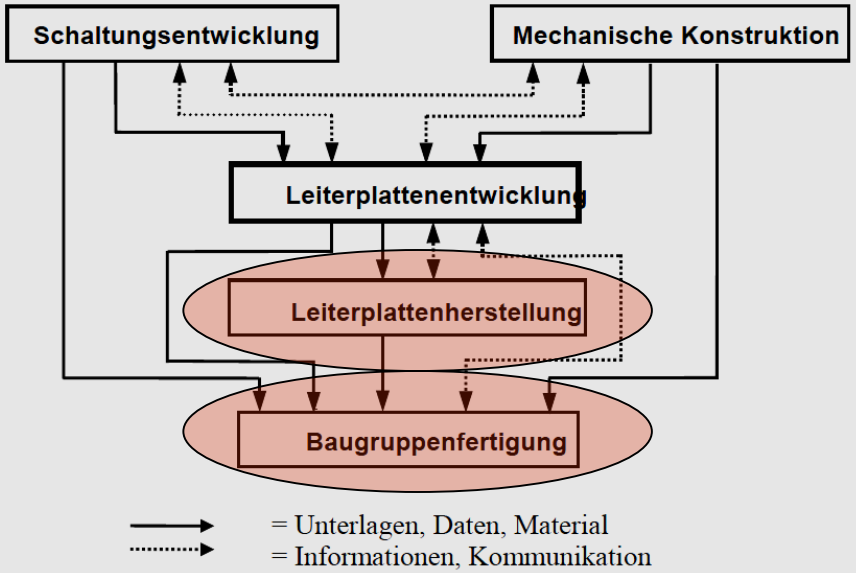
- value chain
- PCP product creation process
- Design Chain



Approach to the topic

3. Kommunikations- und Informationswege

Rechtzeitige Informationen sind Voraussetzungen für einen funktionierenden PKP. Dies setzt störungsfreie Kommunikationswege voraus. Die Leiterplattenentwicklung befindet sich mittendrin: sie bildet die Brücke zwischen Entwicklung und Fertigung:



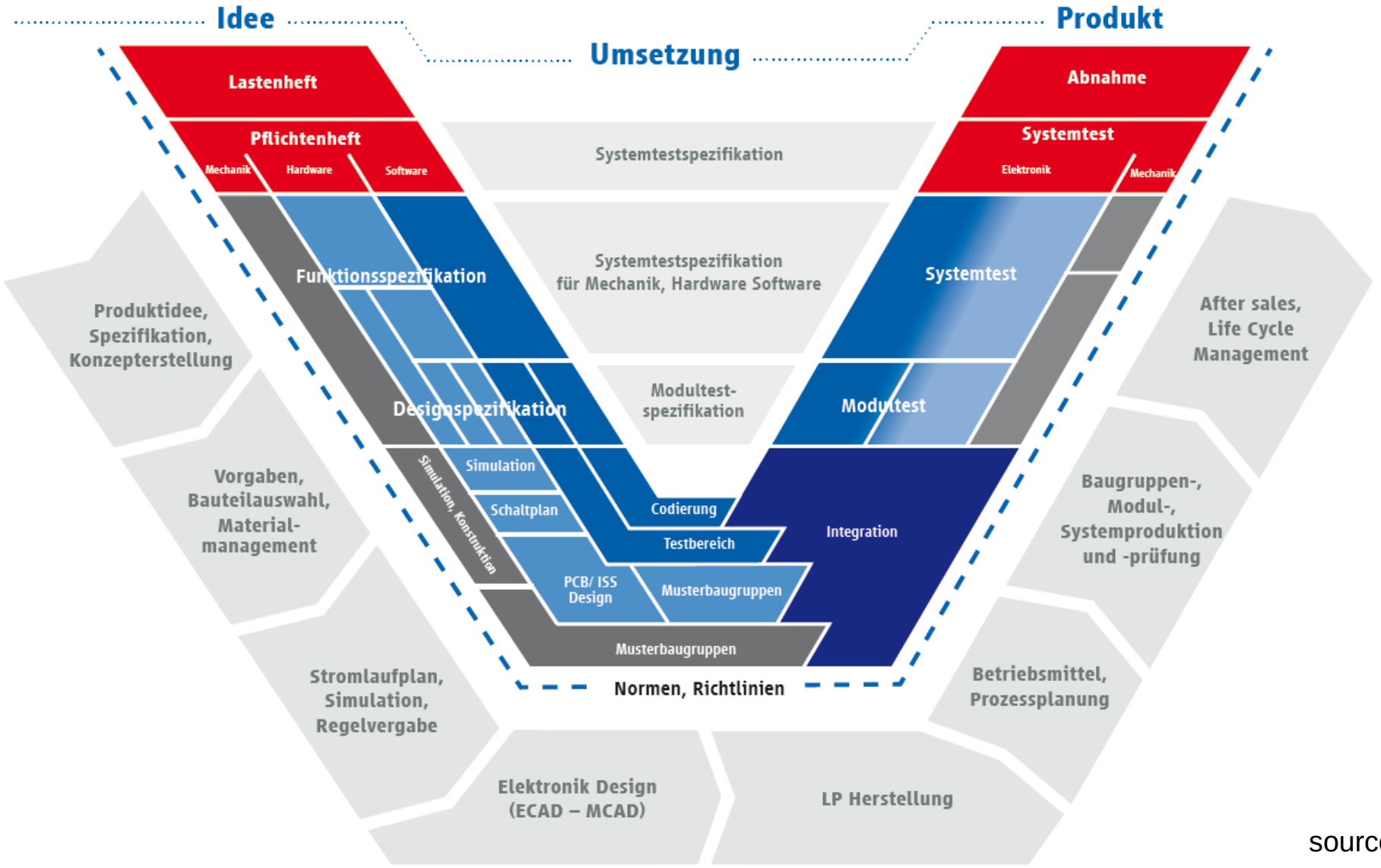
FED

Ihr Fachverband
für Design, Leiterplatten- und Elektronikfertigung

FED-22-02A

FED-Designrichtlinie

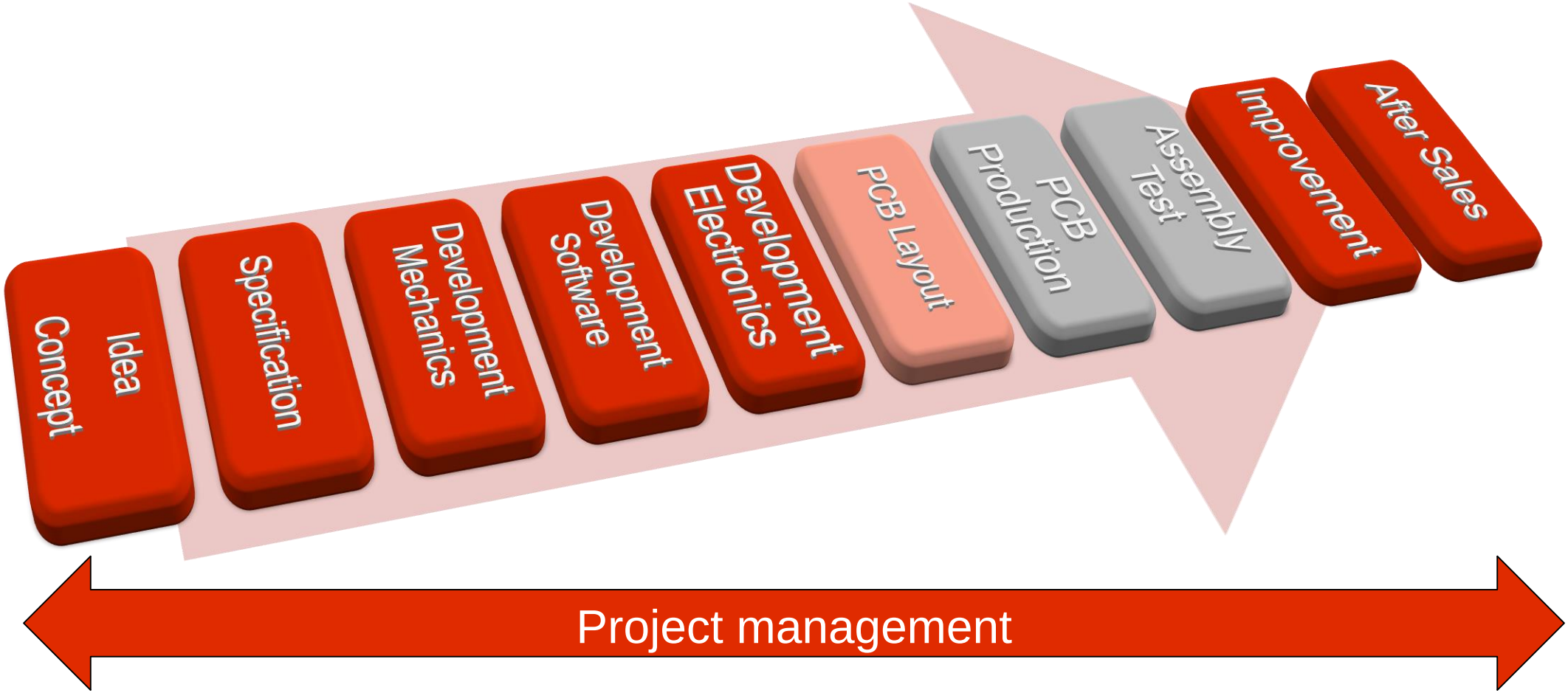
Design Chain of the development of electronic equipment



source: ZVEI

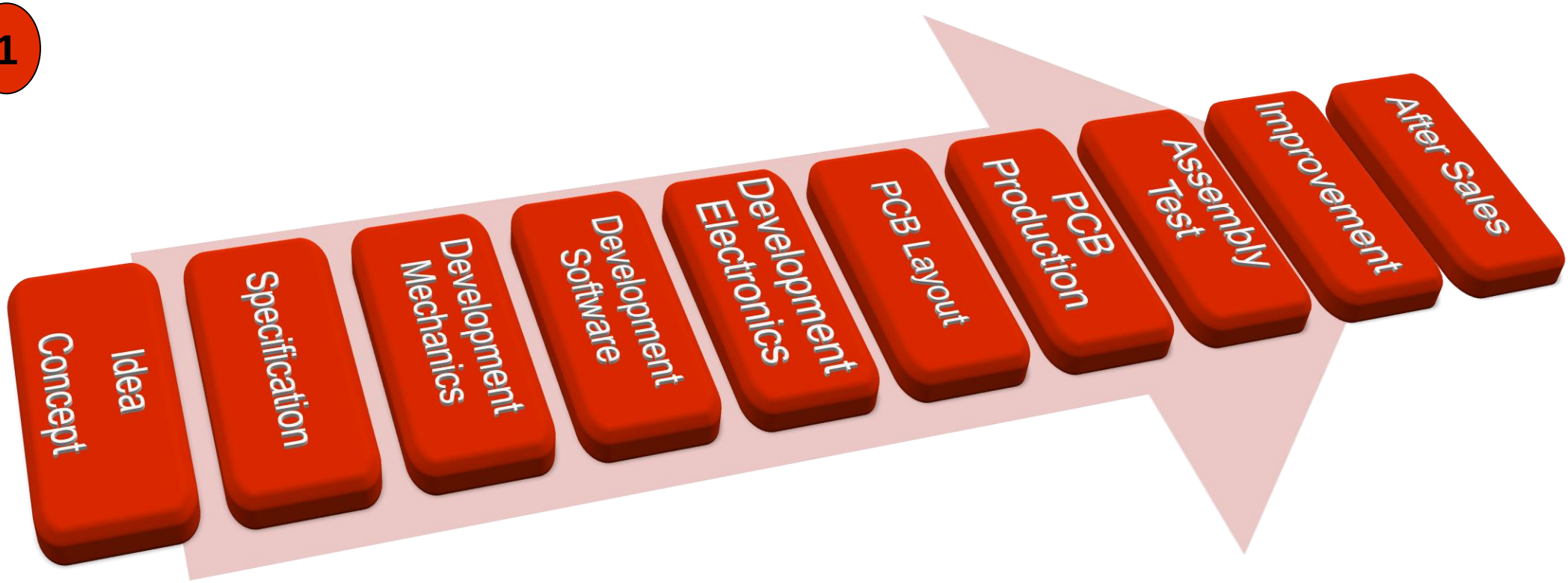
Design Chain of the development of electronic equipment

Design Chain of the development of electronic equipment



24 points which might be important for your succes

1



1

Ongoing Information Aquisition and Training about Technologies, Components, Tools etc.

Fairs, Webinars, Design Conferences, Design Guides, technical articles, Internet

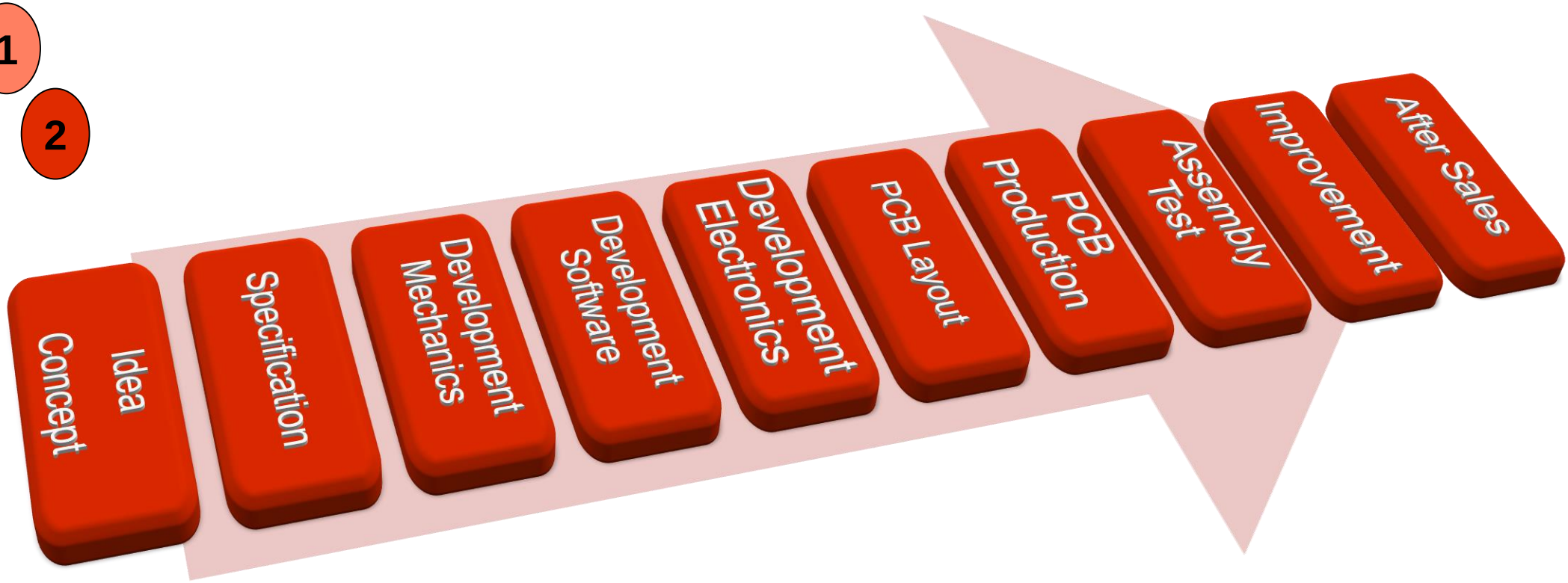
24 points which might be important for your succes

- **Information source Designguides**

24 points which might be important for your succes

1

2



2

Product idea, Concept and Technology Choice

Target market, ramp-up

Modular Approach←→Integrated Approach

Availability, 2nd source

Modular Approach ⇔ Integrated Approach

Power Board
102 mm x 95mm
8 Layer standard FR4
Current Cost ~ £17

Connector Board
102 mm x 104mm
10 layer standard FR4
Controlled impedance
Current Cost ~ £25

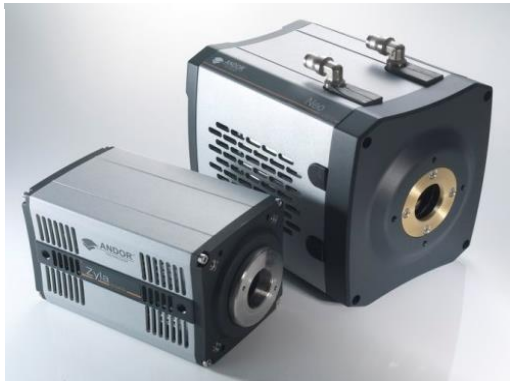
FPGA Board
102 mm x 110mm
16 High Tg FR4
Controlled impedance
Current Cost ~ £43

Sensor Board
90 mm x 95mm
10 layer standard FR4
Controlled impedance
Current Cost ~ £25

PWR/Connector Board
102 mm x 104mm
16 layer high Tg FR4
Controlled impedance

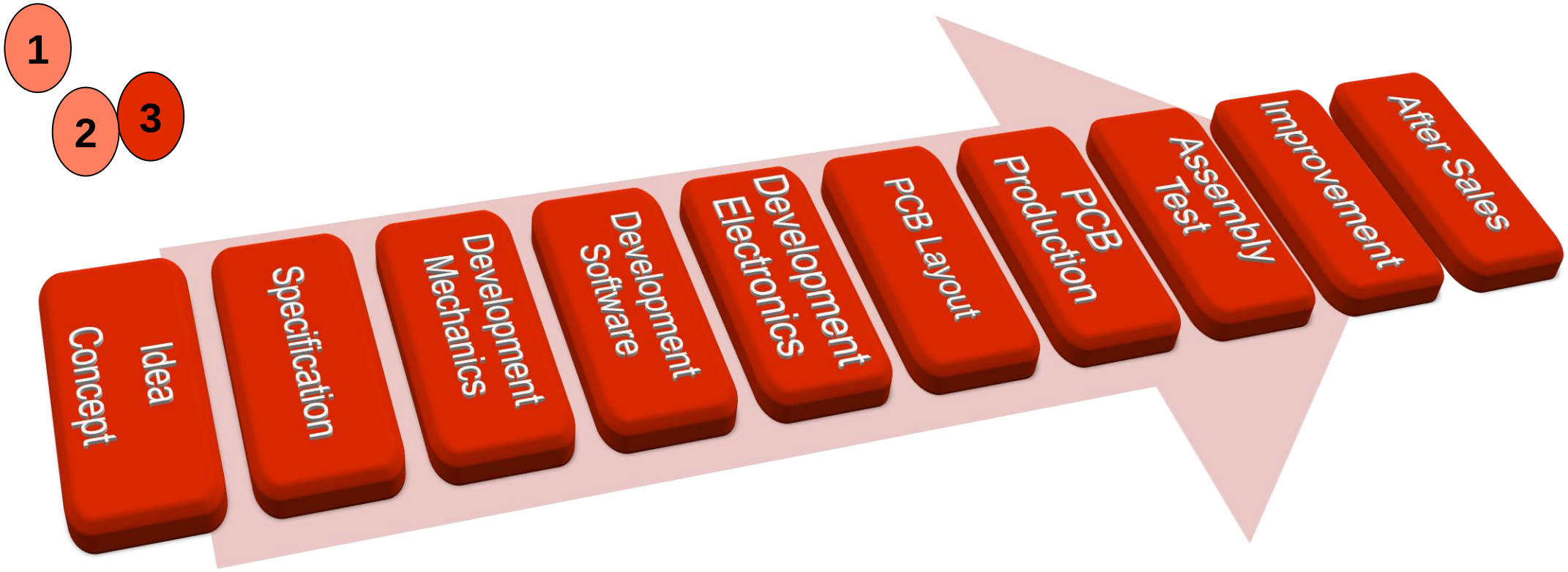
FPGA Board
102 mm x 110mm
16 Layer high Tg FR4
Controlled impedance

PWR/Connector Board
90 mm x 95mm
16 layer high Tg FR4
Controlled impedance



Added flex interconnect
4 layers, signal,GND,signal,POWER

24 points which might be important for your succes

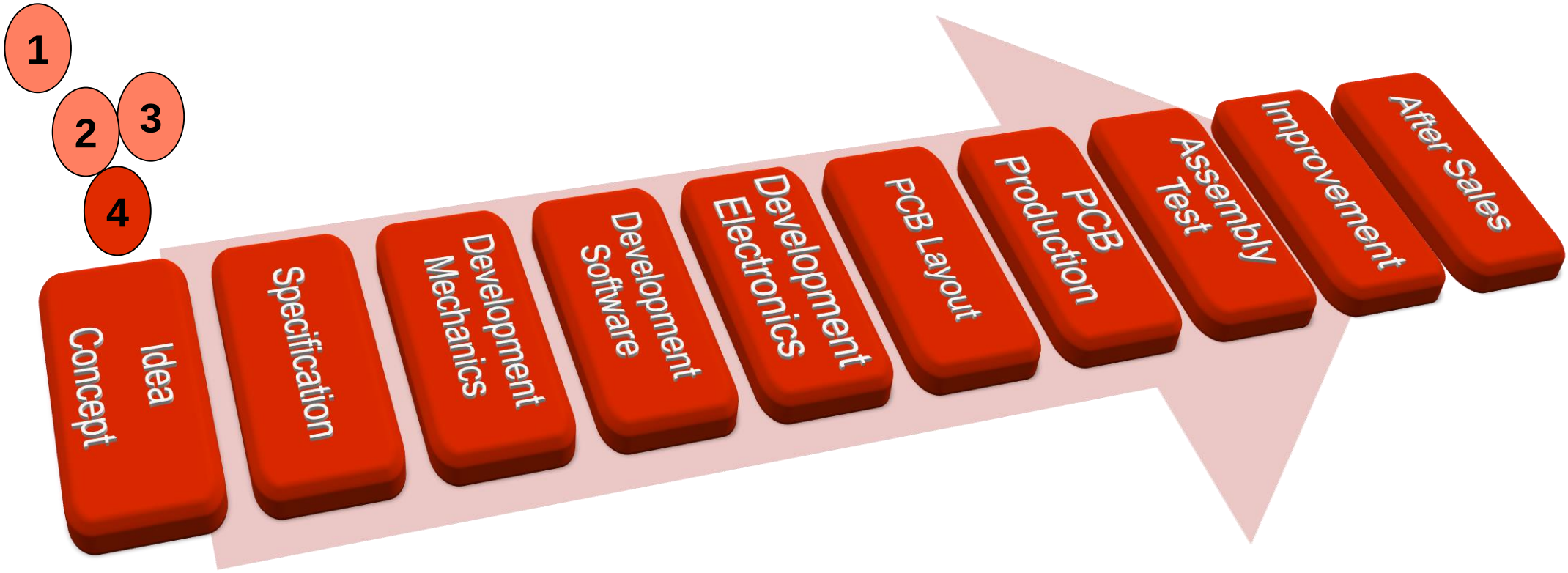


3

Functional Specifications for Mechanics & Elektronics & Software, Size

Requirements for the PCB derived from the System
Start-up may be only „DIN-A4 page“ ➔ high risk of late engineering changes!

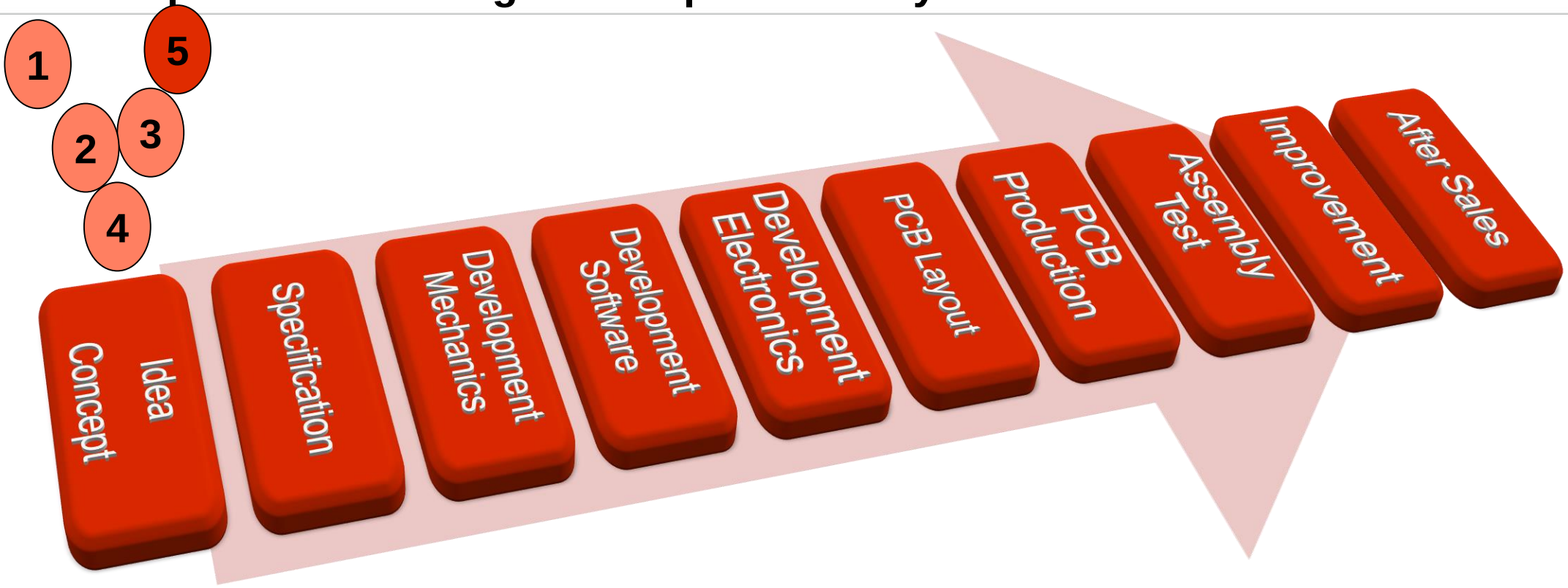
24 points which might be important for your succes



4 Standards und Legal Regulations

Impact from the System onto the PCB

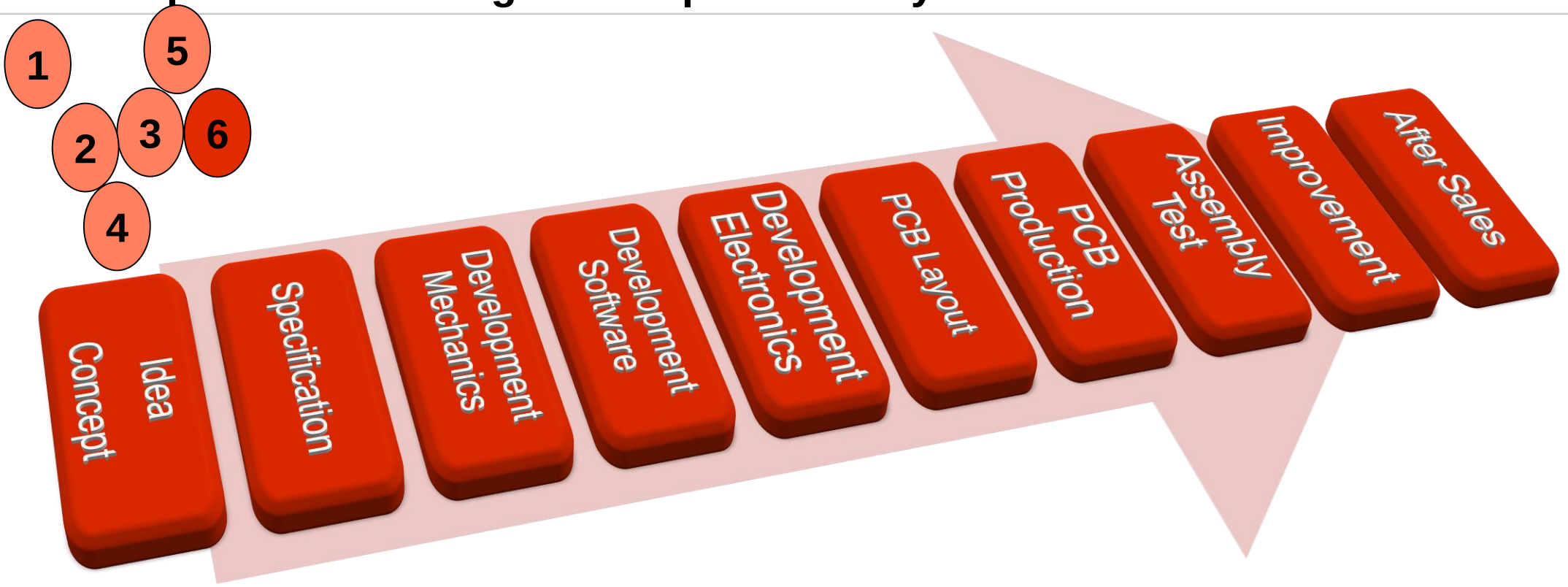
24 points which might be important for your succes



5 **Mission profile, Reliability Requirements, Life Span**

Impact on Components and PCB

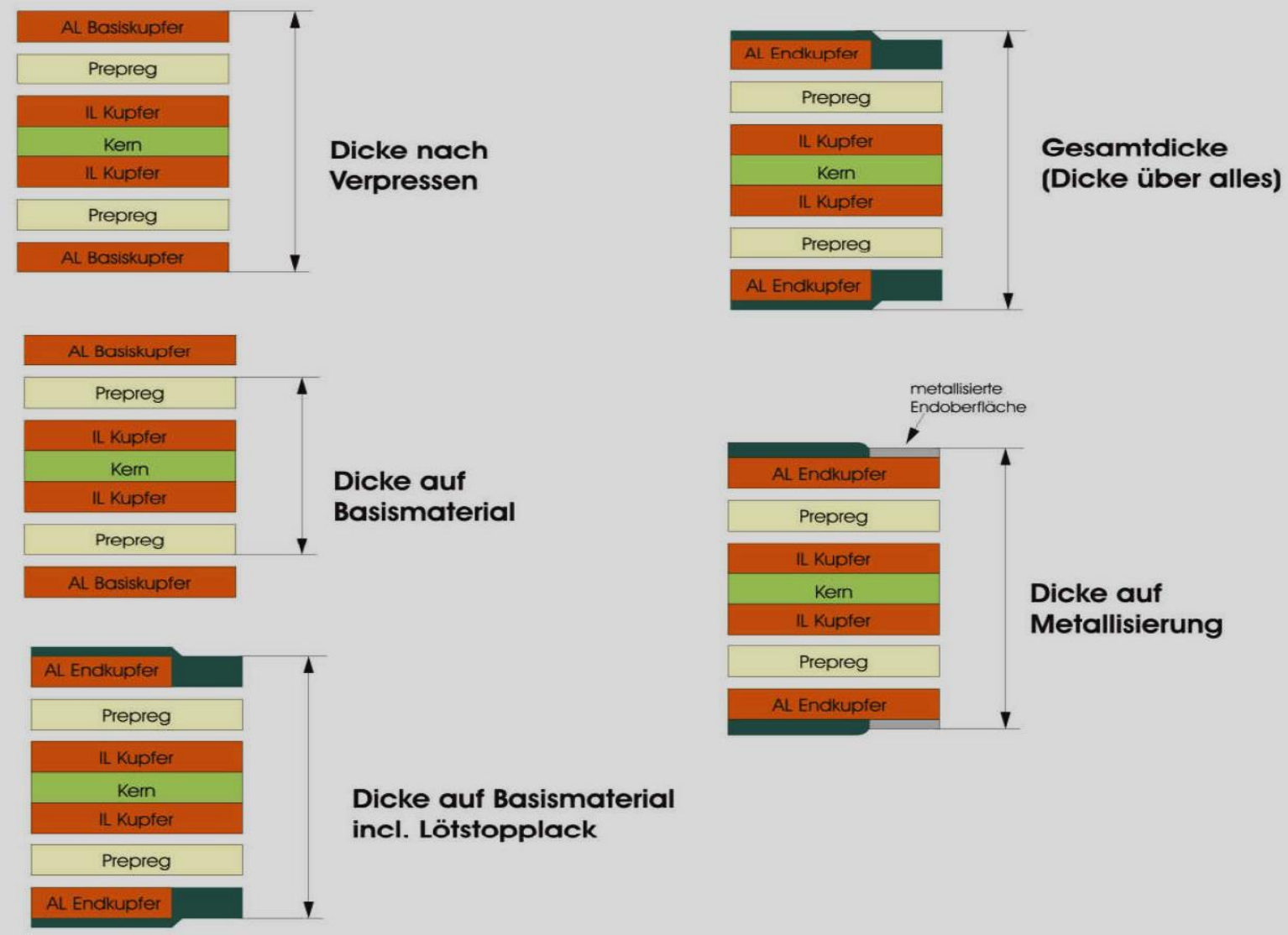
24 points which might be important for your succes



6 Design specifikation, Mechatronics und Miniaturisation

Thickness of the PCB – Definitions and Tolerances
Approach for Miniaturisation of the PCB

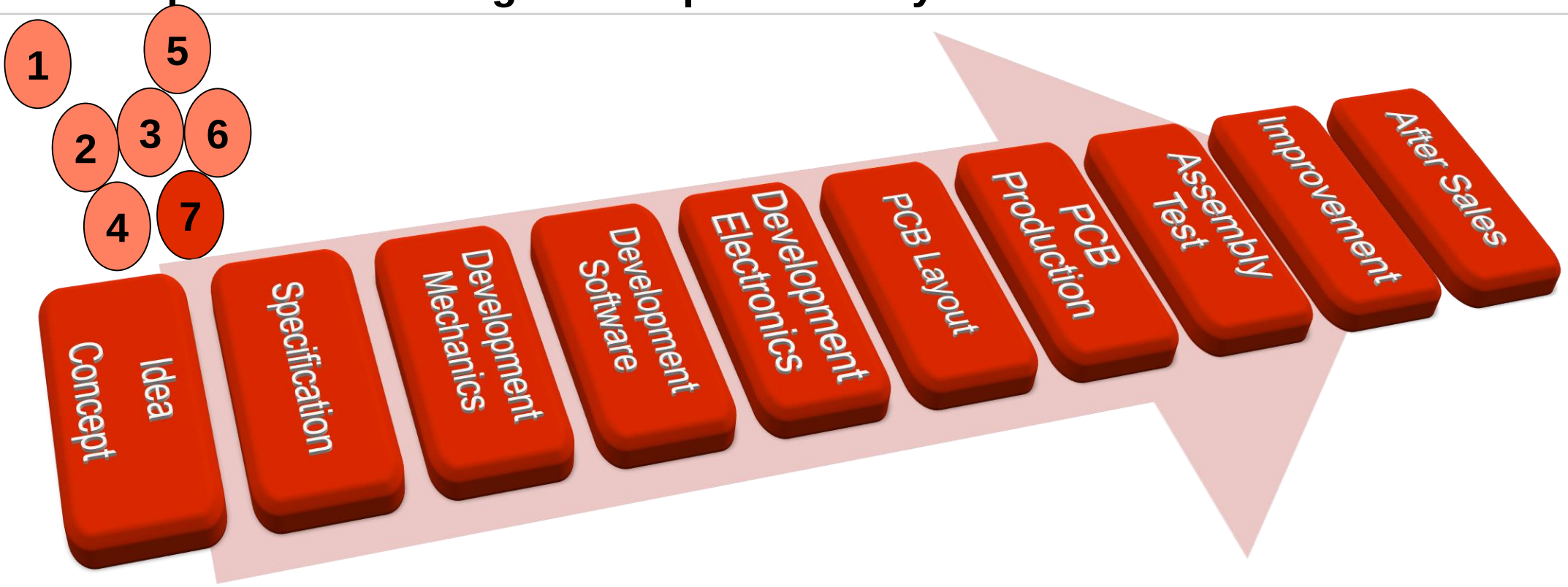
different Definitions of PCB thicknesses



Tolerances:

typical ±10% after Lamination

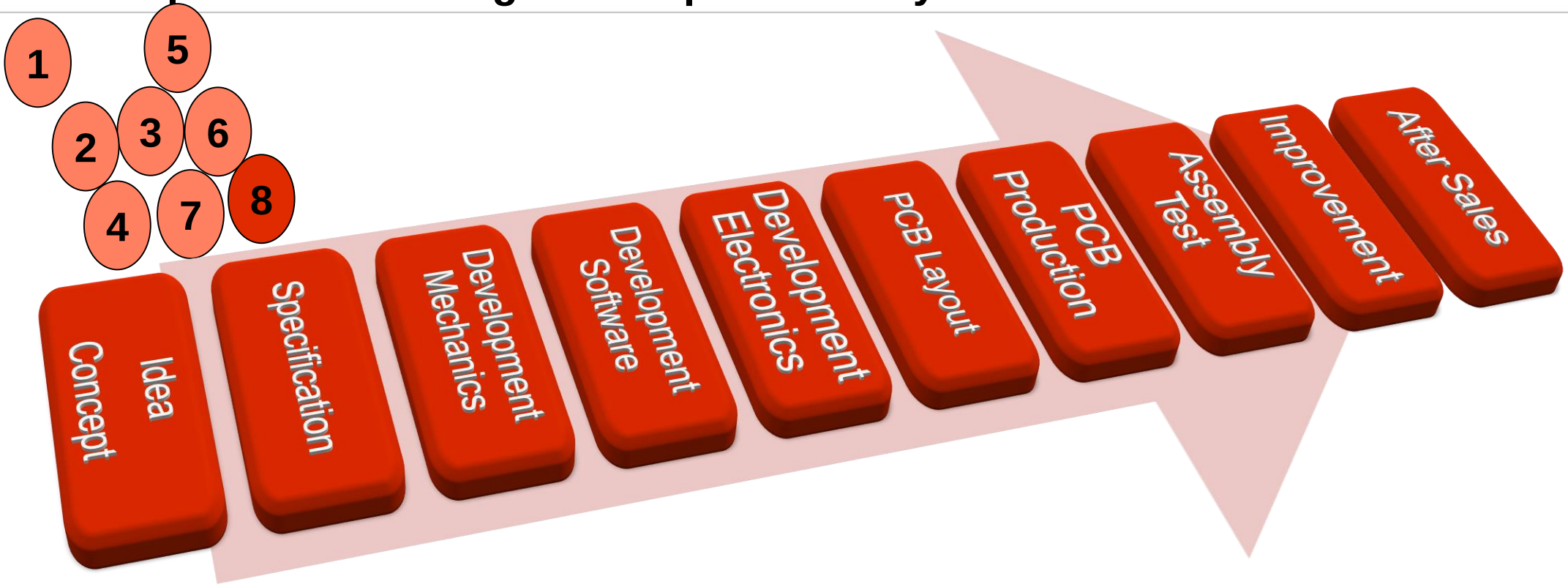
24 points which might be important for your succes



7 Project plan

Estimation of needed Time for Layout and Production of the PCB bare board

24 points which might be important for your succes



8 Mechanics, Assembly and Fastening of the PCB, Shock and Vibration

Options of Fixation

Mechanics: Fastening of a PCB – Shock and Vibration

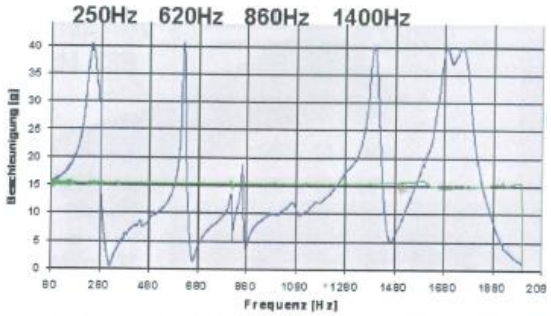
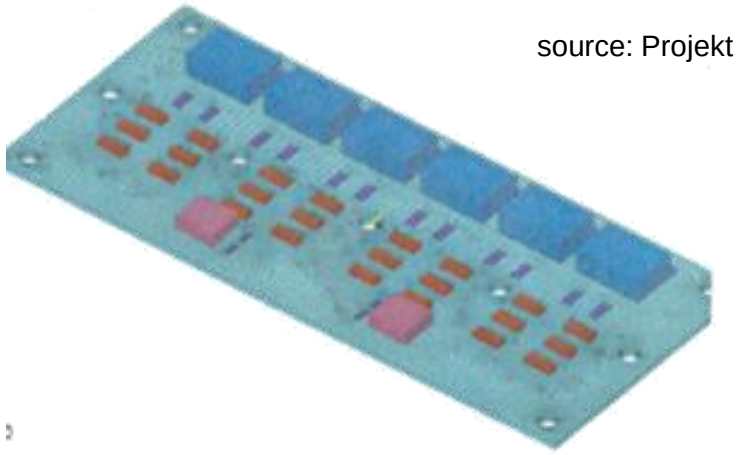


Abbildung 12-15: Experimentell bestimmte Eigenfrequenzen und Modell der simulierten Baugruppe

source: Projekt Hotel



In einer ersten Berechnung wurden die Bedingungen für eine Befestigung der Baugruppe mit nur vier Schrauben analysiert. Abbildung 12-16 zeigt die berechneten Schwingungsformen für die vier ermittelten Eigenfrequenzen.

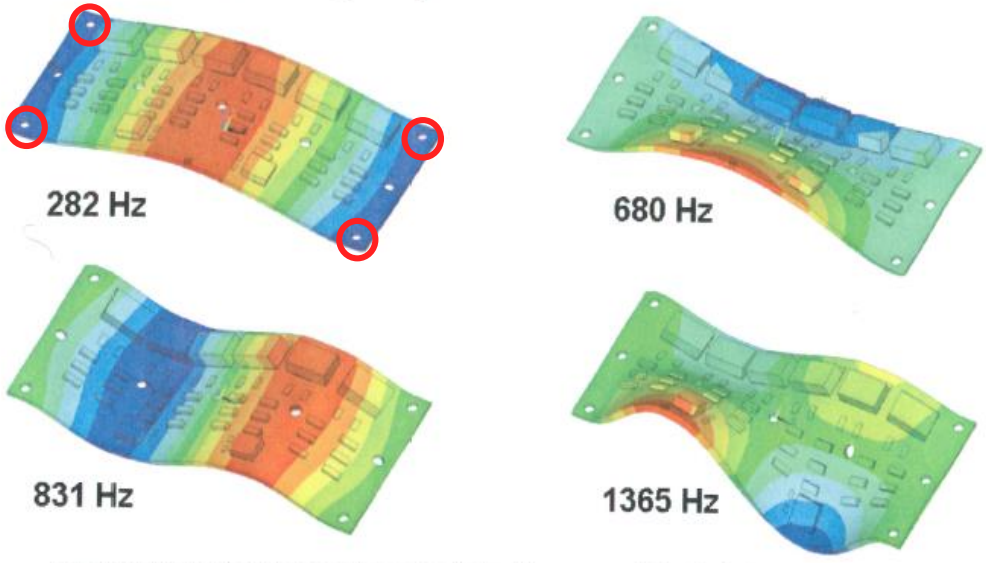


Abbildung 12-16: Eigenfrequenzen der simulierten Baugruppe mit vier Befestigungsschrauben

Fixing with 9 screws:

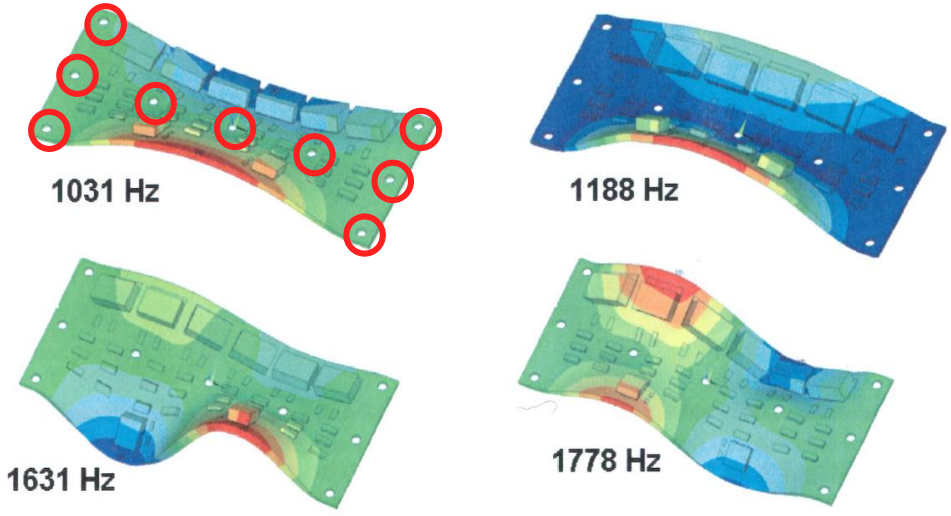
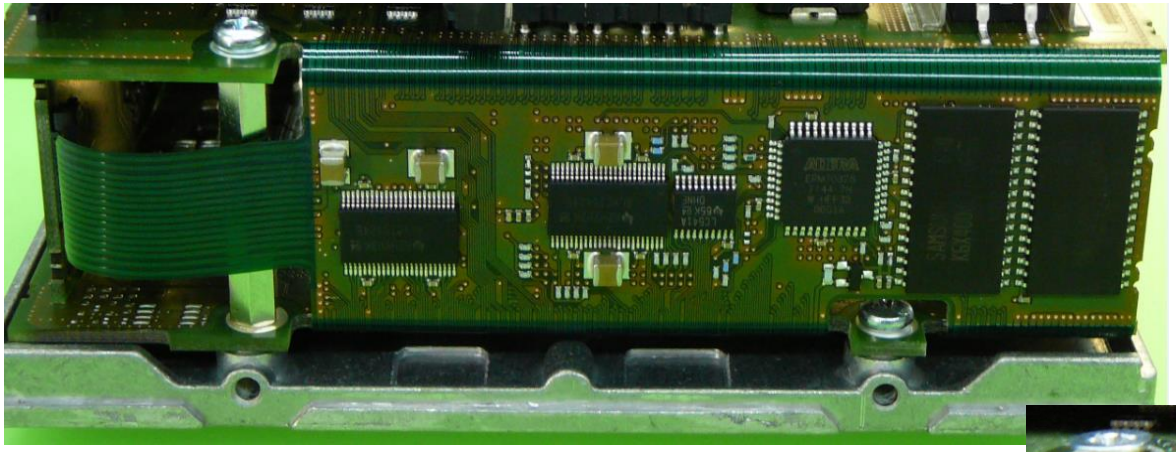
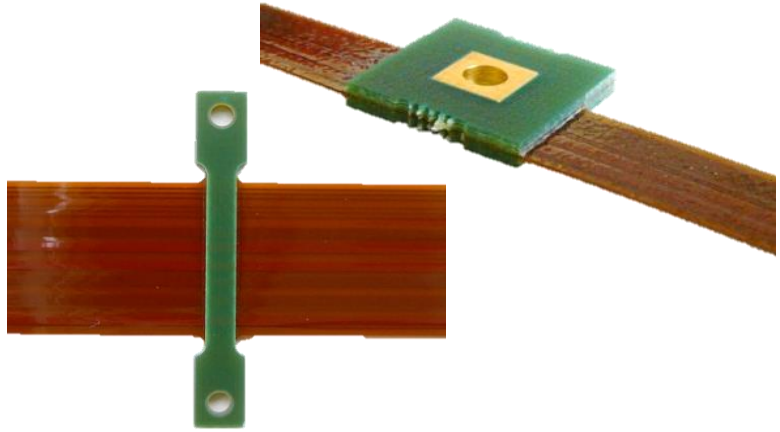


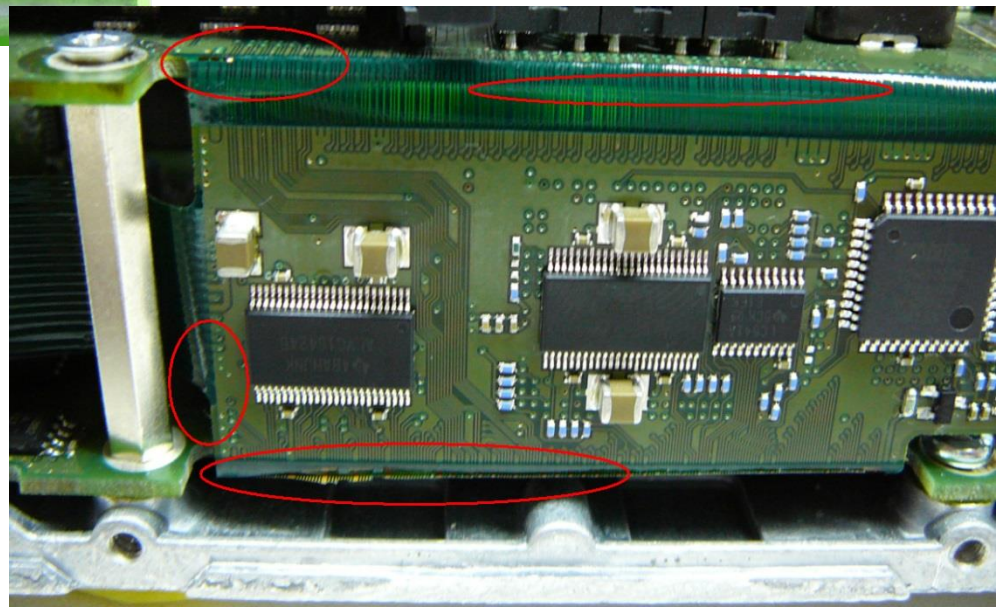
Abbildung 12-18: Berechnung der Eigenfrequenzen der simulierten Baugruppe mit neun Befestigungsschrau-

Mechanics: Fastening of a PCB – Shock and Vibration

NO fixation of one rigid area

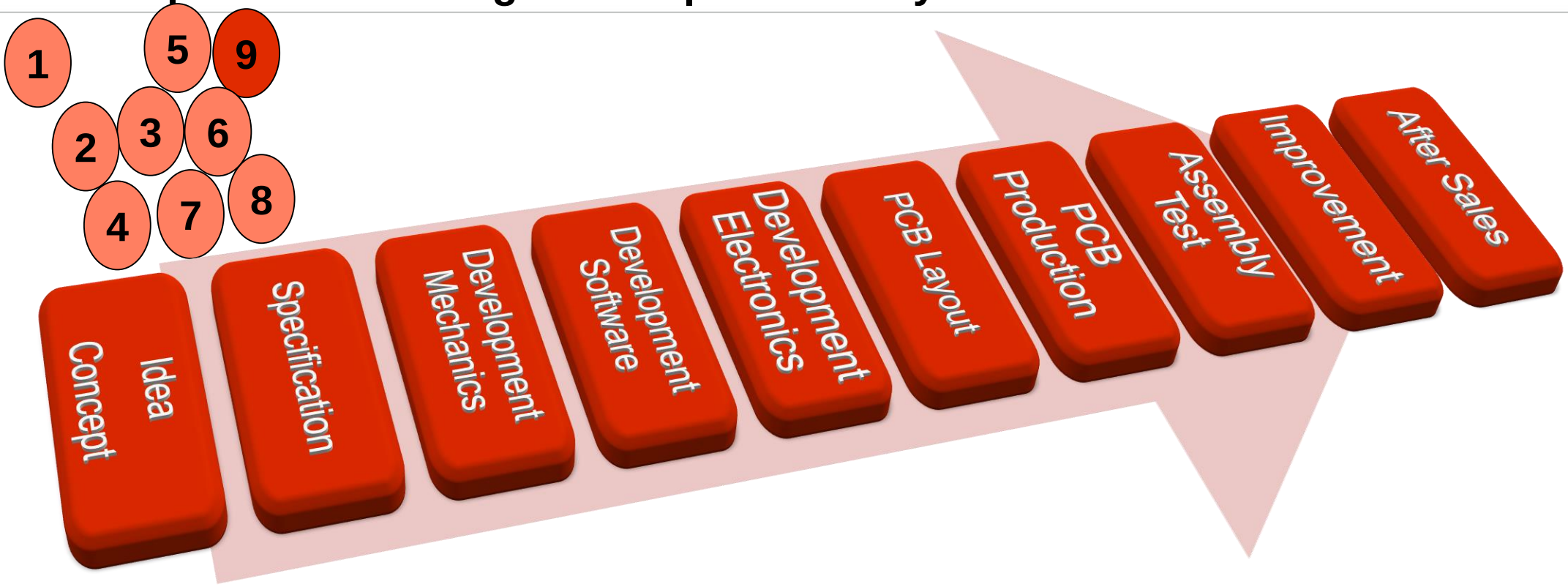






… leads to resonance and destruction even with Rigid-Flex!

24 points which might be important for your succes

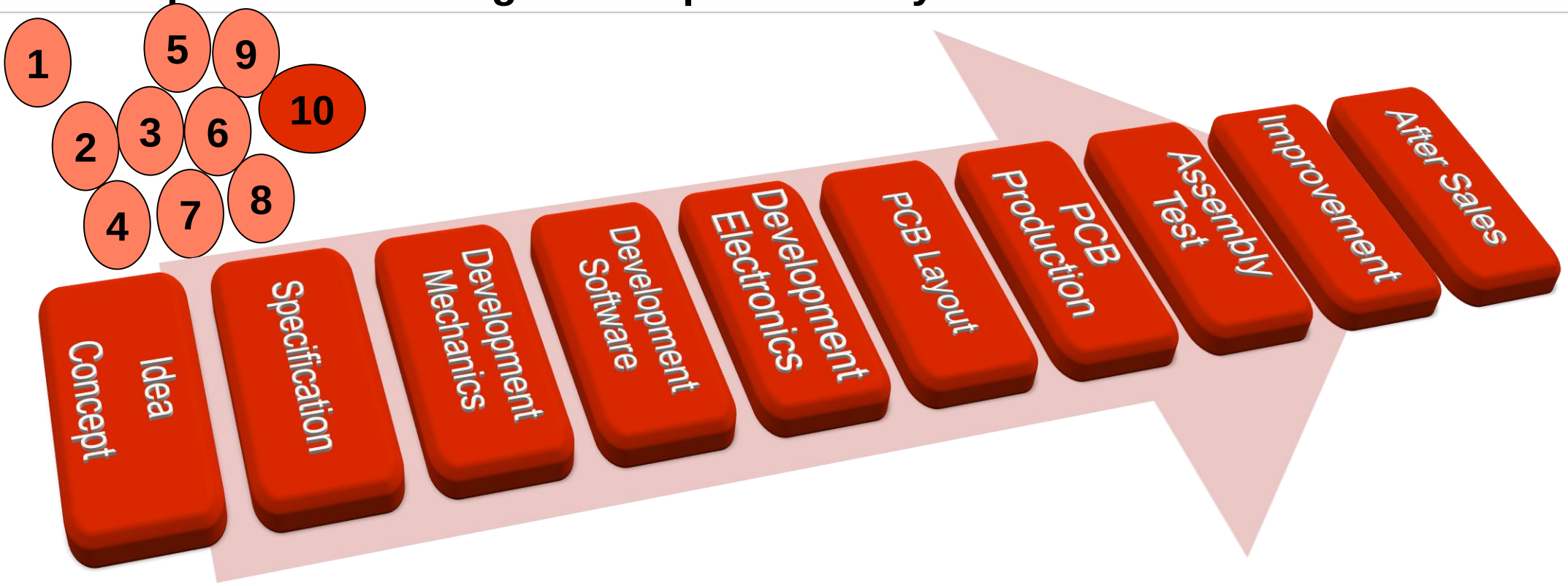


9

EMC: interfaces

Proof of Concept regarding emission and interference (less is better)

24 points which might be important for your succes

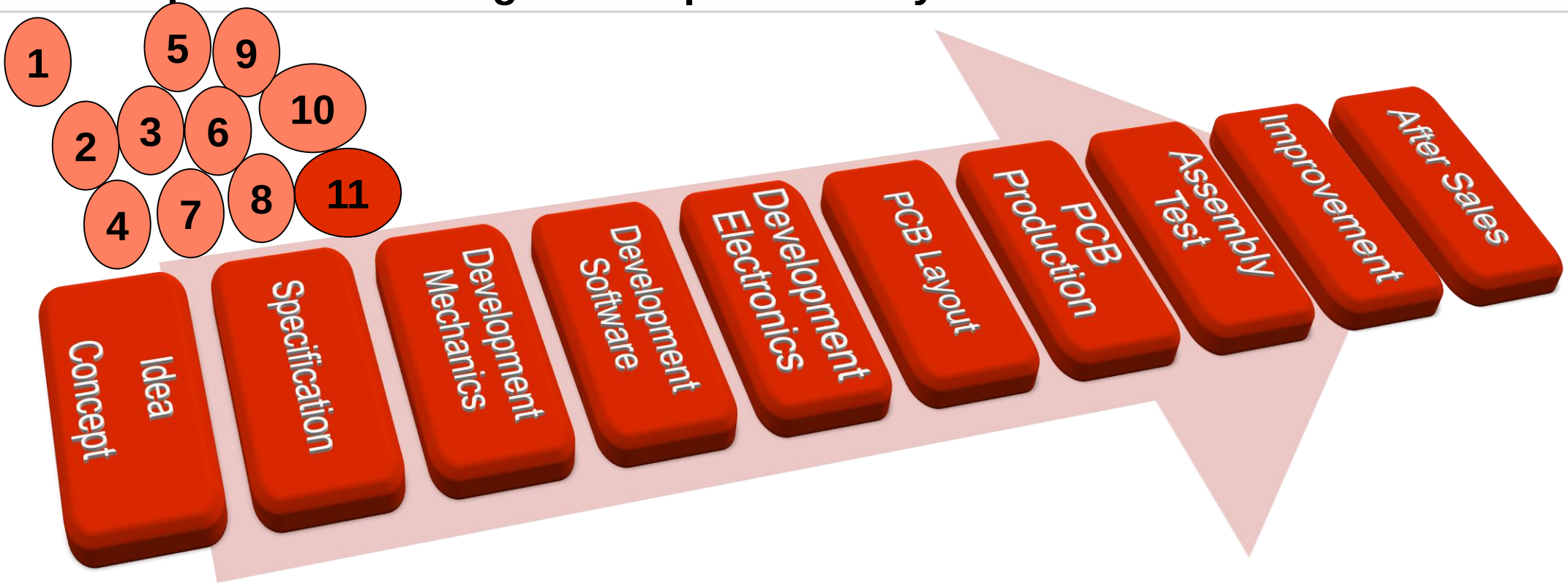


10

Signal integrity

Simulation, Documentation (also for a „simple“ Multilayer)

24 points which might be important for your succes



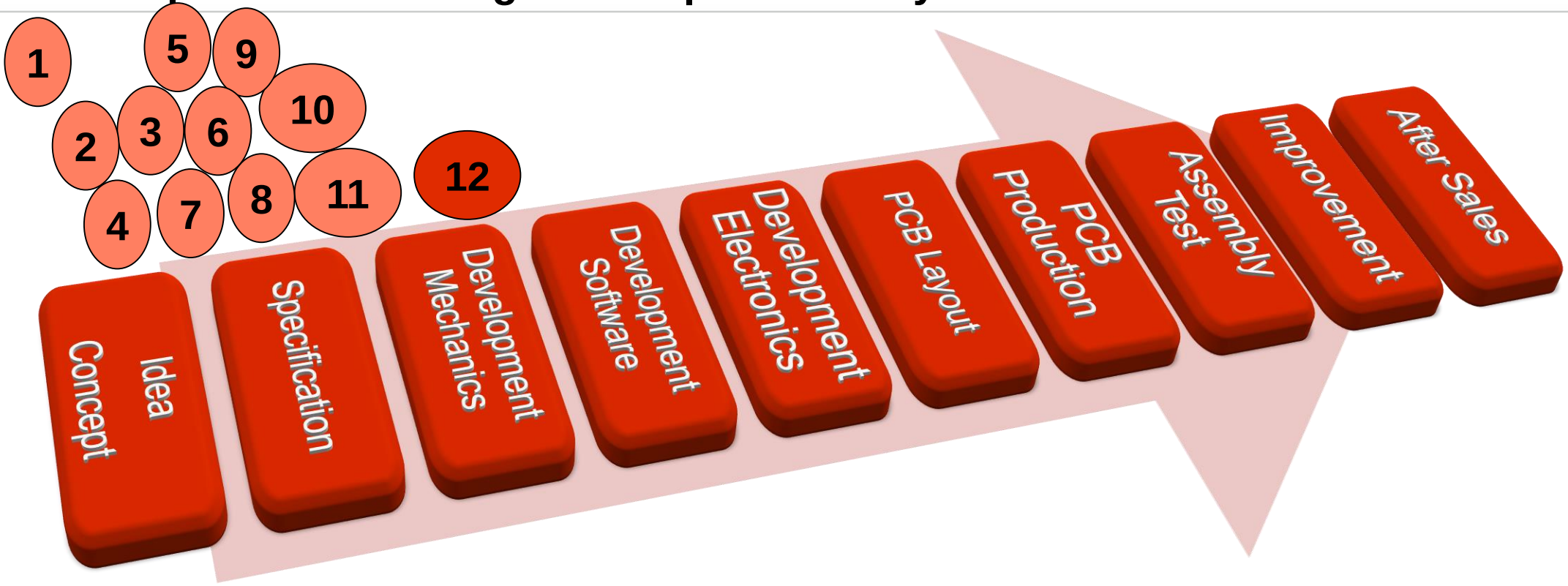
11

Ampacity

According to IPC-2152

Options Thick copper technology ⇔ partial Thick copper technology

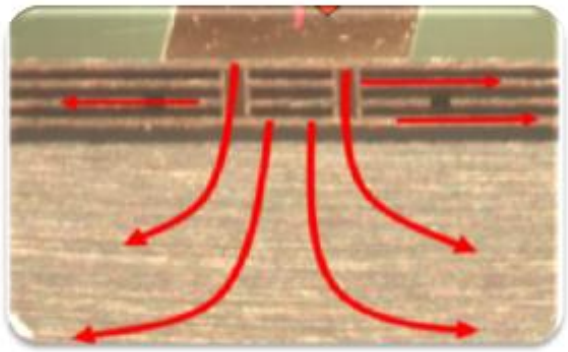
24 points which might be important for your succes



12 Thermal Design

Simulation based on Gerber data, Adaption of PCB Technology

Simulation thermal Design - Variants



Options on PCB basis:

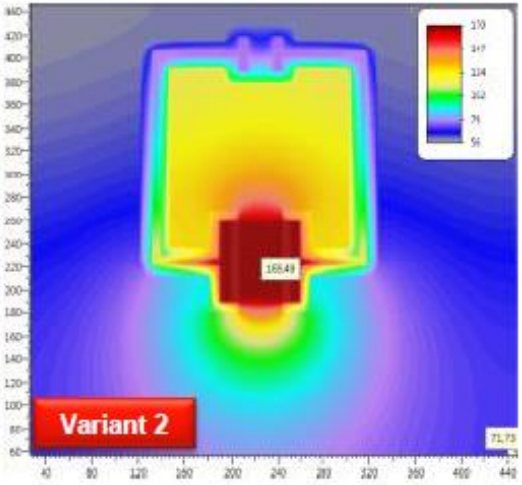
- Heat dissipation using vias
- Heat spreading using planes and heatsinks glued onto the PCBs

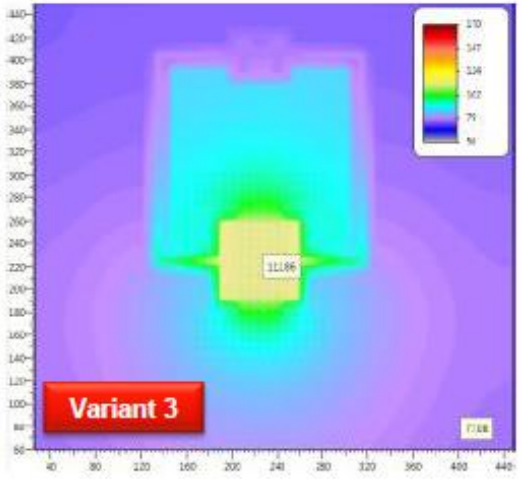
Target:

- Lowering of temperature at the component
- Avoiding critical temperatures inside of the component and unit
- Extention of lifetime and ensure of long term reliability of the unit

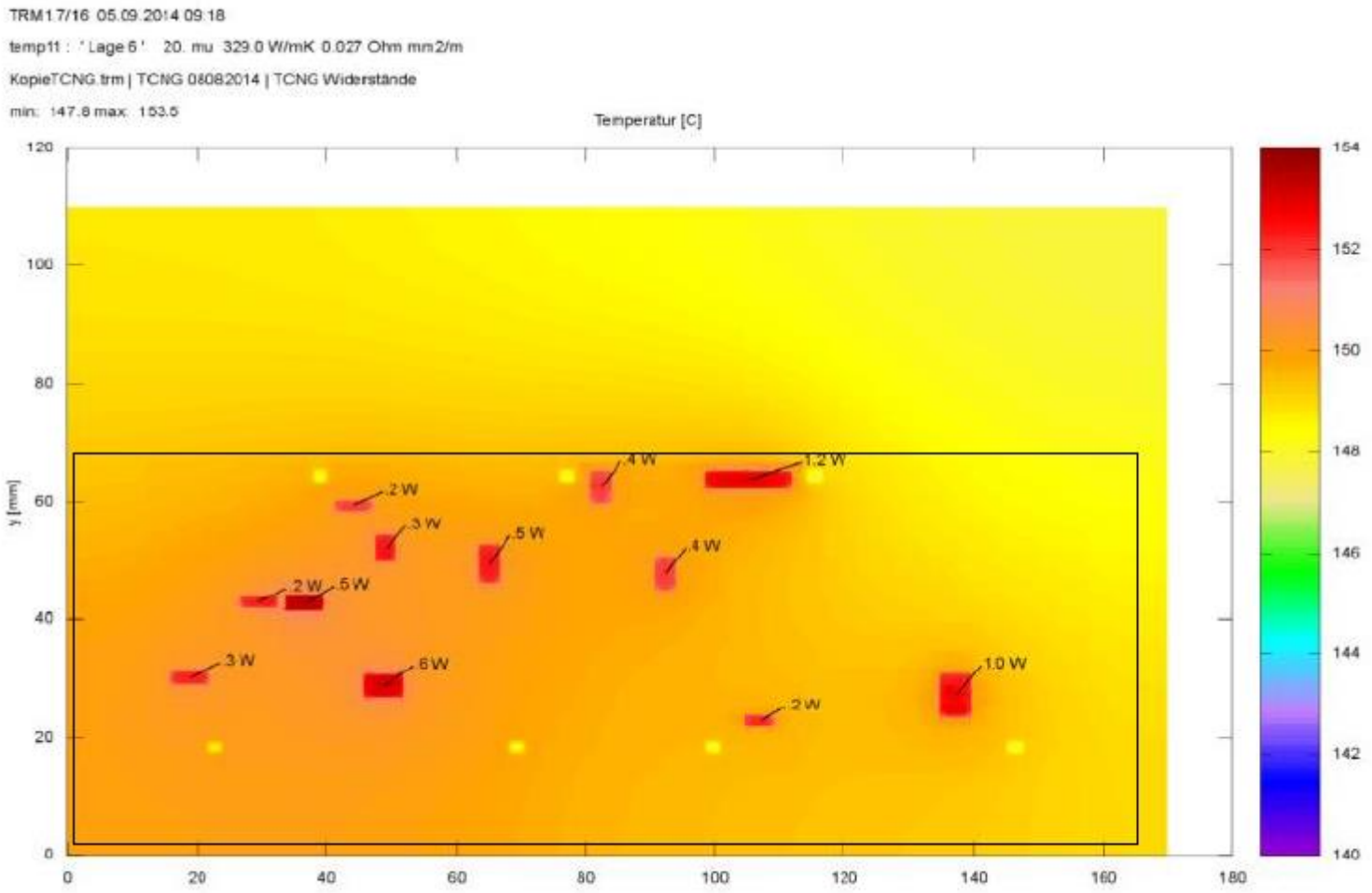
At threshold a thermal simulation in preliminary stages is recommended

Thermal Simulation





Simulation heat dissipation of Polymer Resistors



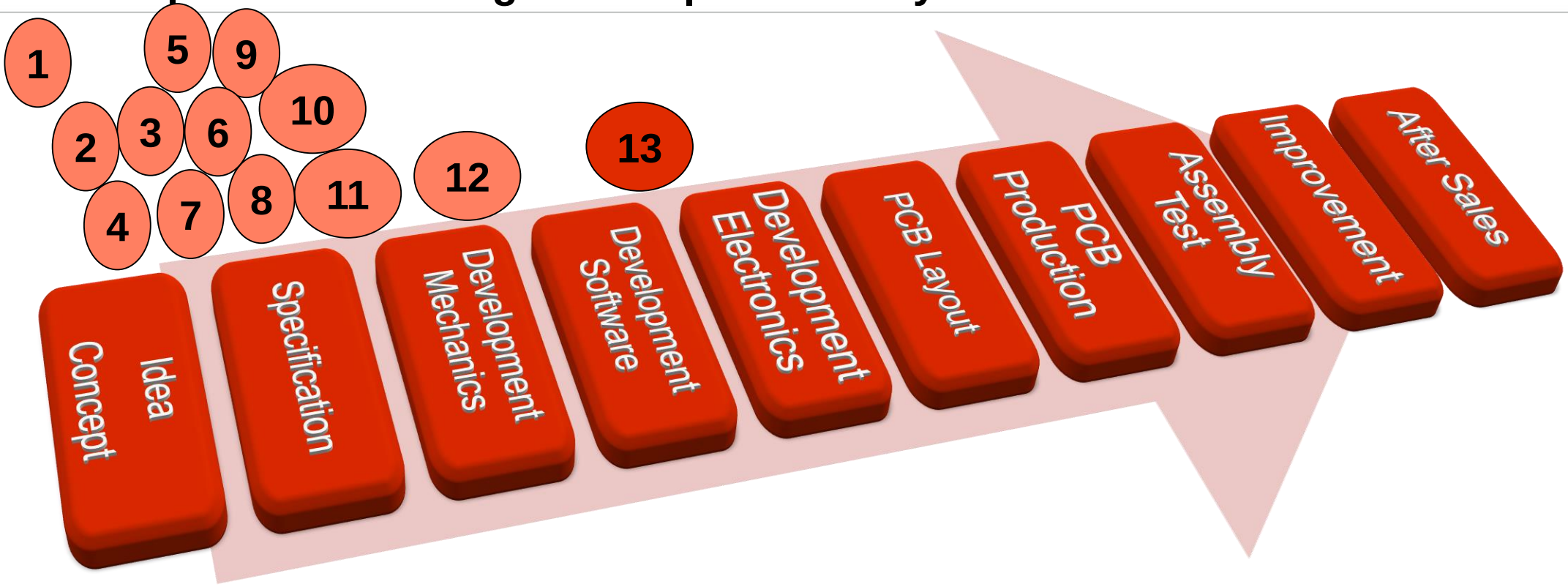
Thermal Simulation - Würth Elektronik CBT Product Management

Ambient temperature: 140°C

Max. temperature at resistor: 153.5 °C

Power in accordance with customer specifikation

24 points which might be important for your succes

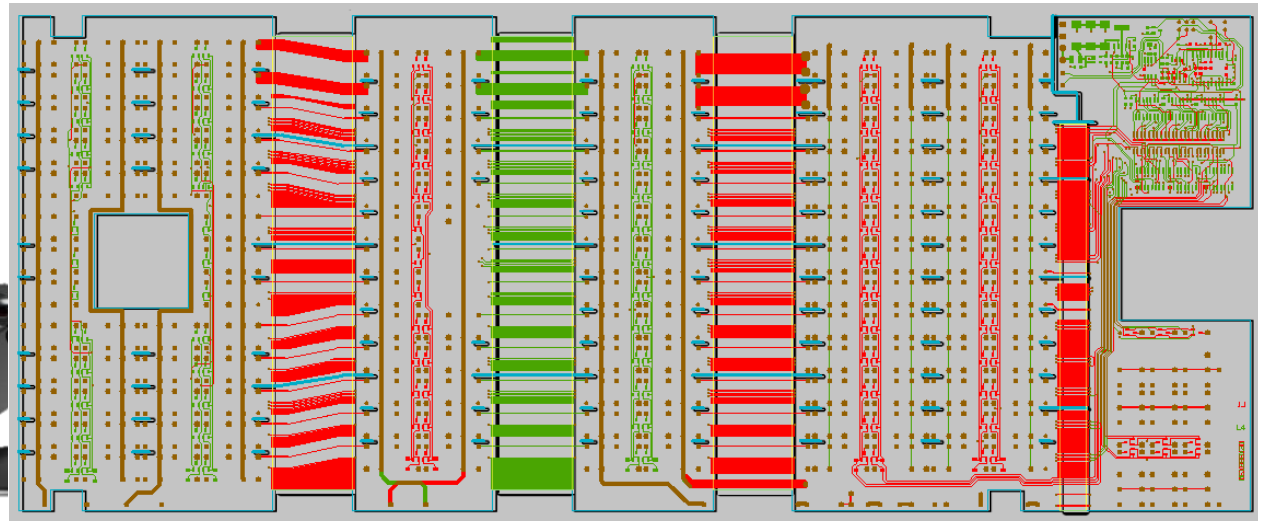


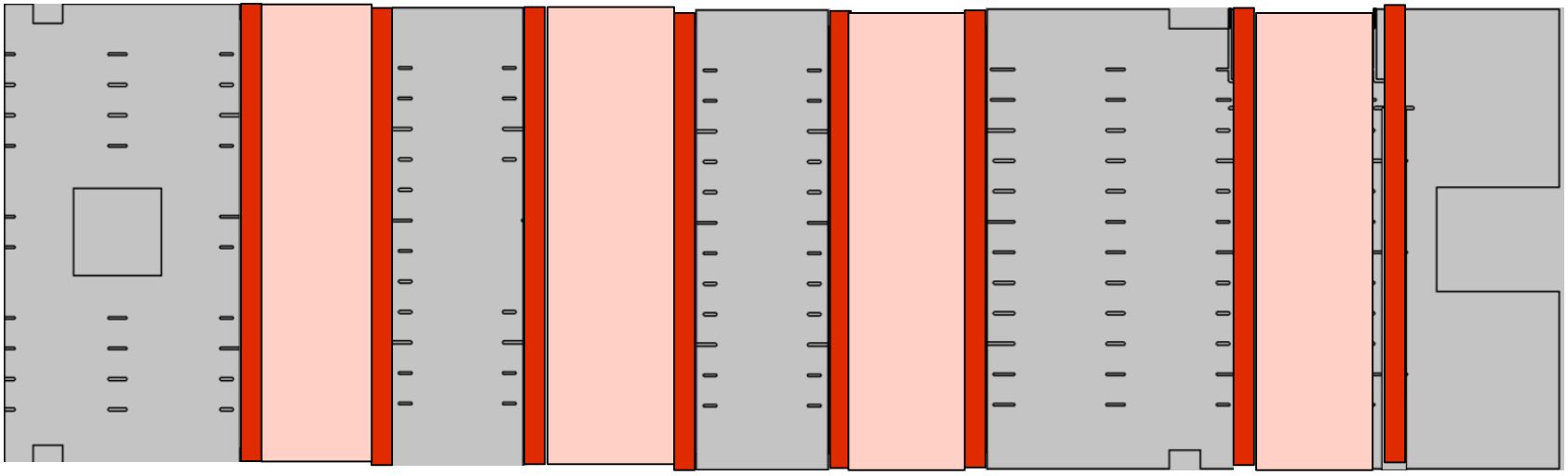
System cost

13

Ball park quotes, System cost estimations

System cost comparison: modular - integrated



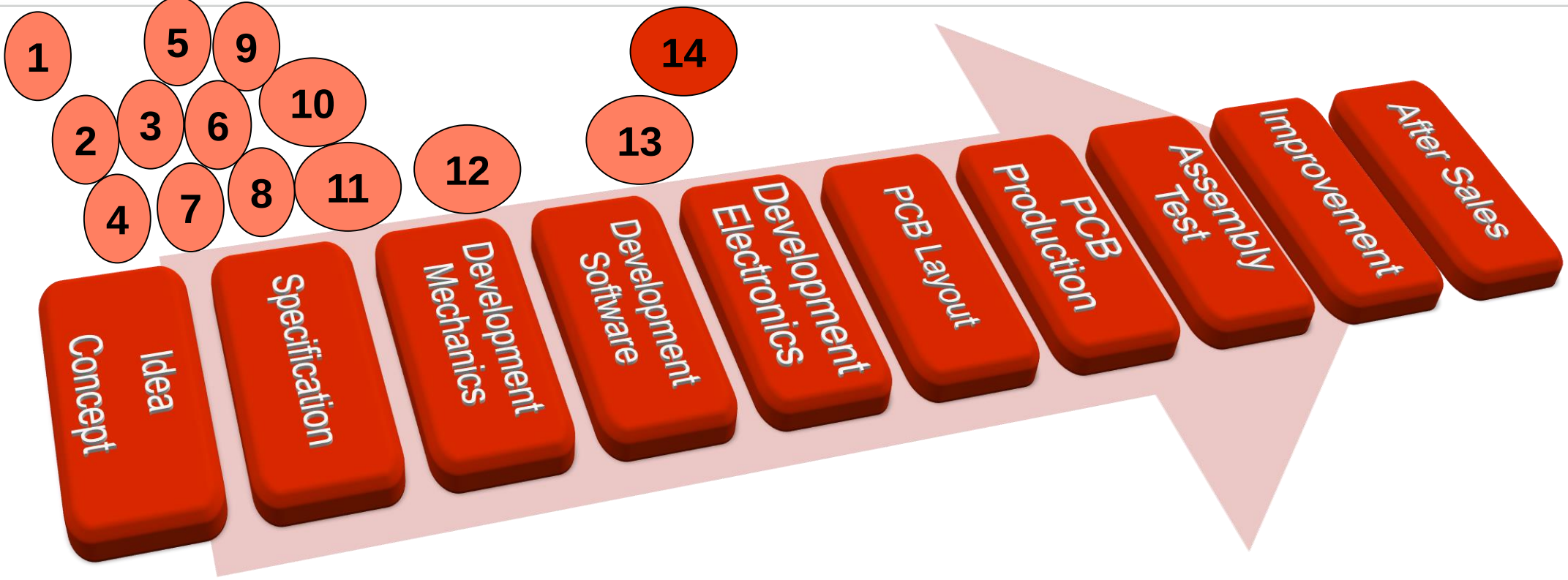


System cost comparison: modular - integrated

balance sheet	rigid pcbs with cables and connectors		Semiflexible pcb		
	100 pcs	1.000 pcs	100 pcs	1.000 pcs	Remarks
a) pcb price	58,50 €	40,50 €	55,90 €	45,50 €	pcbs from Europe
b) FFC cables, ZIF connectors	30,00 €	13,00 €	-	-	EMS Sweden
c) for this SMD assembly AOI	2,00 €	1,50 €	-	-	EMS Sweden
d) final assembly	2,00 €	1,50 €	-	-	EMS Sweden
e) final test	1,50 €	1,00 €	1,50 €	1,00 €	EMS Sweden
sum of BoM and processing	94,00 €	57,50 €	57,40 €	46,50 €	
			-39%	-19%	cost saving
additional cost factors:					
f) design for	5 pcbs		1 pcb		
g) inventory control	17 components + 5 stencils		1 component + 2 stencils		
h) assembly expenditure	5 x		1 x		
i) test expenditure	6 x		1 x		
k) stock / logistics	22 positions		3 positions		
l) Pin- and solder connections	312 ZIF-contacts + 312 solder joints		integrated Semiflex connection		Reliability

1

24 points which might be important for your succes



14 Circuit diagram, Choice of Components

Impact on PCB Technology!

Component with highest density determins PCB technology

Excerpts out of our HDI Designguide:

BGA 0,50 mm Pitch

Für 0,50 mm BGA Pitch müssen auf jeden Fall **Feinstleiterstrukturen** verwendet werden, wir empfehlen 75 µm (3 mil). Zusätzlich ist es erforderlich, die Microviapadgröße, zumindest auf den Innenlagen, auf 275 µm zu reduzieren. Für 75 µm Feinstleiterstrukturen muss die Kupferendschichtdicke auf der Oberfläche auf ca. 25 µm begrenzt werden.

Würth Elektronik empfiehlt die oben dargestellte **Variante 1**, bei der keine Leiterbahnen auf der Außenlage zwischen den BGA Pads hindurchgeführt werden. Damit können auf der Außenlage Feinstleiterstrukturen vermieden werden.

Variante 2 hat den Vorteil einer planaren Lötfläche (geringeres Risiko von Voiding) bei allerdings reduzierter Lötpadgröße.

Bei **Variante 3** muss auch auf den Außenlagen mit 75 µm Strukturen gearbeitet werden, was den Fertigungsaufwand erhöht. Zusätzlich muss hier die Lötstoppmaskenfreistellung auf 35 µm reduziert werden. Diese Variante kann allerdings möglicherweise helfen eine Microvialage einzusparen. Grundsätzlich hängt die Anzahl der erforderlichen Microvialagen, und damit der Lagenaufbau, von der Komplexität des Bauteils ab.

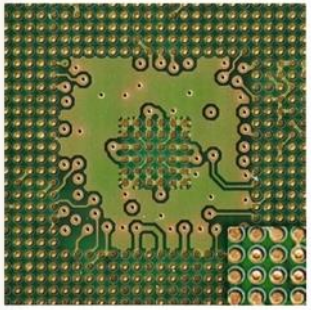
BGA 0.50 mm Pitch

Fine line structures will definitely be required for a 0.50 mm pitch BGA, we recommend 75 µm (3 mil). It will also be necessary to decrease the microvia pad size, at least on the inner layers, to 275 µm. For 75 µm fine line structures the final copper thickness on the surface is limited to approximately 25 µm.

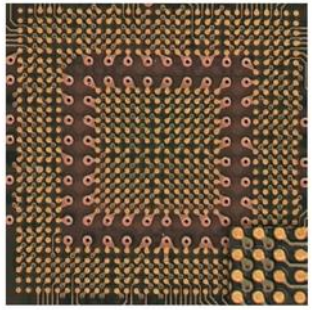
*Würth Elektronik recommends **variant 1** described above, without tracks between the solder pads on the outer layer. This avoids the need to use fine line structures on the outer layers.*

***Variant 2** gives the advantage of a planar surface (lower risk of voiding), but with a reduced solder pad size.*

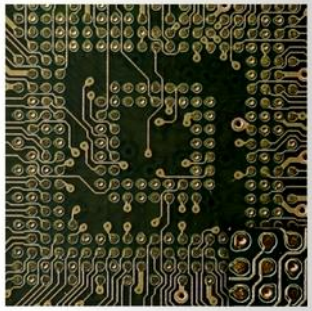
*With **variant 3,** 75 µm structures are needed on the outer layer as well. This increases the production effort and the production costs. Moreover, the solder mask clearance has to be reduced to 35 µm. This variant could probably help to save one microvia layer. Generally the number of the microvia layers required, and the kind of stack-up, depends on the complexity of the component.*



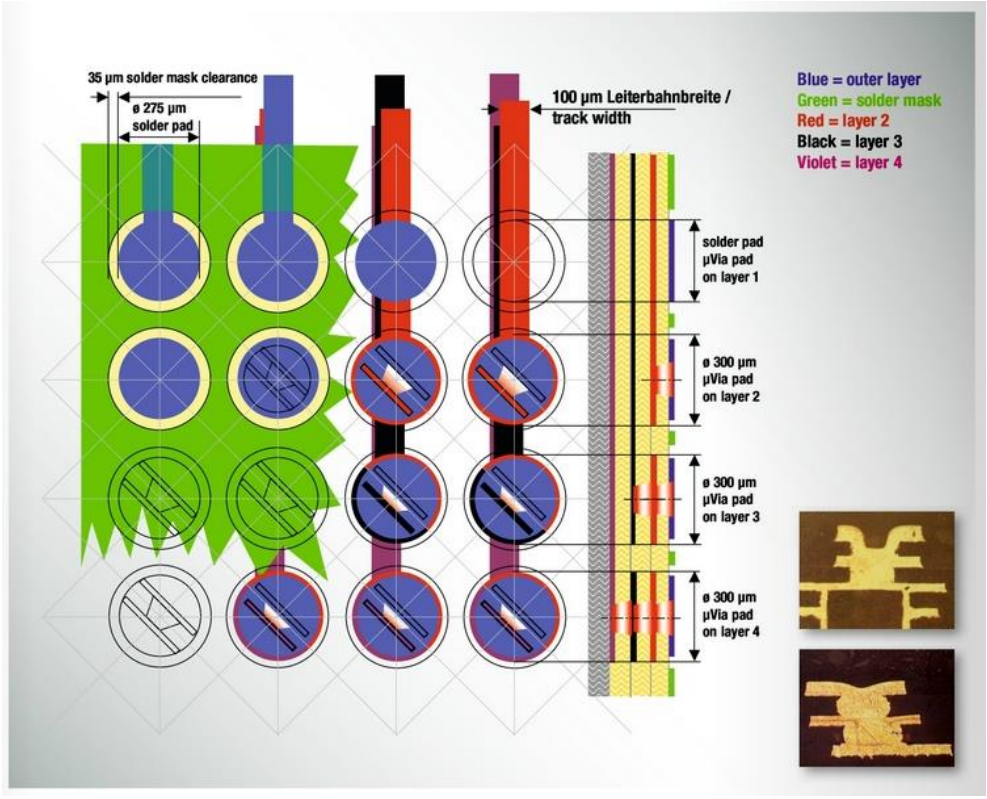
Var.1: Via in Pad



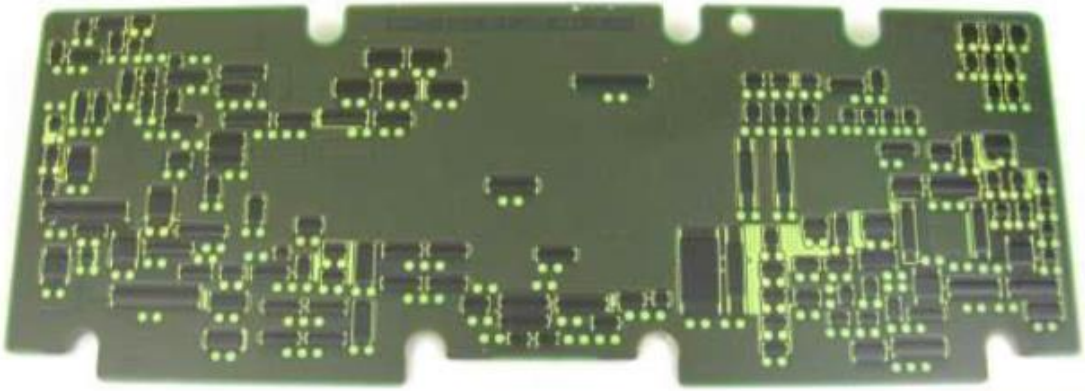
Var. 2: Dogbone



Var. 3: Via in Pad



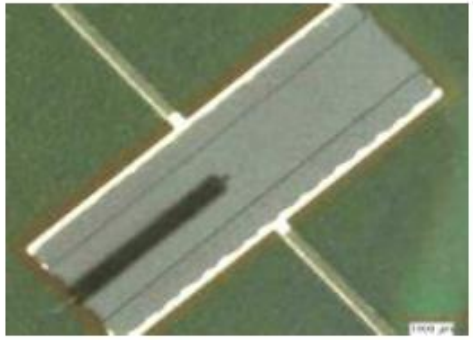
Option: printed Components

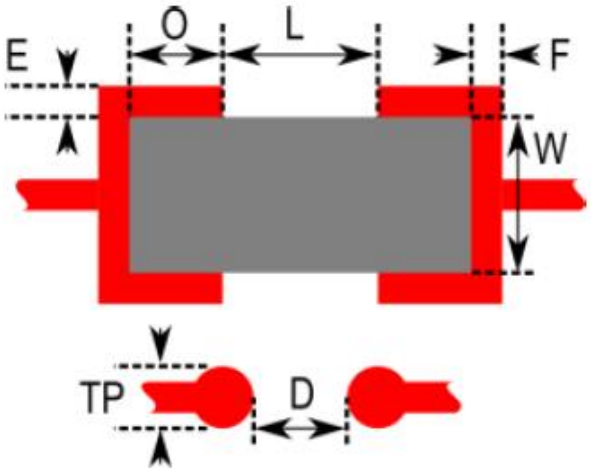


Tolerance of resistance value without laser trimming max. +/- 30%

With Laser Trimming
Process tolerance: down to +/- 1%

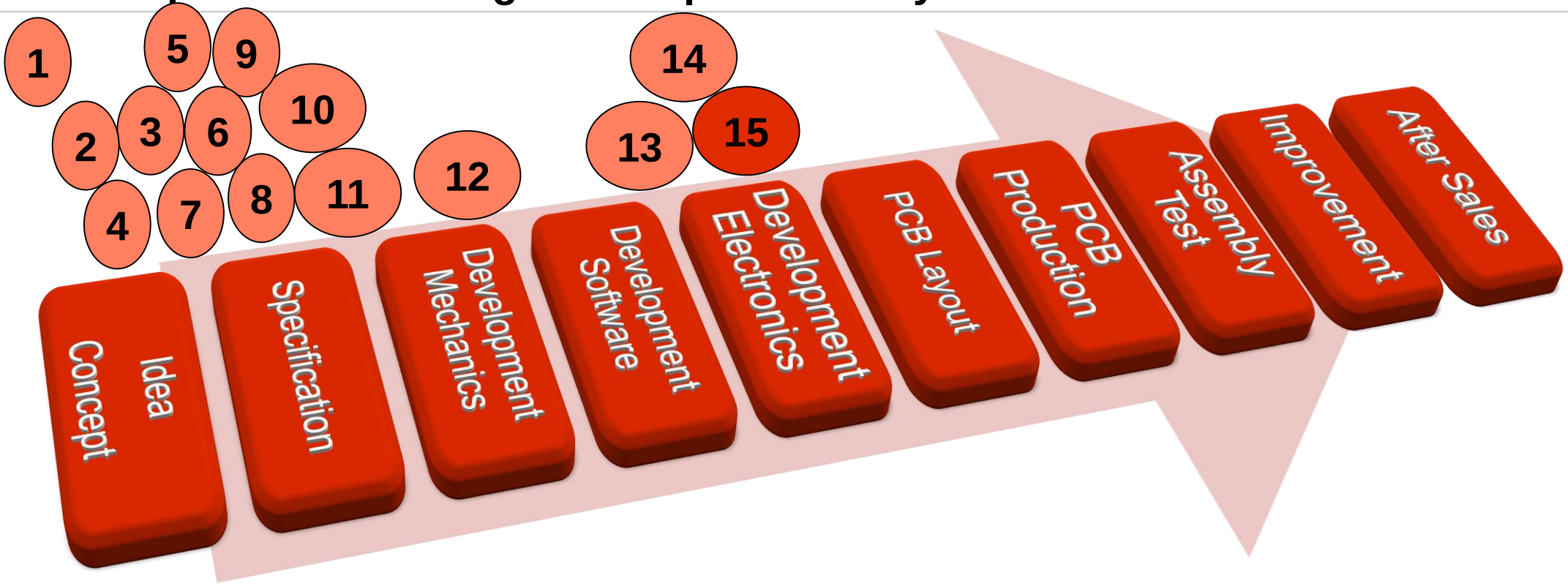
Entire product lifetime: +/- 5%





Traceability:
The laser trimming process can also enable perfect traceability by using binary coding on additionally designed resistors.

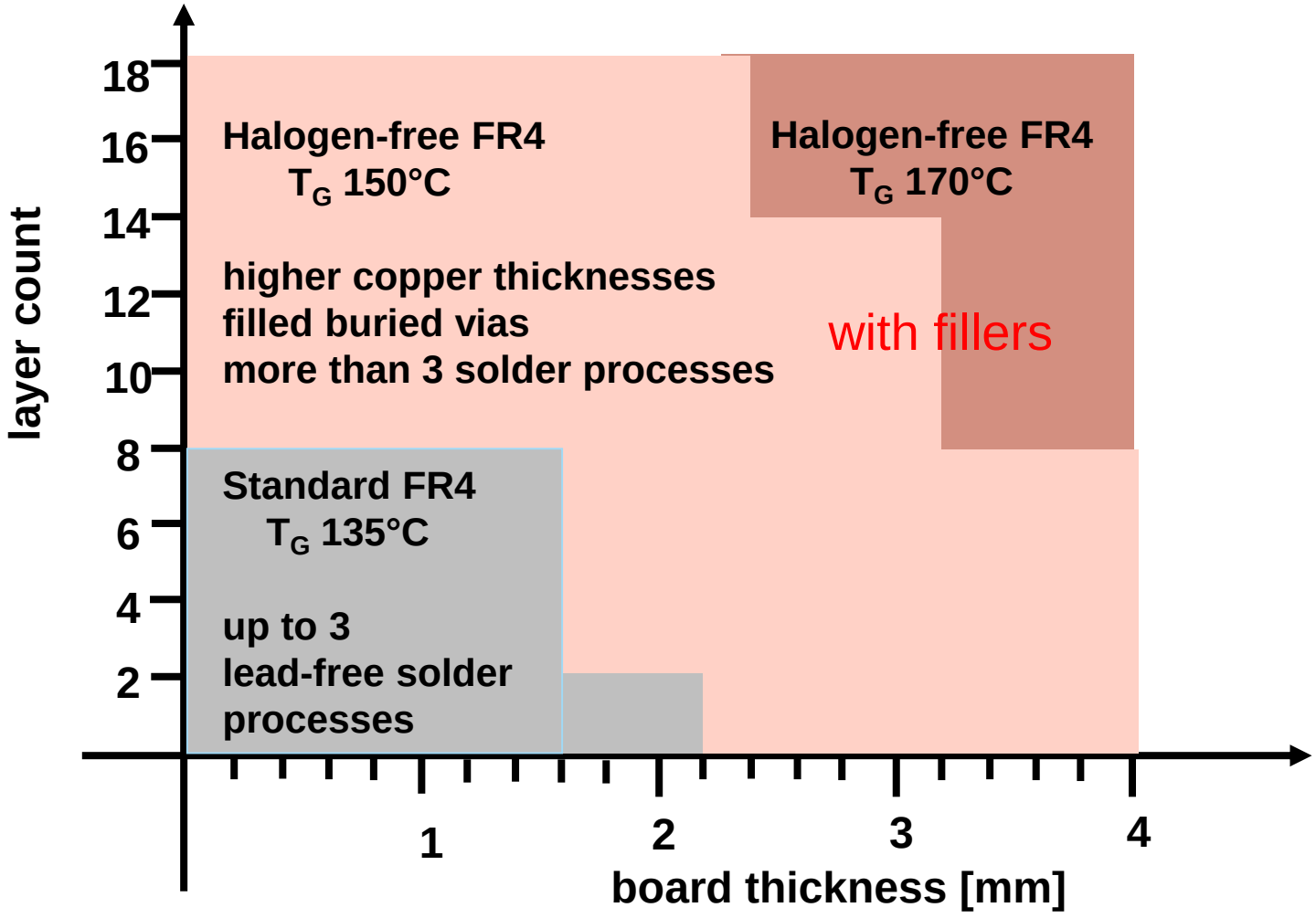
24 points which might be important for your succes



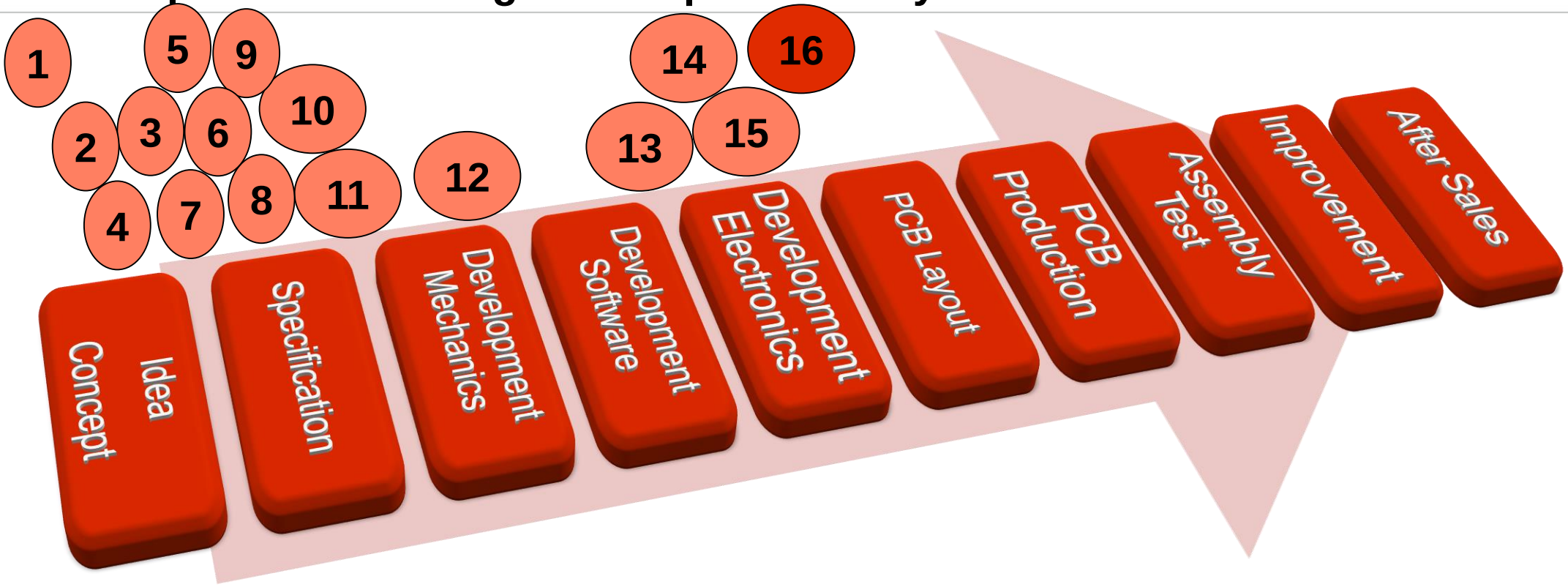
15 **Material Choice for the PCB bare board**

Requirements derived from the System

Recommendations for the usage of base material FR4



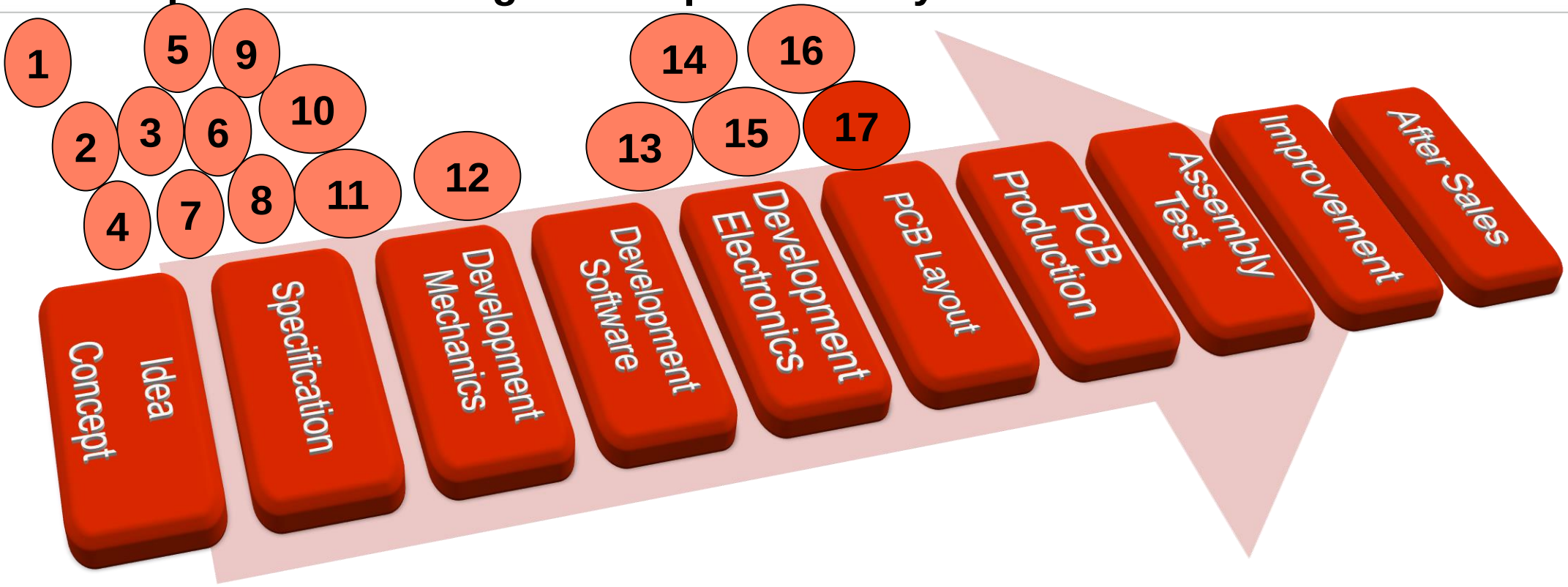
24 points which might be important for your succes



16 Qualification und Test Strategy

Qualification of the pcb technology and ensuring of the serial quality

24 points which might be important for your succes



17 **Traceability**

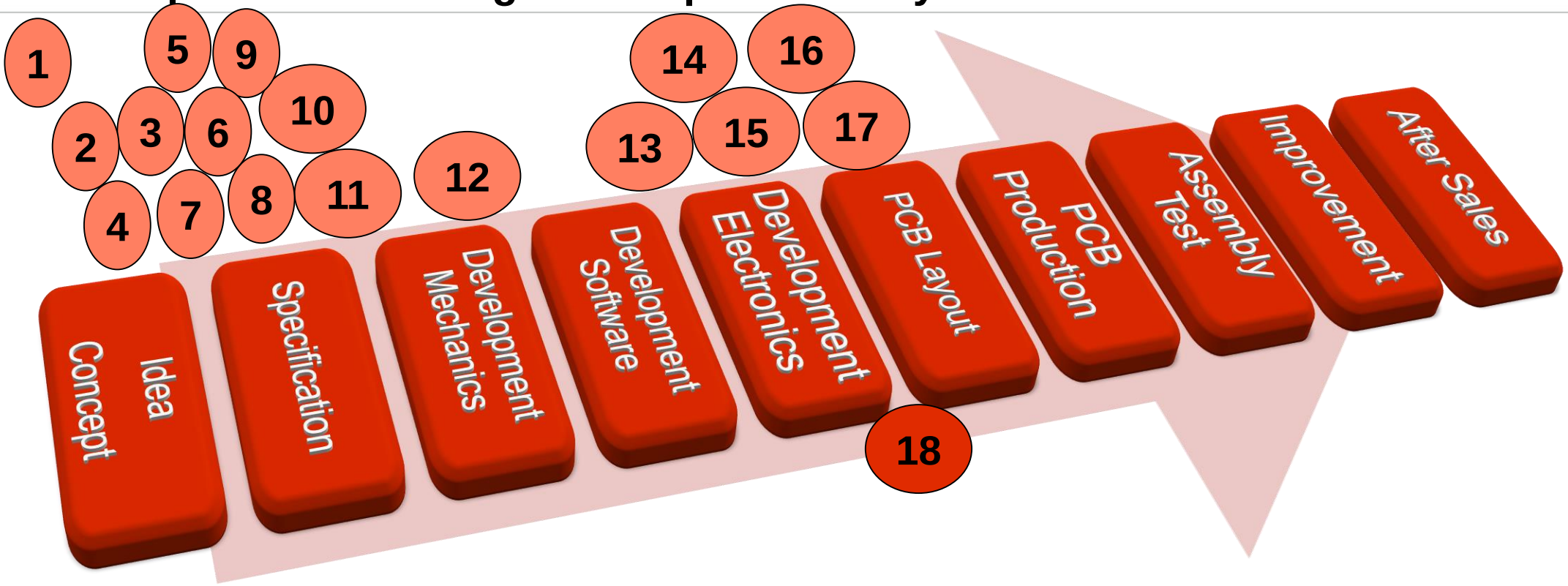
Content and area needed for markings

Marking: Must, may and Should

- **Must: Producer, Datecode**
- **Should: Lot number**
- **UL-Marking**
  - **Must: compay name or file number**
  - **Must: UL-Type designation**
  - **May: Factory identification**
  - **May: UR-Logo**
  - **May: burning test classification**

Marking: Company name or tradename "WE" or file number and type designation. May be followed by a suffix to denote factory identification or burning test classification.

24 points which might be important for your succes

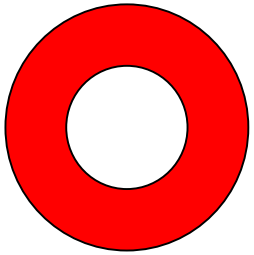


18 PCB Layout

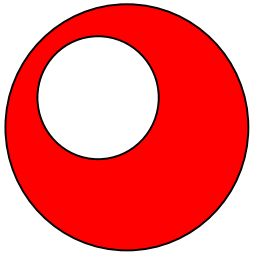
DfM, Design Rules, Annular Ring

Why do we need annular rings?

- **Layout / Screen:**



- **Real life**



IPC-A-600H:

2.10 PATTERN DEFINITION – DIMENSIONAL

2.10.3 External Annular Ring – Supported Holes

2.10 PATTERN DEFINITION – DIMENSIONAL

2.10.3 External Annular Ring – Supported Holes (cont.)

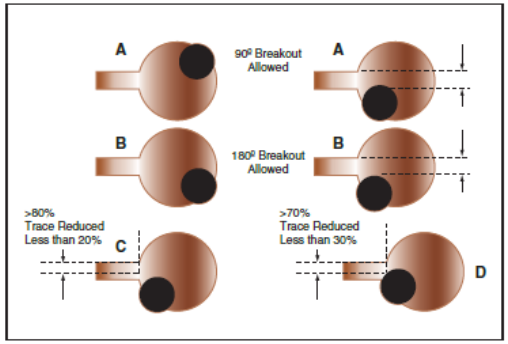


Figure 2103d

Acceptable - Class 2

- 90° breakout or less (see item A in Figure 2103d).
- If breakout occurs at the conductor to land junction area, the land/conductor junction is not reduced by more than 20% of the minimum conductor width specified on the engineering drawing or the production master nominal. The conductor junction should never be less than 0.050 mm [0.0020 in] or the minimum line width, whichever is smaller (see item C in Figure 2103d).
- Minimum lateral spacing is maintained.

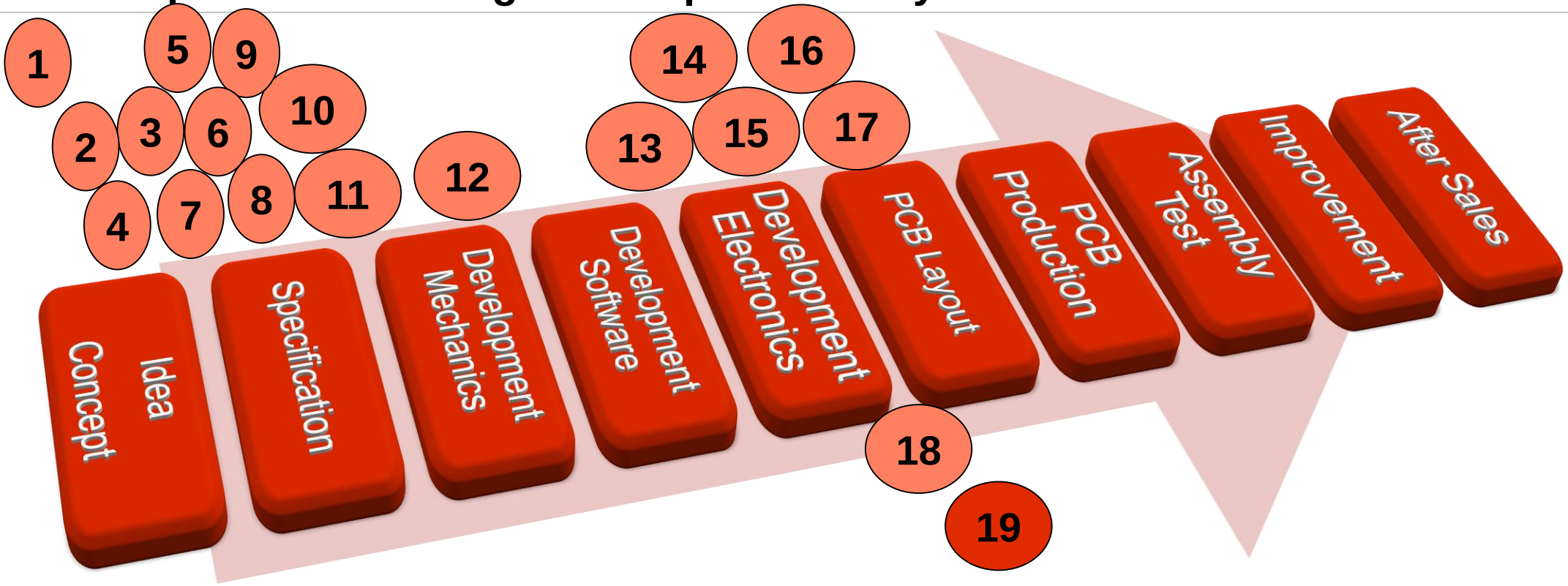
Acceptable - Class 1

- 180° breakout or less (see item B in Figure 2103d).
- If breakout occurs at the conductor to land junction area, the conductor is not reduced by more than 30% of the minimum conductor width specified on the production master nominal (see item D in Figure 2103d).
- Form, fit and function are not affected.
- Minimum lateral spacing is maintained.

Nonconforming - Class 1, 2, 3

- Defects either do not meet or exceed above criteria.

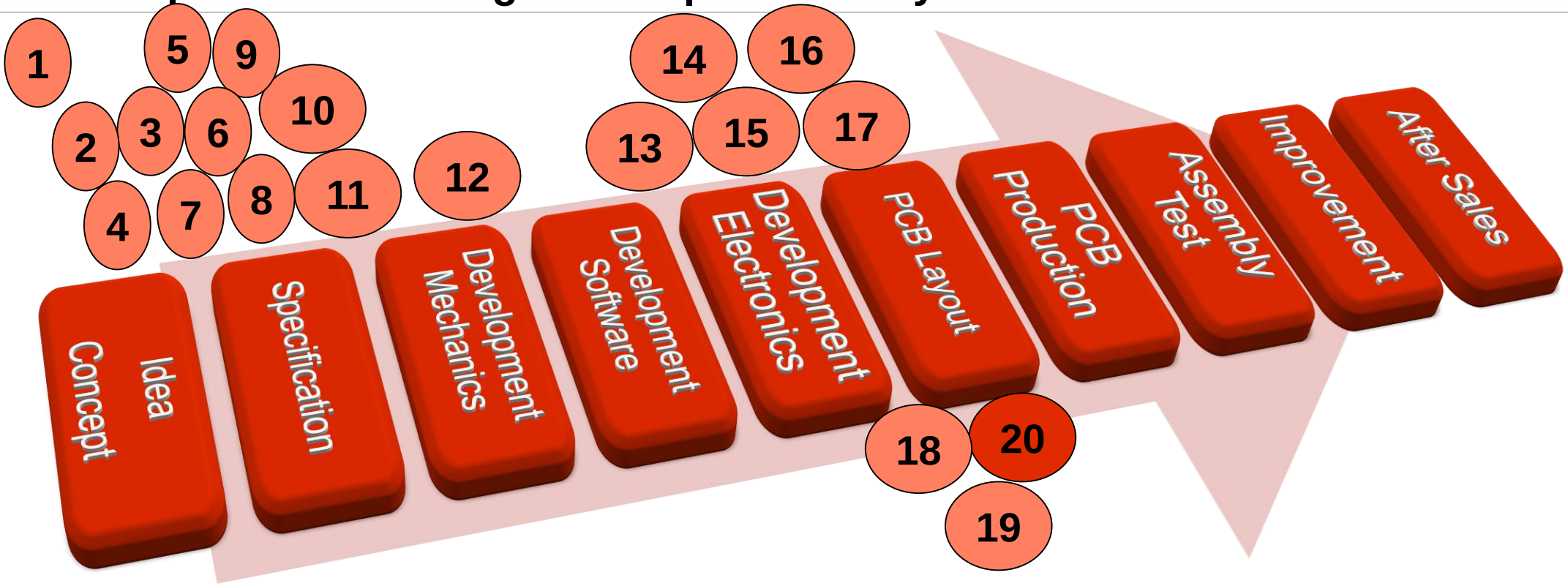
24 points which might be important for your succes



19 **Data post processing and Design of delivery panel**

Recommendation: Format 3.4 metric

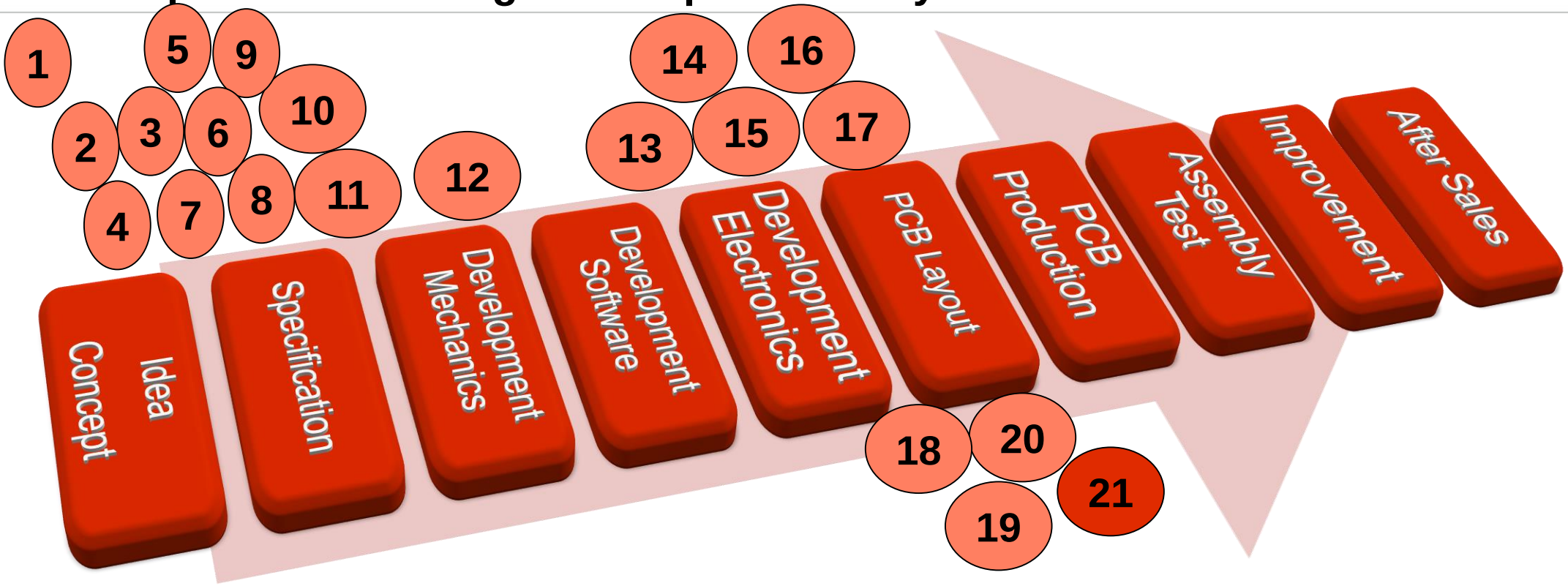
24 points which might be important for your succes



20 Order documents for the pcb bare board

Gerber data, stack-up plan, drawings, Spezifications

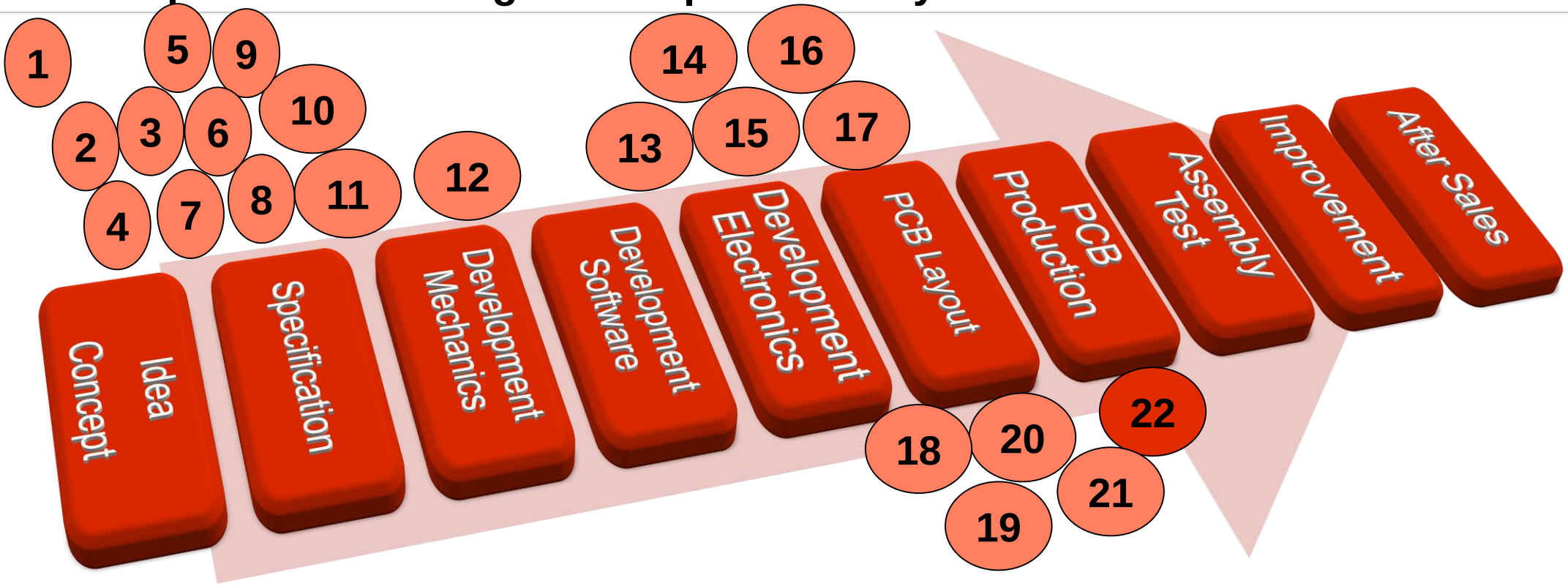
24 points which might be important for your succes



21 **Production PCB bare board**

Rush service, Logistics solutions of Würth Elektronik, Shop WEdirekt

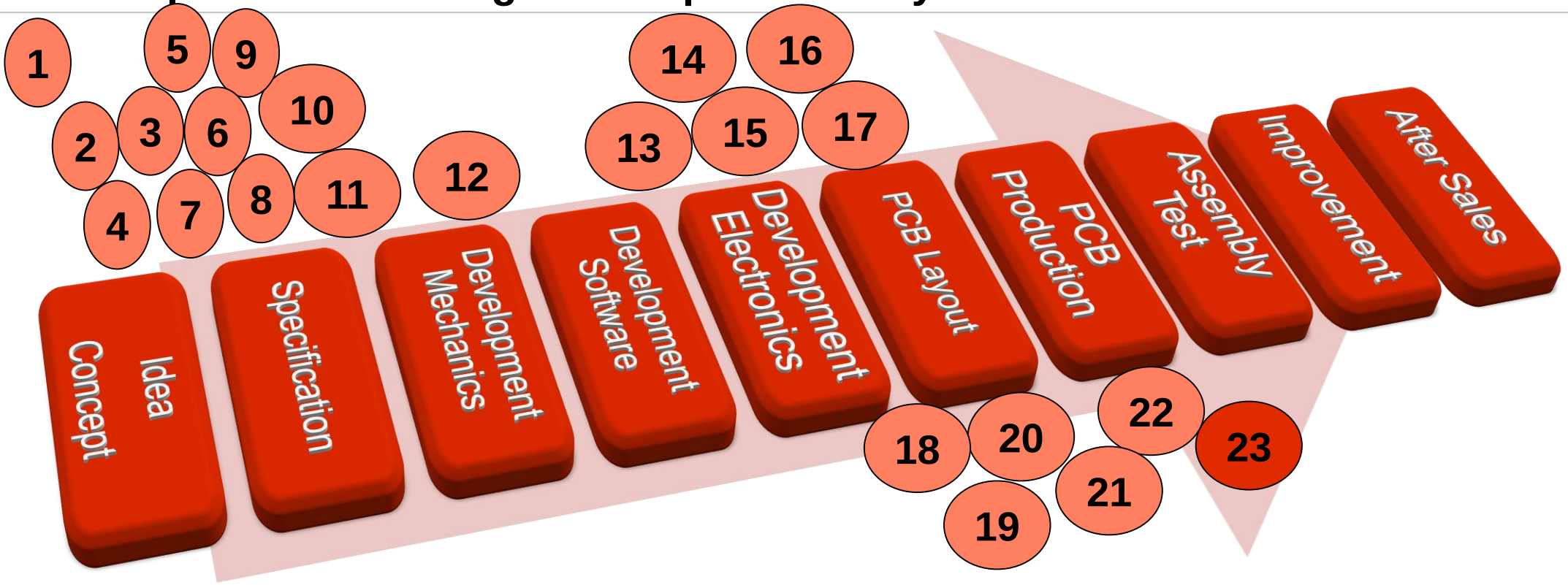
24 points which might be important for your succes



22 **Delivery documents**

from delivery note to PPAP (Production Part Approval Process)

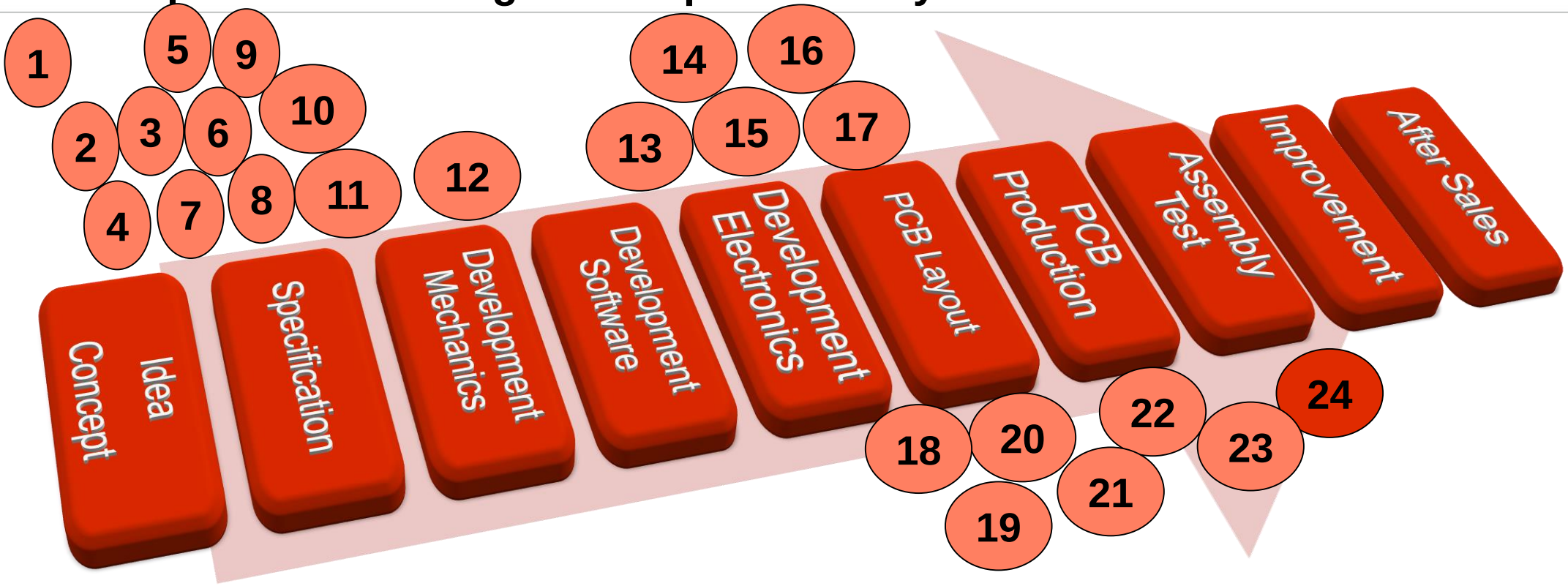
24 points which might be important for your succes



23 **Further processing of the PCBs**

Download „Drying recommendations“

24 points which might be important for your succes



Panel separation

24

Which capabilities does your production have? Side cutter ?

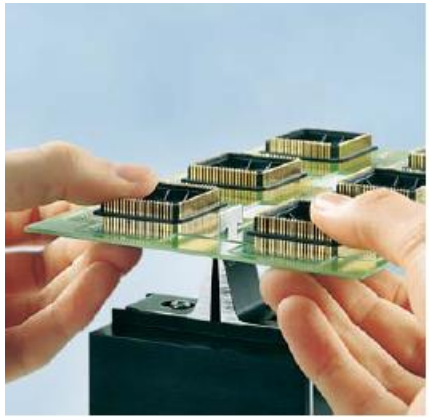
Panel Separation - examples

<u>several processes are in use:</u>

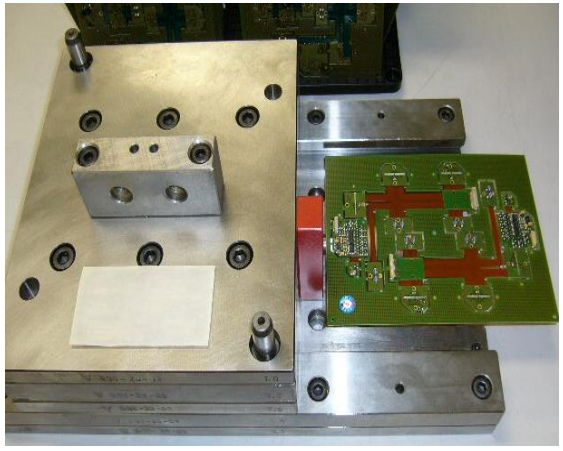
1. **Tab remover (i.e. Hektor) for cutting single tabs**
2. **cutting knife for V-cut panels (Rolling or fixed knifes)**
3. **Laser up to 0,8mm pcb thickness**
4. **Routing (expensive but good!)**
5. **Stamping or Sawing (for big volumes)**
6. **Cracking of predetermined breaking points**

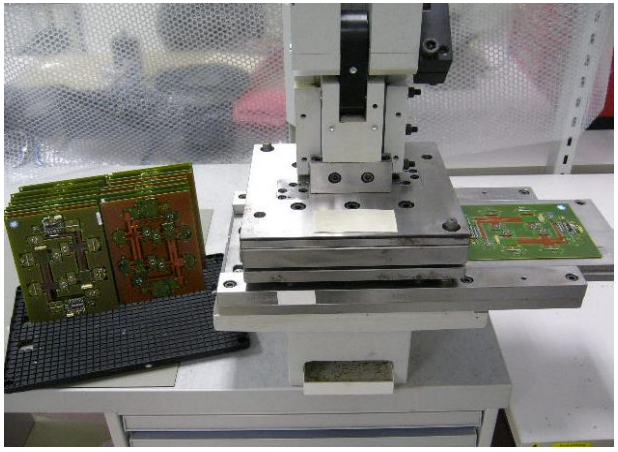
Ritznutzen / *V-cut panels*

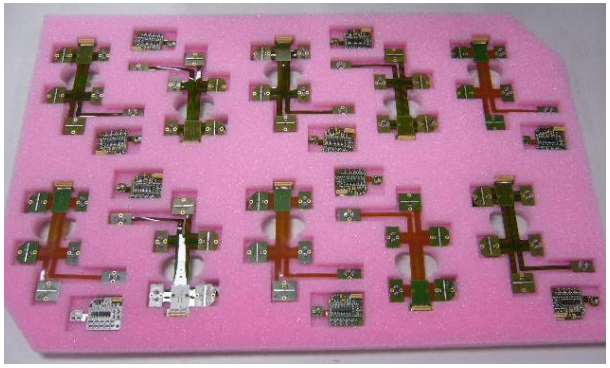
Entfernung von Stegen / *tab removal*



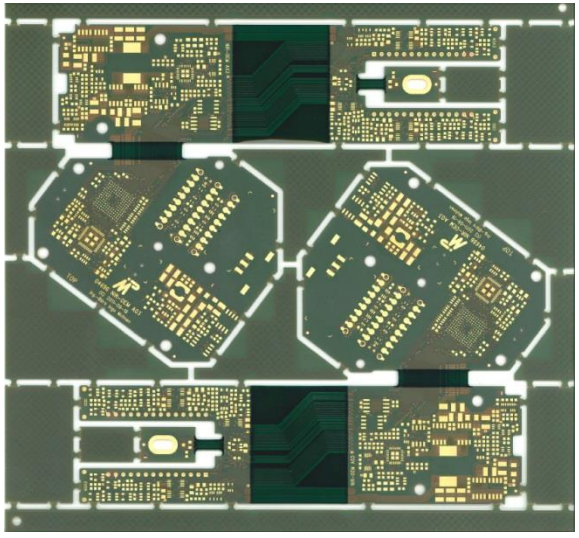
Panel Separation by stamping - Transport







Quelle: Fa. acd



Summary

the development of an electronic system

- **could be very complex**
- **needs a lot of different technical disciplines**
- **needs networking and communication very much**
- **WE like to support you in a project**
- **You are already in a redesign or improvement loop?**

  We are pleased to help you!
- ***Please contact us as soon as possible!***

Thank you very much for your attention!

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