Living Automotive Excellence

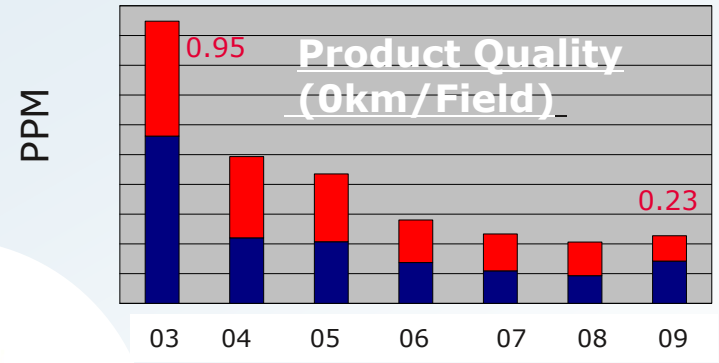
On the way to Zero Defect products and services

Infineon established the Automotive Excellence Program in 2003

Infineons Automotive Excellence Program is your competitive advantage

Goals:
- Sustainable quality improvement
- Zero Defect Culture

Measurables:
- Decrease of number of customer returns and quality spills
- Increase of customer satisfaction



Improvement Examples:

Advanced Process Control

Excellent Requirement Management

Our target of ZD is your competitive advantage:

- no quality events
- defect-free product launches
- low non-conformance costs
- highest quality image in your market
- more business due to satisfied customers

Our quality is clearly seen as industry benchmark by almost all of our customers

Content

- Motivation for “Zero Defect”
- Infineon “Automotive Excellence Program”
- Our Zero Defect Culture
- First Time Right in Product Development (examples)
- Excellence in Front End Wafer Production (examples)
- Excellence in Backend Production (examples)
- Our Quality is industry benchmark

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Too valuable to compromise

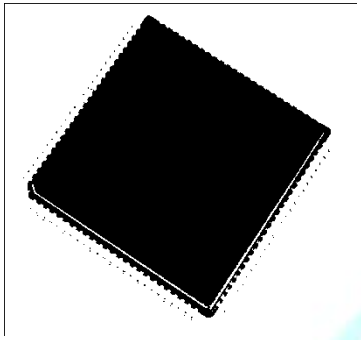
Living Automotive Excellence

- to create a competitive advantage through excellent quality
- to exceed your quality expectations

Zero Defect products to guarantee the highest safety possible

1ppm (1 defective part per million) is close to Zero Defect.
Would 1ppm not be enough?

Component



1 ppm components

300

ECU*

300ppm defect ECUs*

50

Car

15,000 cars defect out of 1,000,000 (1.5%)

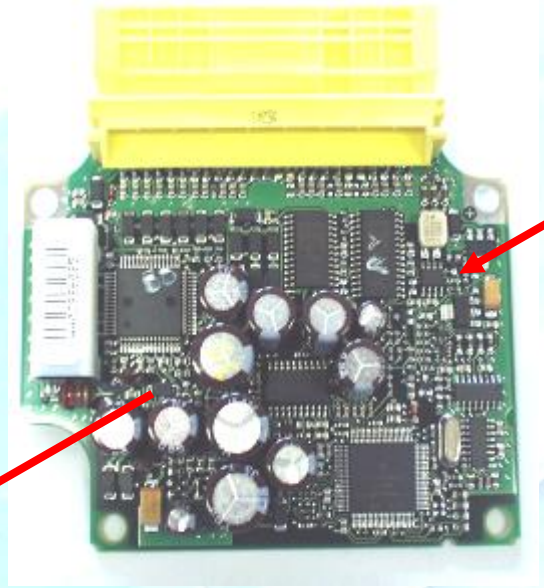
➔ To guarantee highest safety, we need Zero Defect

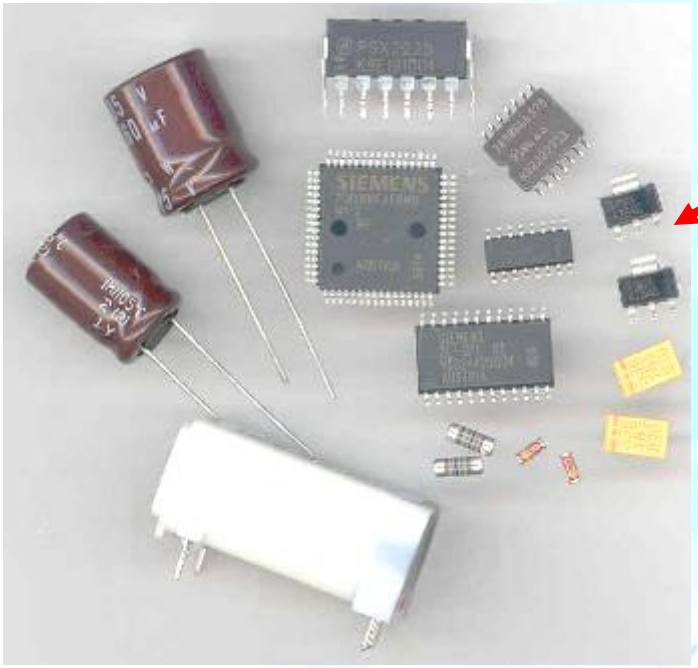
*ECU: Electronic Control Unit

Customer Returns = FARs

failure cause of Airbag ECUs (0 km-/Field)

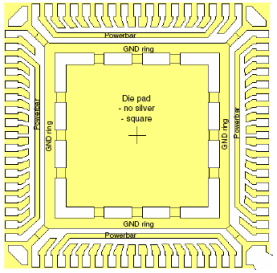
up to 90% caused by supplier of electronic components (Semiconductor)

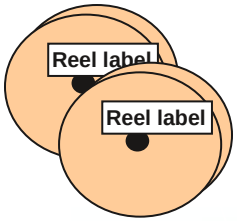




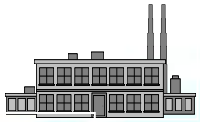
In the automotive industry each failing device comes back to the supplier as a
Customer Return
or
FAR
Failure **A**nalysis **R**equest

Why invest in Zero Defect Supply Chain ?

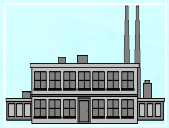




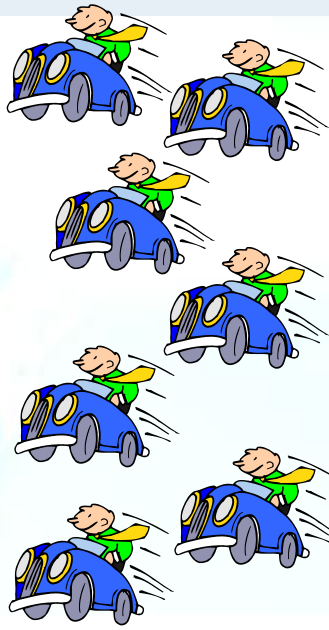
Devices in IFX fab



Plant 1



Plant 2



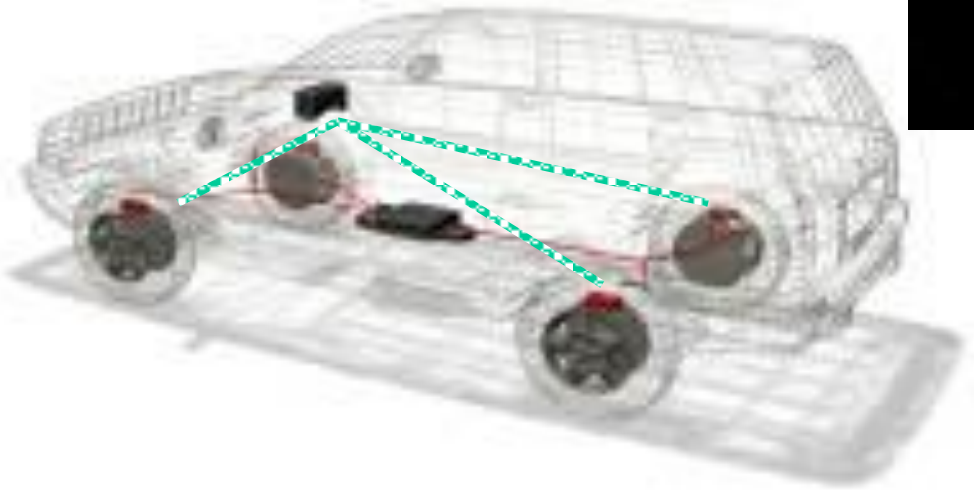
Supplier → **Infineon** → **Tier 1 Supplier** → **OEM** → **End customer**

Example : Cost Explosion in case of a supplier quality event

Failure analysis	Failure analysis Cost of Scrap	Cost of Scrap Cost of Overtime	e.g. 1 day linedown Controlled shipping	e.g. recall of 10,000 cars
~ 10 k€	~ 50 k€	~100k€	~1000k€	~10000 k€

Motivation: Why zero defect?

Reliability in cars: A question of life or death!



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Automotive Semiconductors
Commitment leads to success

Reliability through experience:
High quality products and services for the automotive industry for 40 years

Innovative product portfolio covering the complete control cycle:
From sensing over computing to actuating

System expertise with broad application competence:
Powertrain, Safety Management, Body & Convenience

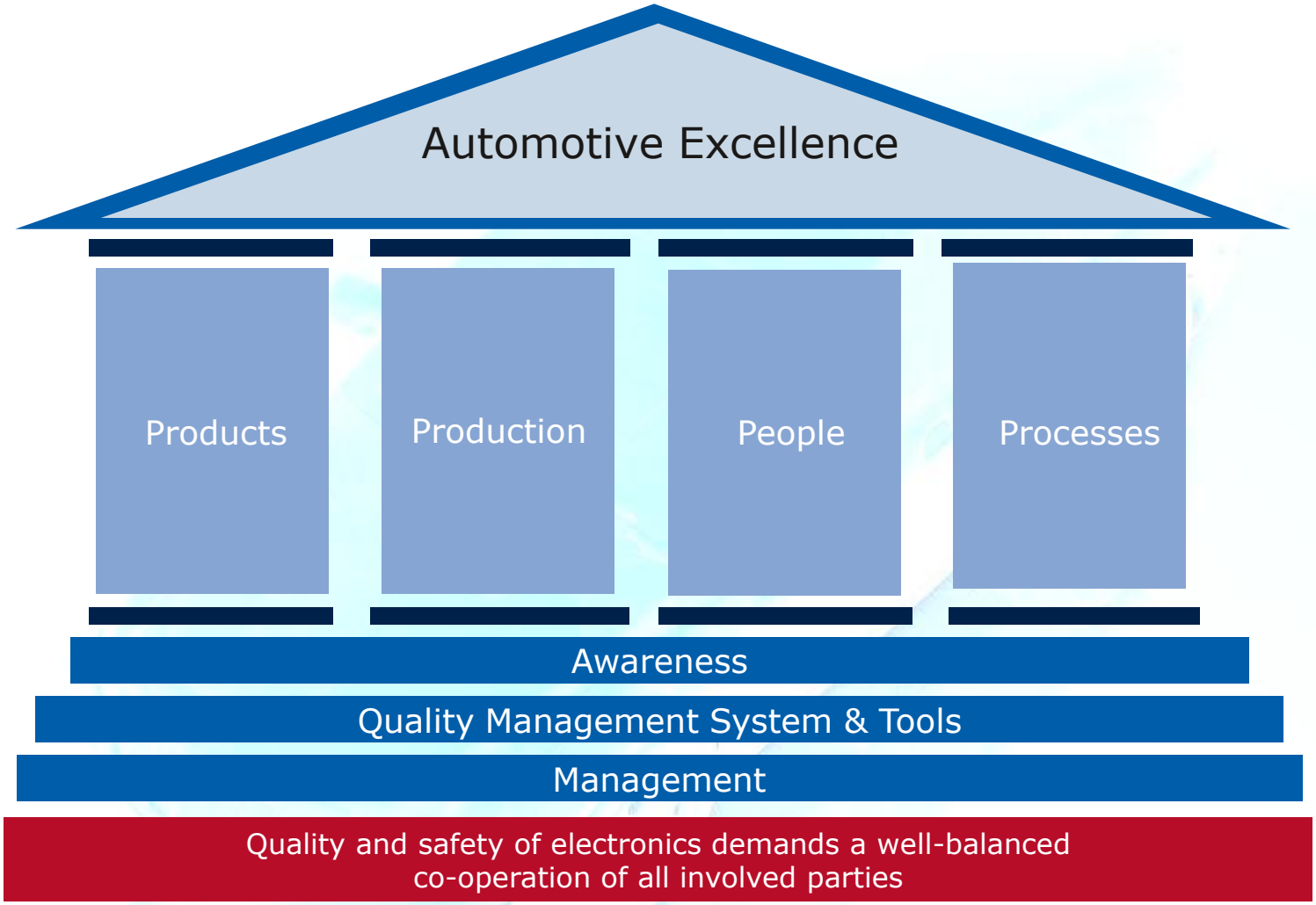
Automotive Excellence:
Most comprehensive quality program in the industry

Market leader in automotive semiconductors:
No. 1 worldwide, No. 1 in Europe, No. 2 in USA,

(Source: Strategy Analytics)

Automotive Excellence

The most comprehensive quality program in the industry



Automotive Excellence Program Setup
Responsibility and Accountability in the Line Organization is key for a successful program

Sponsor
Dr. Reinhard Ploss
Jochen Hanebeck
Claus Geisler
Michael Seitz

Program Manager
Alexander Müller

Project Office: Dr. G. Mauckner (ATV)
Dr. C. Zeller (Production)

Steering Commitee
Automotive Division Board and Operation Board

Business Lines	Production	Support Functions
Standard Power F. Schwertlein / L.A. Past	**Cluster Zero Defect Initiatives** A. Heitzer	**Power Technology Platform** T. Gutheit
Powertrain Safety & ASICs A. Doll / W. Glawischnig	**Frontend** Dr. H.D. Loewe Dr. M. Polzer	**Advanced Technology Management** A. Rahm
Body Power T. Fitzek / K. Jauck	**Assembly & Test Power** K.T. Ng C.H. Yang	**Supply Chain Management** S. Wollenberg M. Stegherr
Microcontroller P. Schäfer / R. Petter	**Assembly & Test CMOS** W.T. Gan Ch. Chan	**Sales & Marketing & Distr.** A. Müller
Sense & Control S. Hofschen / Dr. I. Trapp		**OEM Business Development** C. Preuschoff
Electric Drive Train M. Muenzer / Dr. Eschbaumer		**Quality Management** A. Müller C. Zeller/G. Mauckner/ E. Palmeda

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Automotive Excellence has goals and measureables

Goals

- Sustainable quality improvements by running projects and continuous improvement actions
- Growing towards a Zero-Defect Culture

Measurables

- Decrease of number of customer returns (FARs) and quality spills
- Increase of customer satisfaction (feedback & ratings)

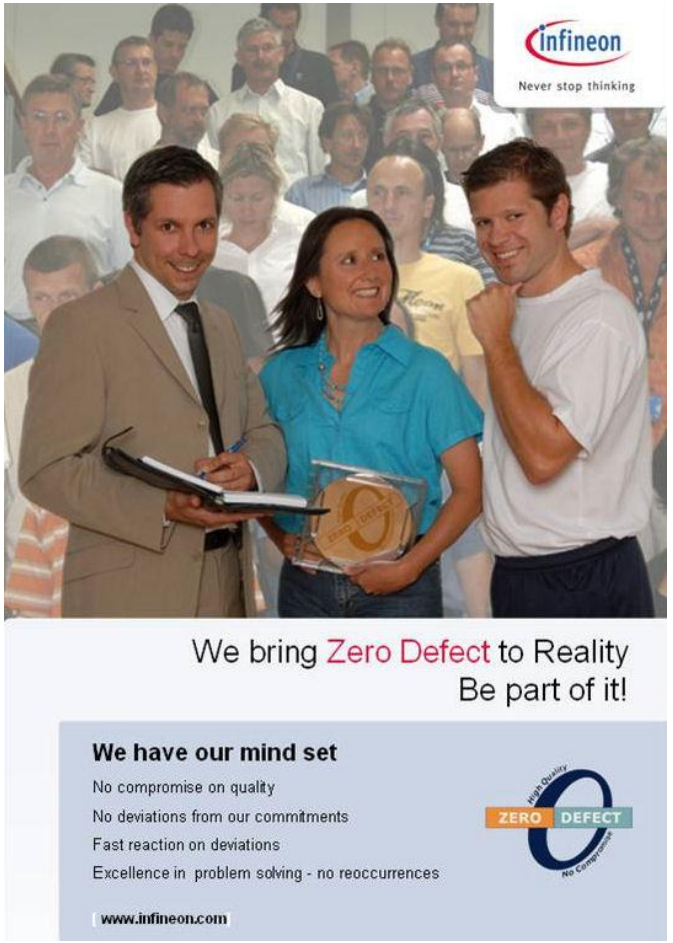
Our Zero Defect Policy

- **Zero Defect is a strategic mindset**
- **Zero Defect is . . .**

  - embedded in our business processes,
  - driven by our people, and
  - stimulated by personal senior management leadership

- **Zero Defect mindset means …**

  - No compromise on quality
  - No deviations from our commitments
  - Fast reaction on deviations
  - Excellence in Problem Solving – no reoccurrences



We bring Zero Defect to Reality. Be part of it.

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Project Management @ Automotive Excellence

- Dedicated project structure with representatives…
  - of all business lines, logistics, technology development and sales of the Automotive Division
  - of all production units

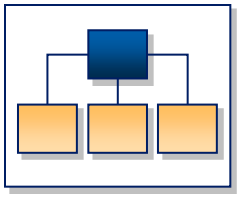
- Almost 6 years, more than 200 Sub-Projects from all areas with an active participation of more than 1000 Employees

- Methodology:
  - a systematic structuring of the projects according to the „4P – approach" into the 4 pillars „Products, Production, Processes, People" guarantees an holistic approach
  - Consequent project management for our activities
  - Review Meetings on working and management level
  - Program KPI Reviews

Automotive Excellence Program
Embracing all sites and lines worldwide

Enablers

- To establish and staff a dedicated AEX organization
- Consequent Project Management
- Regular Zero Defect review at sites / segments
- Quality Spill reviews



Relevant Production Sites

- Frontend (FE): Regensburg, Villach, Kulim, Dresden
- Backend (BE): Regensburg, Singapore, Batam, Malacca, Wuxi, Warstein

Relevant Automotive Business Lines

- Microcontroller
- Powertrain Safety & Asics
- Sense & Control
- Electric Drive Train
- Standard Power
- Body Power

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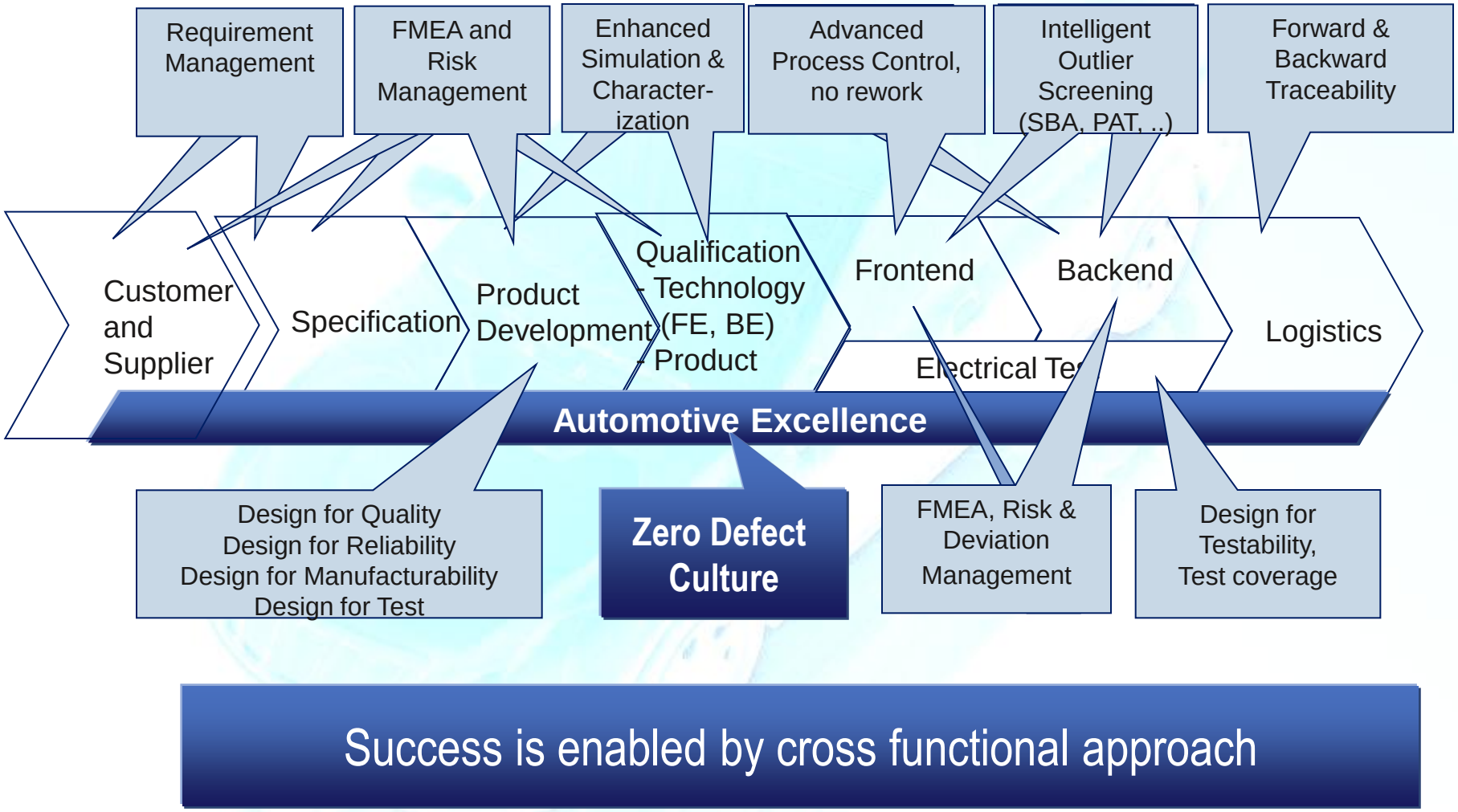
Examples of automotive quality measures implemented along the semiconductor value chain



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Our Way to a Zero Defect Culture
Your satisfaction has utmost importance

Full Management Commitment

Zero Defect Event Day

5S/Fuguai Program

Error Proofing

Zero Defect Training

Zero Defect Poster Campaign

Internal Audit

Quality Bonus

Zero Defect Culture - Change of mind set is the key enabler to achieve our goals

Who is able to contribute to success will be proud of it

Source: IFX, AEP Consultant

5th Birthday
Automotive Excellence Program

ZeroDefect
Zero Deviation from Requirements

AIM Quality Day

Tuesday, April 15th 2008 4 pm Casino Campeon

Dear Colleagues,
We warmly invite you to our AIM Quality Day under the motto 'Get into Dialog' on **Tuesday, April 15, 2008, starting at 4 p.m**.

Together we'll be celebrating five years Automotive Excellence Program. The afternoon will be centered on dialog with you. The various facets of 'Zero Defect – Zero Deviation from Requirements' will be explored in panel discussions, followed by in-depth debate in small rounds.

We'll be welcoming **Ernst Schmidt, Head Semiconductor Platforms & Technology Electronics BMW Group** in Munich as our guest. His talk will give insight into requirements management in the automotive industry and its significance for semiconductor manufacturers.

Zero Defect as Key for our Future Mindset

Target:

Highest awareness of

all employees on quality and

and customers expectations

Actions:

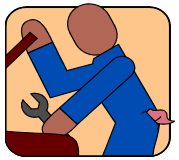
- Employee's training
- Target group oriented information given by managers
- Poster advertising
- Article in employees magazine
- Zero Defect exhibitions

Zero Defect Exhibitions at OPP FE

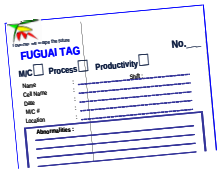
Regensburg and Villach

Abnormality Management System

We work to remove abnormality before it turns into defect



Identify & Fix abnormality



Classification of abnormality

Process?
Equipment?
Productivity?

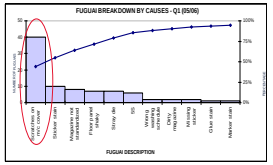
Tracking of abnormalities

What is abnormality?

Abnormality = Fuguai

- ***Not at standard condition***
- ***Different from the normal state***
- ***Any Difference in Sound, Color, feeling of Touch, Smell, Speed***

Identify focus areas



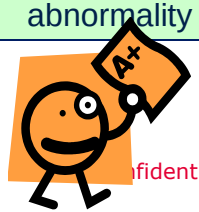
Analyze and Identify root cause

Man?
Method?
Material?
Machine?

Eliminate root cause

Human factor?
Poor design?
Incoming Material?
Handling Procedures?

Prevent future occurrence of abnormality



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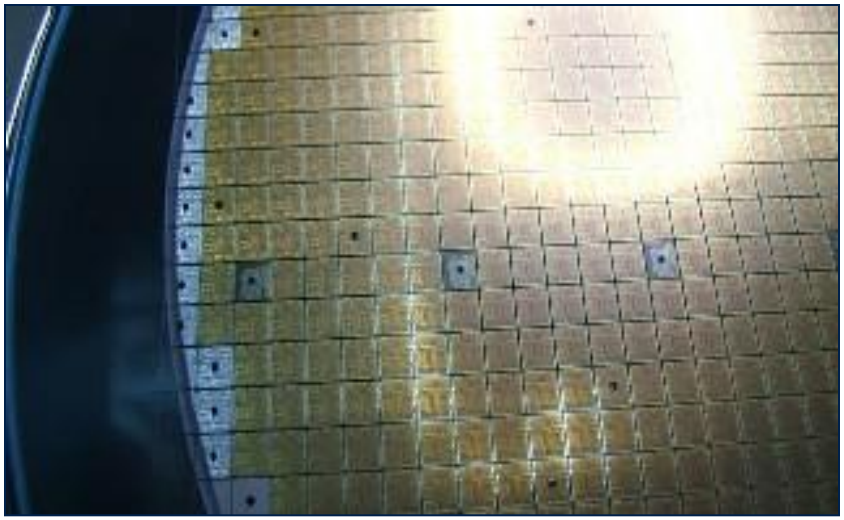
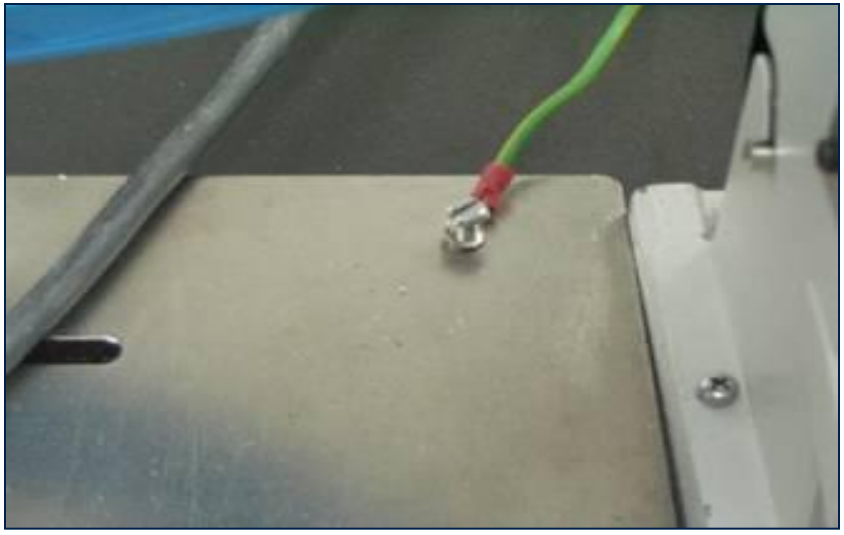
Examples of Fuguai ……..



Wafer Colour Variation

Water on the floor



Grounding Wire Not Secured

Tower Light Faulty

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Sustainable problem solving: No Reoccurrence

- We follow the 8D (8 disciplines) systematics
- We focus on 7.D: Permanent corrective actions and standardization
- Systematic rollout of solutions to all relevant fabs and sites
- Longterm follow-up of preventive actions within Automotive Excellence Program

1D: Team

2D: Problem verification

3D: Containment action

4D: Root cause analysis

5D: Corrective action and verification

6D: Implementation of corrective action

7D: Prevention

8D: Congratulate Team

8D flow

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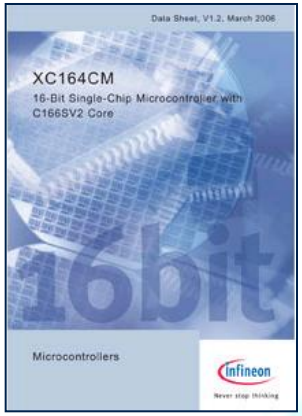
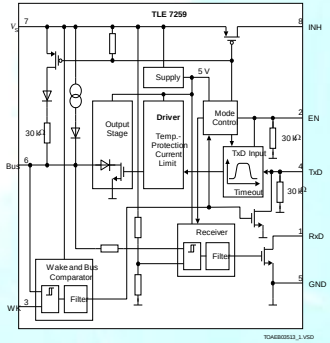
Excellent requirement management to ensure perfect fit for customer's application

Data Sheet



Chip Design



Product

Application

Customer requirements

An excellent data sheet is required to develop an excellent product that fits your application

Motivation for Data Sheet Excellence
Example of critical wording: Short Circuit Protection

General Description

- N channel vertical power MOSFET with charge pump, ground referenced CMOS compatible input and diagnostic feedback, monolithically integrated in Smart SIPMOS® technology.
- Fully protected by embedded protection functions

„Fully protected“ : What does it mean ?

Customer Impression: „Indestructible“

But:

- Protection functions are not meant for repetitive operation
- Depending on conditions any device can be damaged

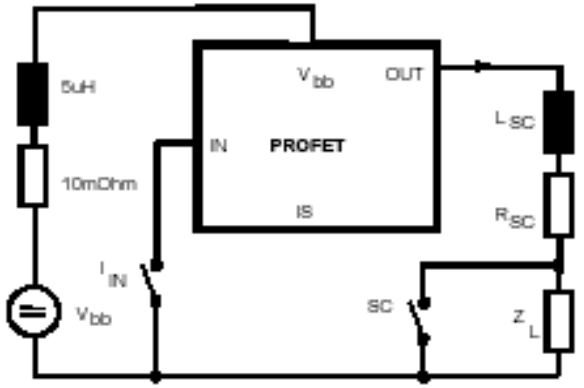
Data Sheet Excellence
Example: New Short Circuit Specification

Improved Version

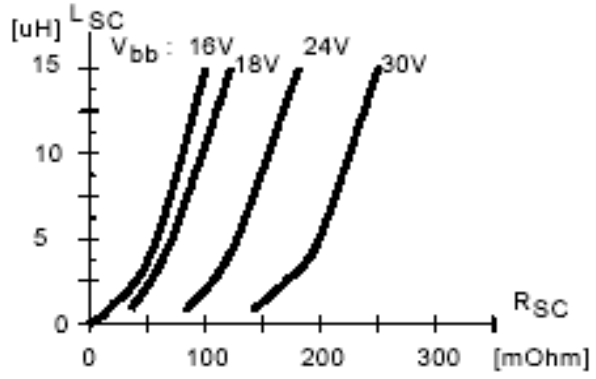
- Detailed description of Short Circuit protection feature
- Description of the Influence of inductance and resistance
- Showing the limits of the feature

Short circuit

Short circuit is a combination of primary and secondary impedance's and a resistance's.



Allowable combinations of minimum, secondary resistance for full protection at given secondary inductance and supply voltage for single short circuit event:



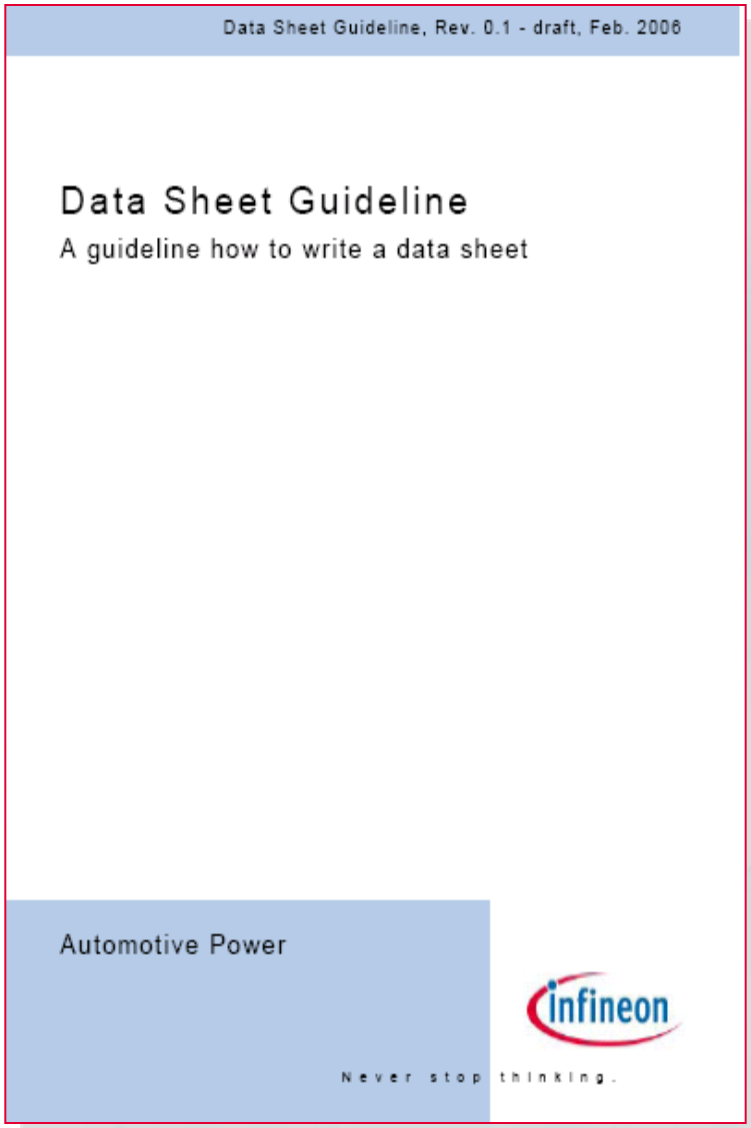
Data Sheet Excellence Team Tasks

- Review existing Data Sheets
- Create a guideline for writing Data Sheets
- Update the AP Data Sheet Template
- Define a release process for Data Sheets
- Roll-Out of guideline and release process

The Data Sheet Excellence Team is:

- Tobias Otter (AIM AP M AE)
- Günter Schwarzberger (AIM AP M AE)
- Andreas Kiep (AIM AP M AE)
- Jürgen Kositza (AIM AP M AE)
- Gunther Krall (IFNA AI)

Data Sheet Excellence
Data Sheet Guideline Topics



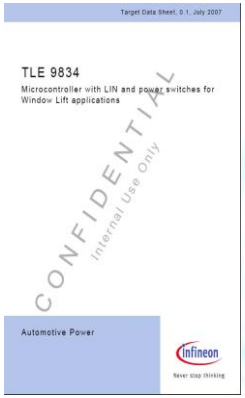
- Absolute Maximum Ratings
- ESD Definition
- Thermal Resistance
- Operation Range
- Short Circuit
- Functional Description
- Electrical Characteristics
- Application Diagram
- Legal terms

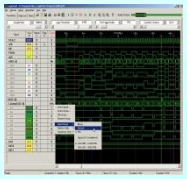
Only products with proof of design quality

Customer Requirements

Your advantage: Each of your requirements is reliably fulfilled

Data Sheet





almost automatically

Generic verification, validation plan

Experiments

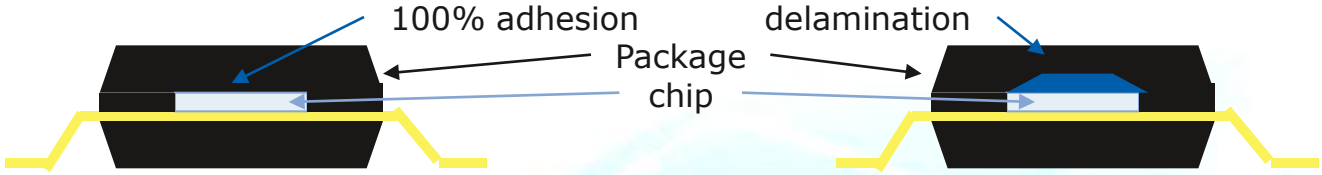
Stringent flow from requirements to simulation and lab measurement

Spec compliance due to full traceability and completeness of requirements

Reuse for simulation and lab verification

Automation in simulation/lab characterization and documentation

Our products are robust in automotive environment



Infineon OptiMOS™

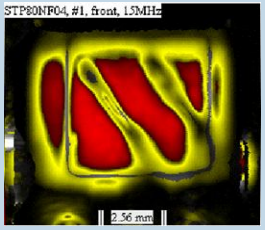
No delamination even after 260° C preconditioning and 1000TC with robust package

(TC = Temperature cycles)

4 different competitors

Total delamination already after 260° C preconditioning (red areas)

A



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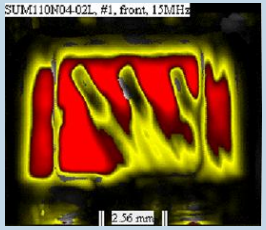

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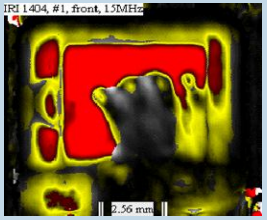

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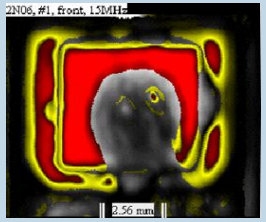

Your advantage: High reliability in the field

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Excellence in Production

- Examples of Automotive Excellence Projects
  - No rework
  - Advanced Process Control wafer fab
  - Advanced Process Control assembly
  - Via testchip and redundant vias
  - R2D2: Reliability Related Defect Density
  - Intelligent outlier screening

Due to our ‘No rework’ principle we deliver first-time-right products

No Rework in Front End and
Back End Production

A Zero Defect principle

Our engineers focus on process stabilization

Wafer flow in production interrupted due to process instabilities and rework

Smooth and stable production flow without interruption

Your advantage: You receive first-time right products

Excellence in Production

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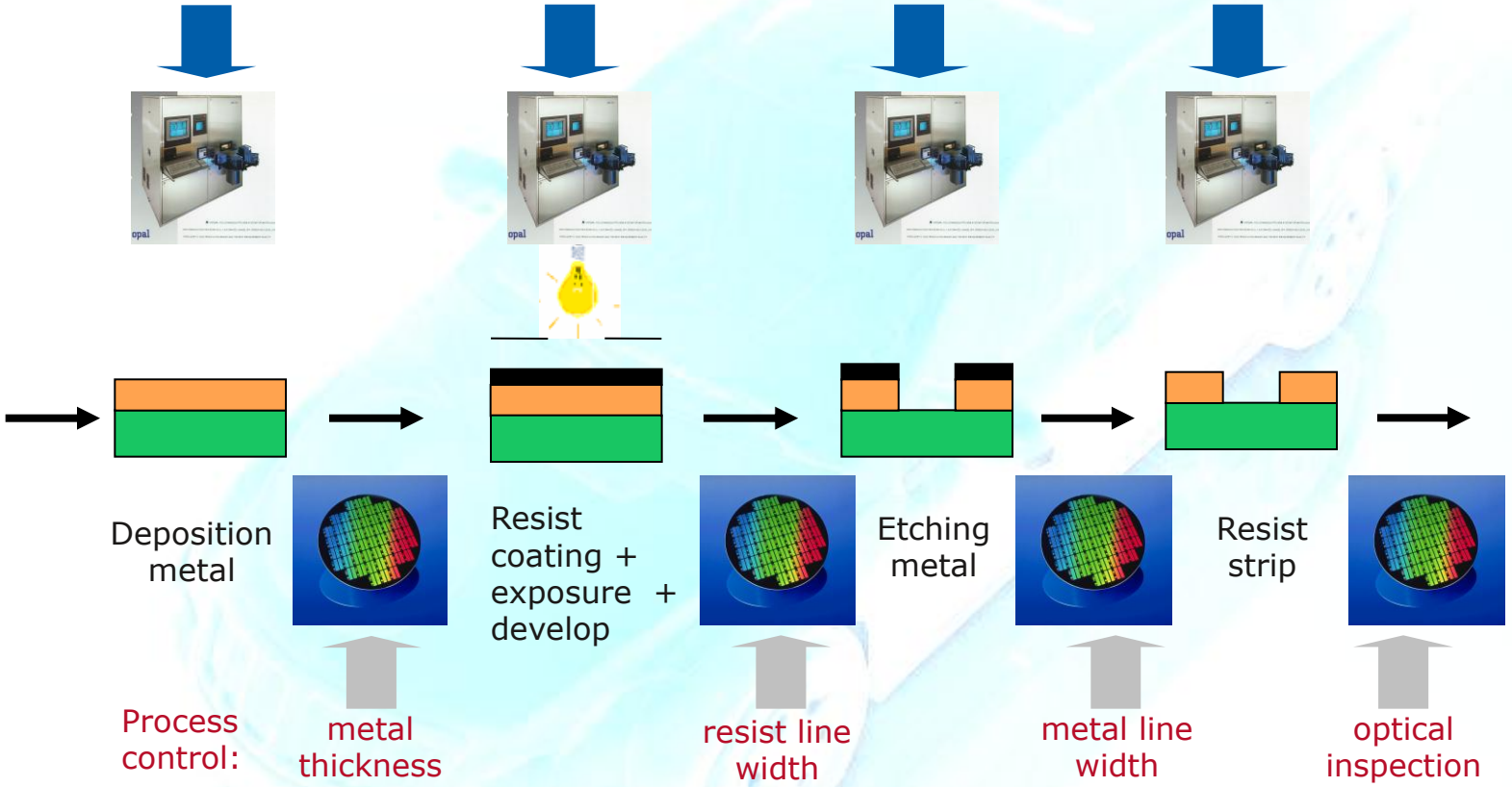
  - No rework
  - Advanced Process Control wafer fab
  - Advanced Process Control assembly
  - Via testchip and redundant vias
  - R2D2: Reliability Related Defect Density
  - Intelligent outlier screening

With Advanced Process Control we realize deviations before they affect the product

APC Advanced Process Control:
Real-time monitoring of key process parameter

New



SPC Statistical Process Control:
Control Limits and Process Capability cpk

Standard

APC = Equipment Integration + Fault Detection & Classification

Equipment Integration

Tool Integration Milestones	
T1	Specification agreed & Characterization done
T2	Tested in Simulation
T3	Tested with Equipment
T4	User Acceptance
T5	FDC tested and accepted
T6	Rollout to all tool instances
T7	Stability run
T8	Final acceptance

In principle available from T5
Operatively available from T8

Fault Detection and Classification

FDC Stage	Status	Description
0	NO USAGE	PDA is not ready.
1	PDA AVAILABLE	PDA is ready and accepted based on specification.
2	KN SETUP	Simple Keynumbers are set in Config
3	MONITORING	Keynumbers are build in Config; Systematic usage of APC trend. (includes LFA)
4	OOCAP	Systematic usage of APC Trend. Limits are set, reaction on violations during office hours. (EQ FMEA required)
5	MESSENGER	Same as "4" additional MESSENGER is switched on.
6	AUTO STOP	Same as "5" additional LH, INL and/or Tool Stop is switched on.
7	CONTINUOUS IMPROVE MENT	Constant usage of FDC for continuous improvement, e.g. Cpk, yield, scrap. Automatic stop reactions are set on 100% of FMEA requested Keynumbers.

no use

offline FDC use

online FDC fast reaction

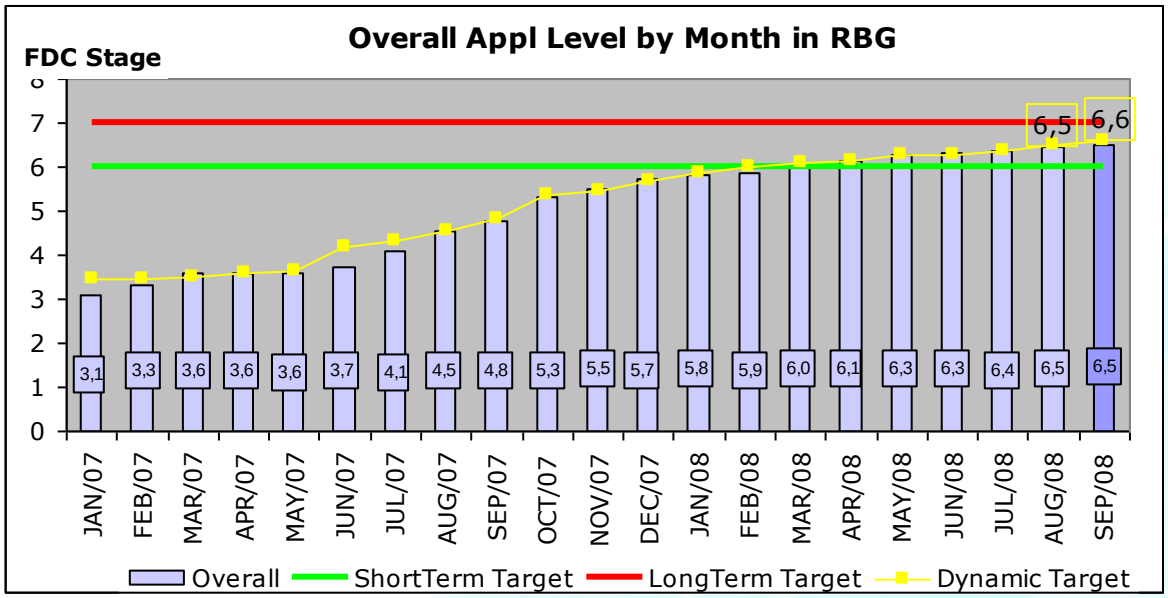
Living FDC

Definitions

Definitions

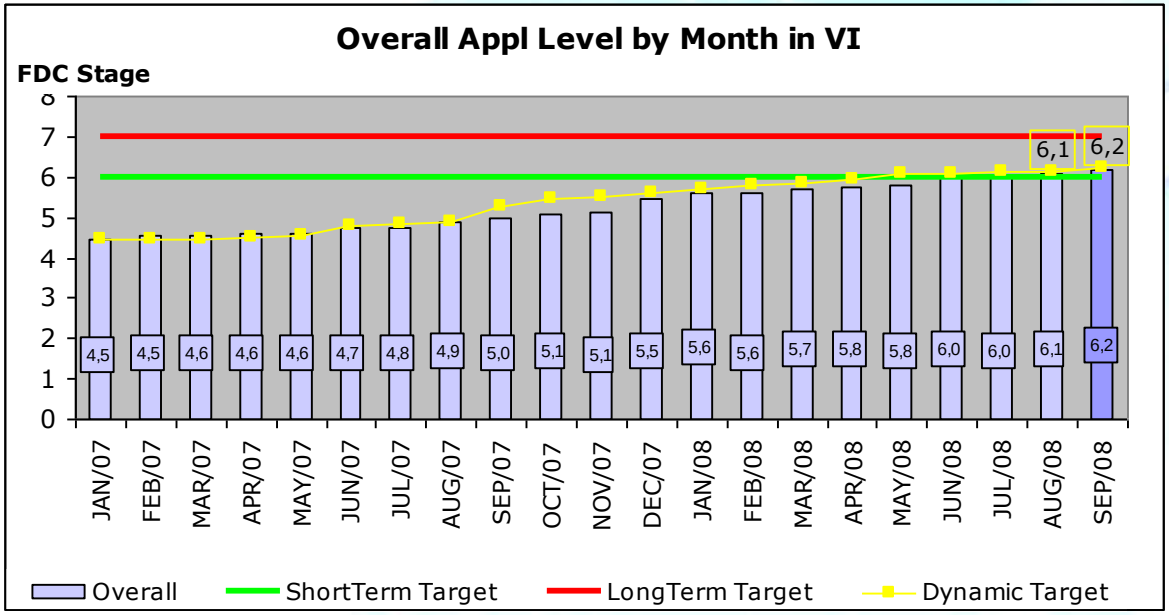
PDA = Process Data Acquisition

APC Road Map and Status Sept. 2008
RBG + VIH



RBG

- Overall FDC stage slightly above target



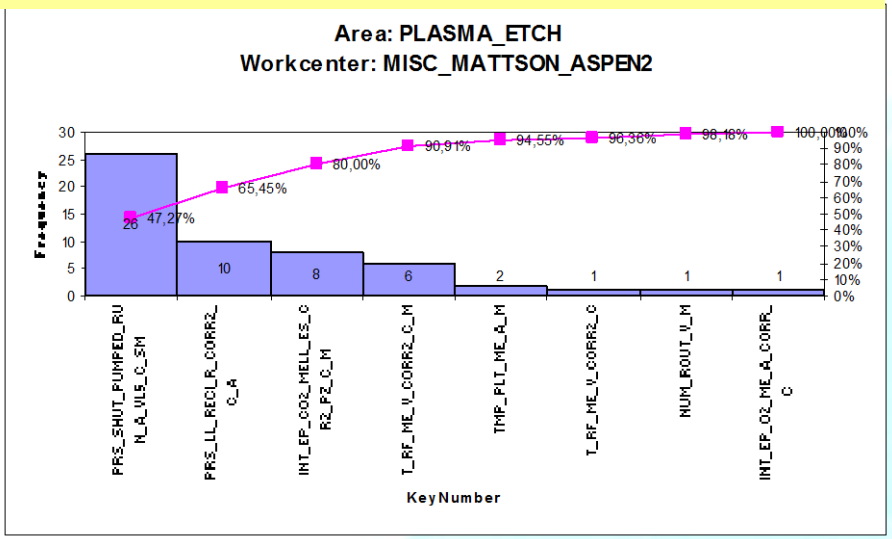
VIH

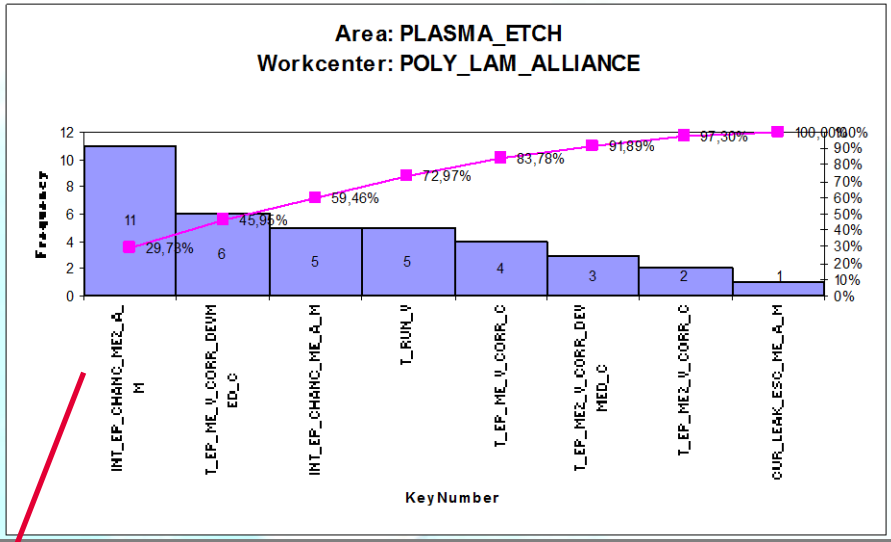
-FDC stage on target
-CR due to EI reasons (e.g. EI of ASM) and parameter availability from tool (eg. RCD Litho)

Quelle: K. Forster

Achievement:
Weekly APC Violation Review Meeting

Pareto Analysis:
Keynumbers with most violations



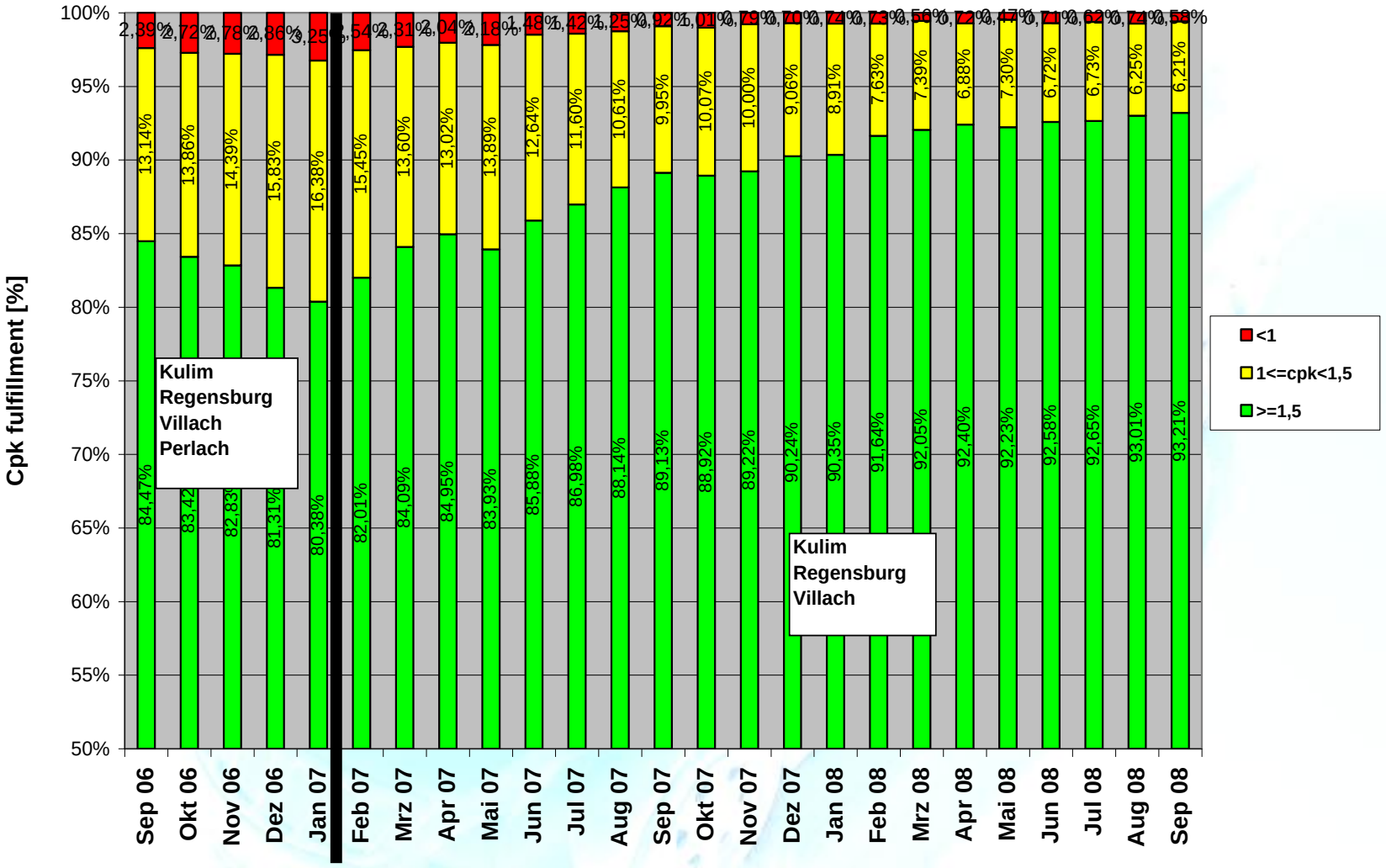


detailed analysis
of single violations

EQUIPMENT	BATCHID	LIMITID	FEATURENAME	MSG	INHIBIT	HOLDLOT	TOOLSTOP	DATUM
ALLIAN4	247315	2866566	INT_EP_CHANC_ME_A_M	1	1	0	0	19.01.2008
ALLIAN4	247315	2866813	INT_EP_CHANC_ME_A_M	1	1	0	0	19.01.2008
ALLIAN4	247315	2867195	INT_EP_CHANC_ME_A_M	1	1	0	0	19.01.2008
ALLIAN2	239801	2875261	INT_EP_CHANC_ME_A_M	1	1	1	1	23.01.2008
ALLIAN2	239800	2876920	INT_EP_CHANC_ME_A_M	1	1	1	1	23.01.2008
ALLIAN1	247312	2870171	INT_EP_CHANC_ME_A_M	1	1	0	0	21.01.2008

Detailed analysis and reporting:
Top 3 work centers per Area =>
key numbers with according equipment/recipe, defined action, status and due date
weekly limit violation review meeting with key user / UPS
running since March 2008

Result of APC:
Continuous increase of process stability

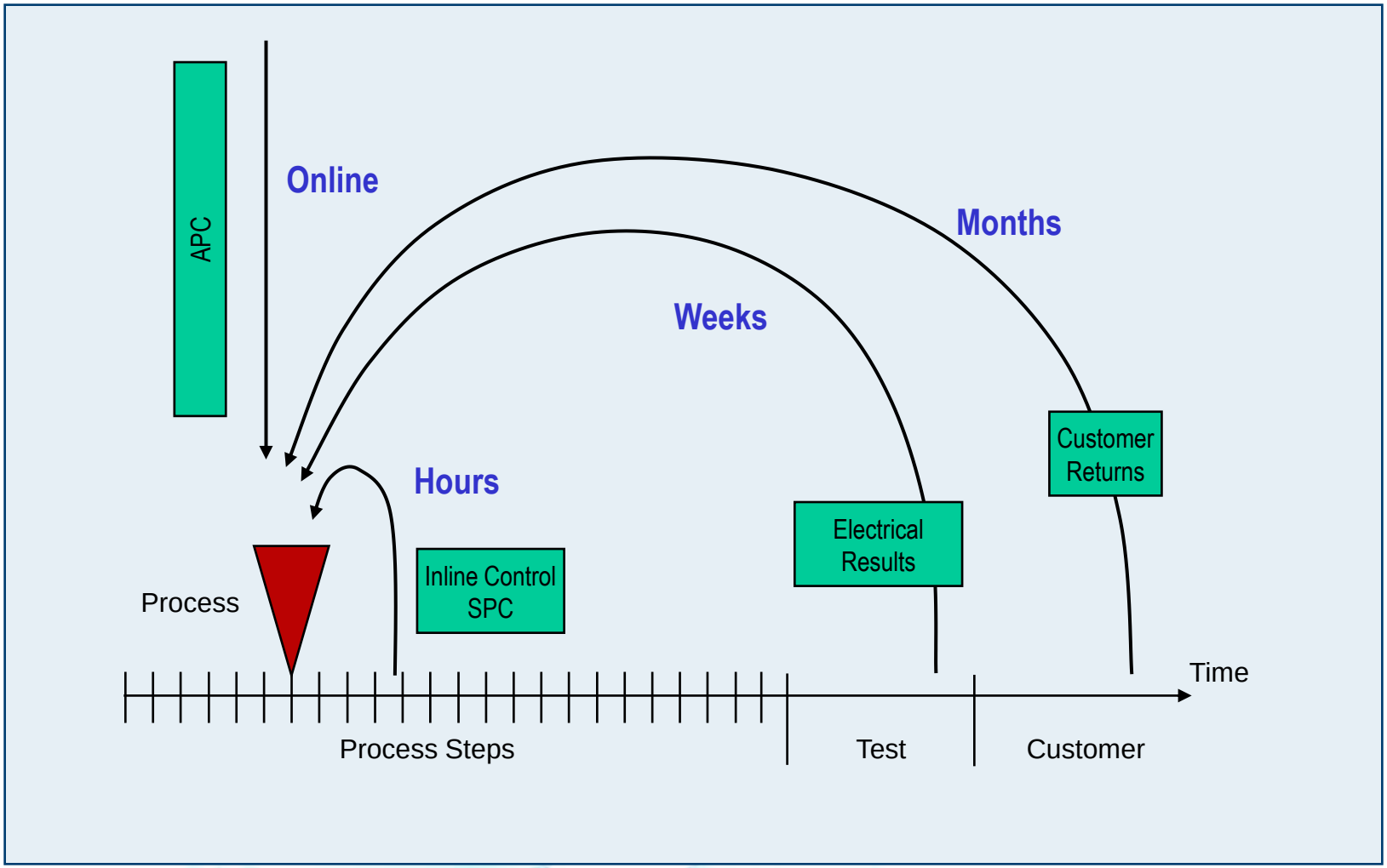


* Target for green process steps < 100% as continuously new processes are implemented

Excellence in Production

- Examples of Automotive Excellence Projects
  - No rework
  - Advanced Process Control wafer fab
  - Advanced Process Control assembly
  - Via testchip and redundant vias
  - R2D2: Reliability Related Defect Density
  - Intelligent outlier screening

APC (advanced Process Control) means we act on process deviations online, preventing deviations of the product

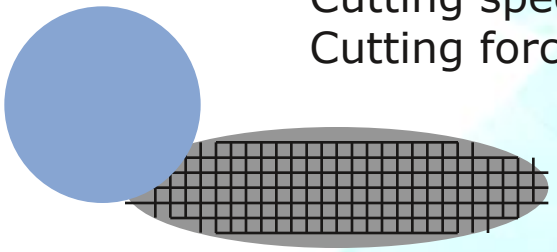


We invent innovative methods to detect deviations in the assembly fabs

Together with the tool vendors we develop sensors to measure tool parameters that are critical for the result of the process step.

Wafer Sawing:

Spindle speed
Cutting speed
Cutting force



Wire Bond:

Bond Force
Bond Power
Temperature

Moulding:

Speed
Position
Temperature
Transfer Pressure

Trim&Form:

Acoustic signals

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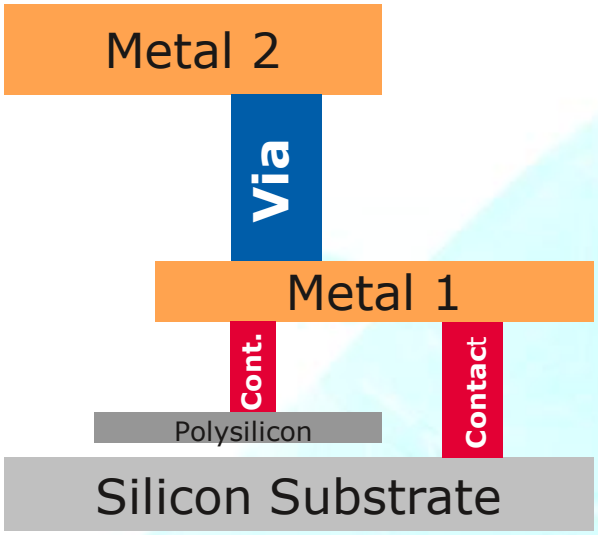
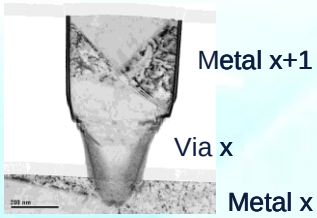
With via testchip and via doubling for µCs we came close to Zero Defects for via-related fails

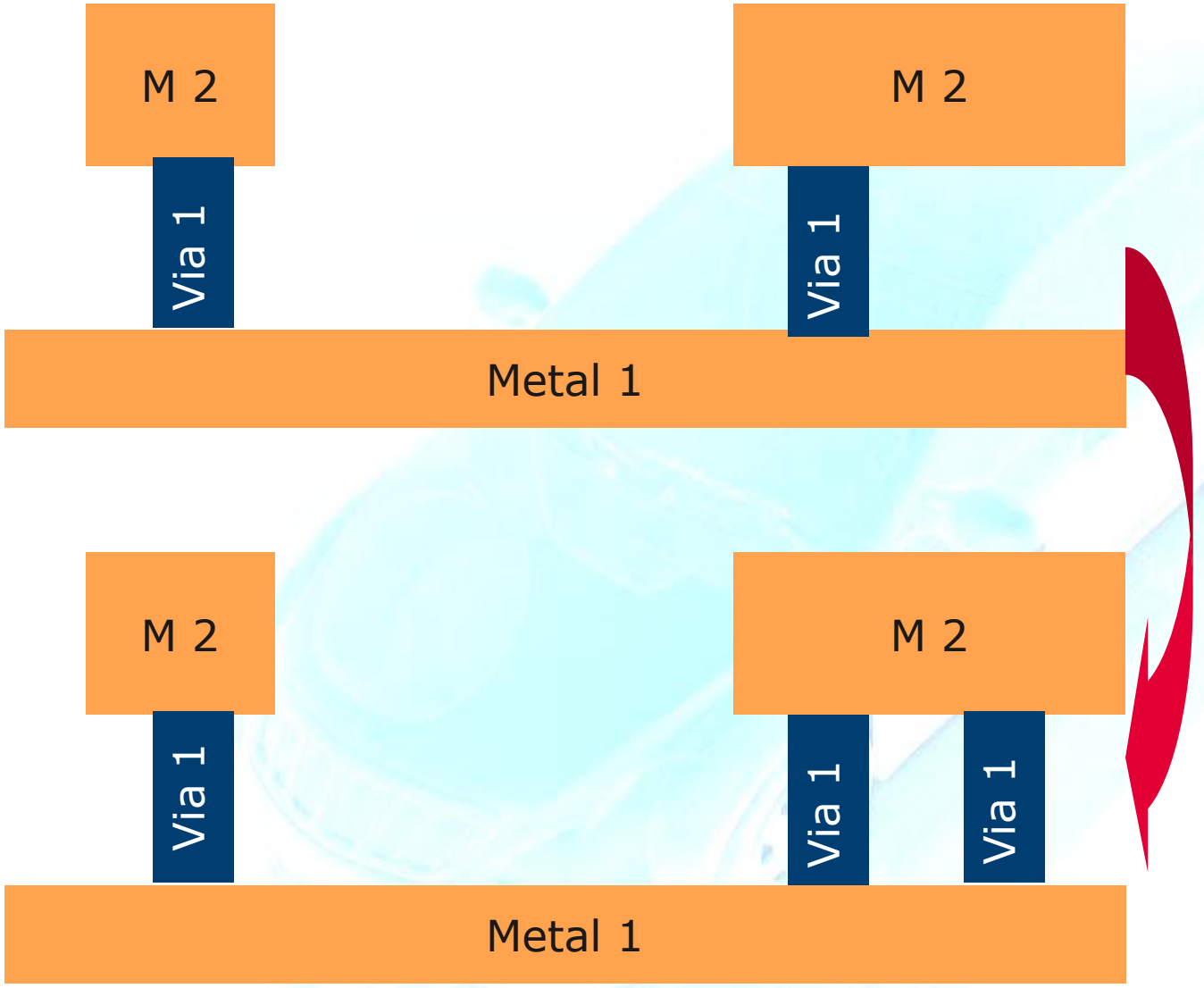




On a typical C11 chip there may be more than 10 million vias

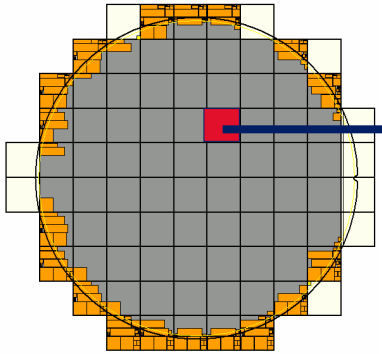
With our innovative via testchip and via doubling we reach a defect level for via related fails that is close to zero!

What is via – doubling?

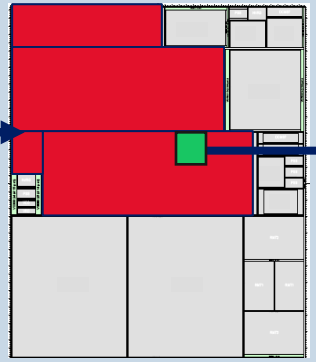


Automatic routine doubles vias, wherever possible

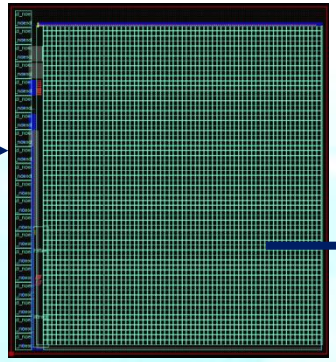
R2D2 Test Chip – Overview C11FLA



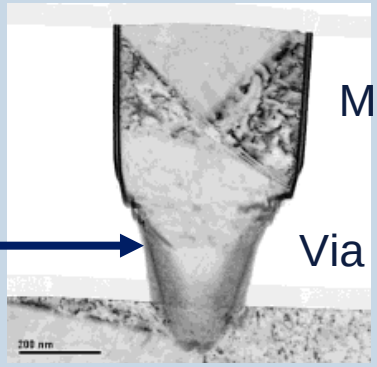
- 8 inch wafer
- 68 chips
- 12 wspw



- 4blocks with 34 arrays (40% of area)
- other structures



- 512x512 vias per array
- Each via is addressable



- contact holes (CA)
- all Via levels (till VQ) connecting thin wires
  all Via levels connecting fat wires
- stacked Vias
- misaligned Vias
- design rule variations
- short Via chains

Overall:
About 3.2 billion contacts/vias

Concept

- Measuring
- Analysis ⇒ Yield Improvement
- Stressing
- Measuring
- Analysis ⇒ Reliability Improvement

Excellence in Production

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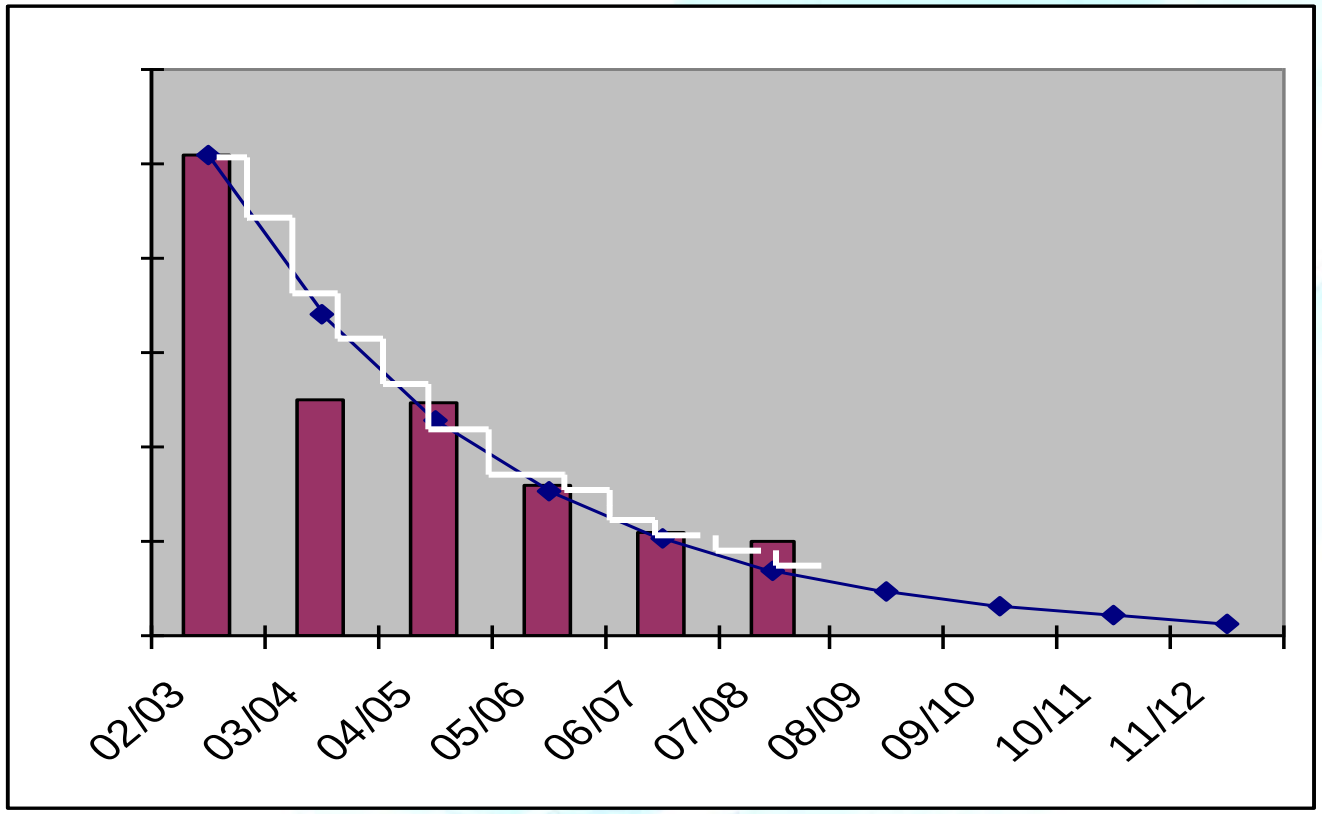
R2D2: Reliability Related Defect Density
Focus not only on yield -, but on reliability related defects

An essential contributor to ppm reduction is the continuous reduction of defects with impact on reliability



The continuous downward trend of ppm rates is the result of numerous activities:

Detection of single defects

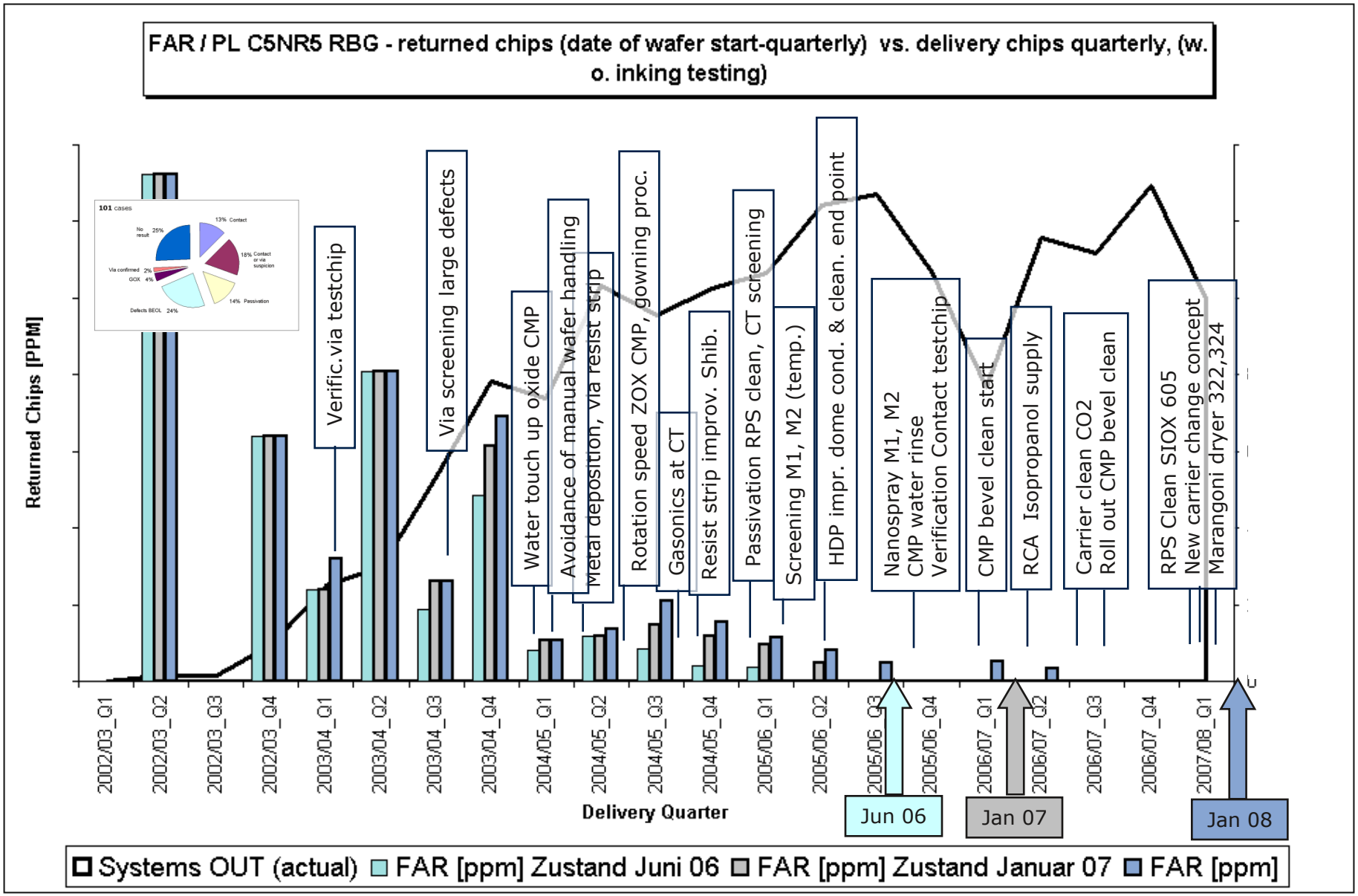
Pareto analysis

Root cause finding

Root cause elimination

One after the other…

Result of R2D2:
Continuous reduction of ppm rate



FAR data : M. Schmalzbauer, based on SAP

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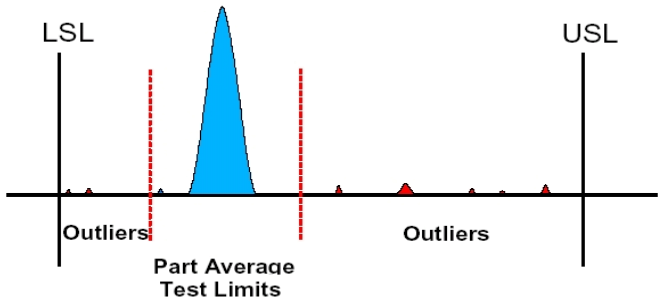
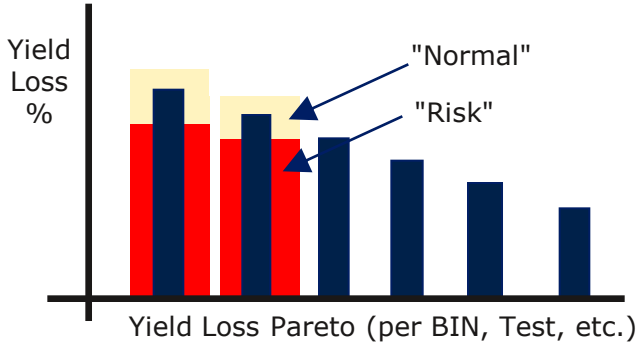
Highest outgoing product quality by intelligent outlier screening

X Intelligent PAT* Screening

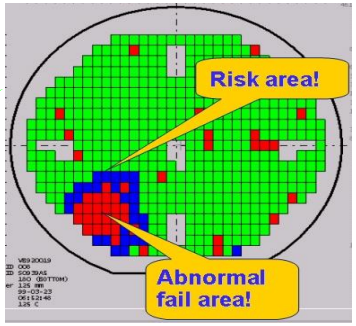


X under SBA** control



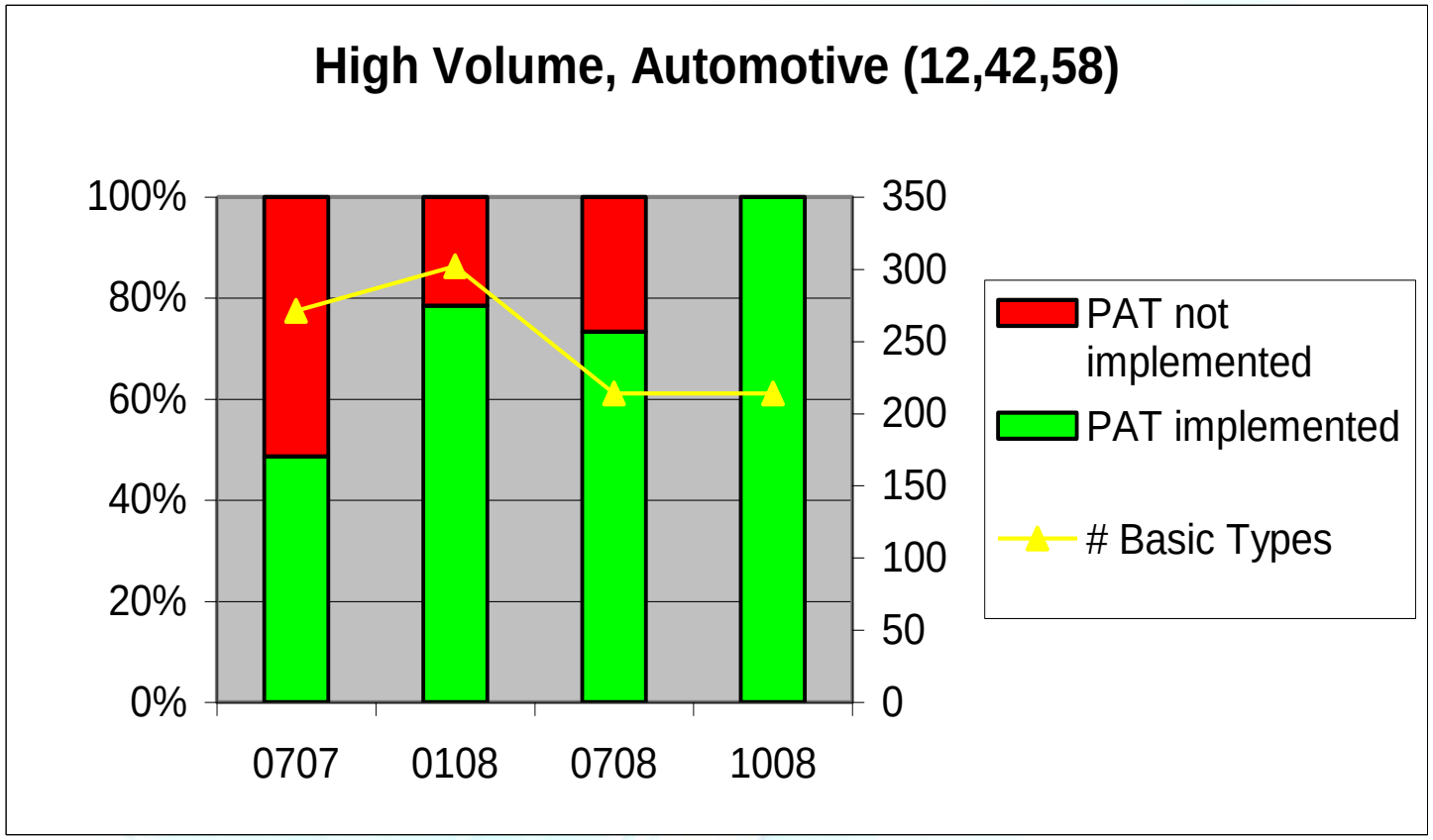
X with Pattern Recognition

Single & stacked



*PAT: Part Average Testing; **SBA: Statistical Bin Analysis

PAT
Implementation of PAT in automotive wafer fabs

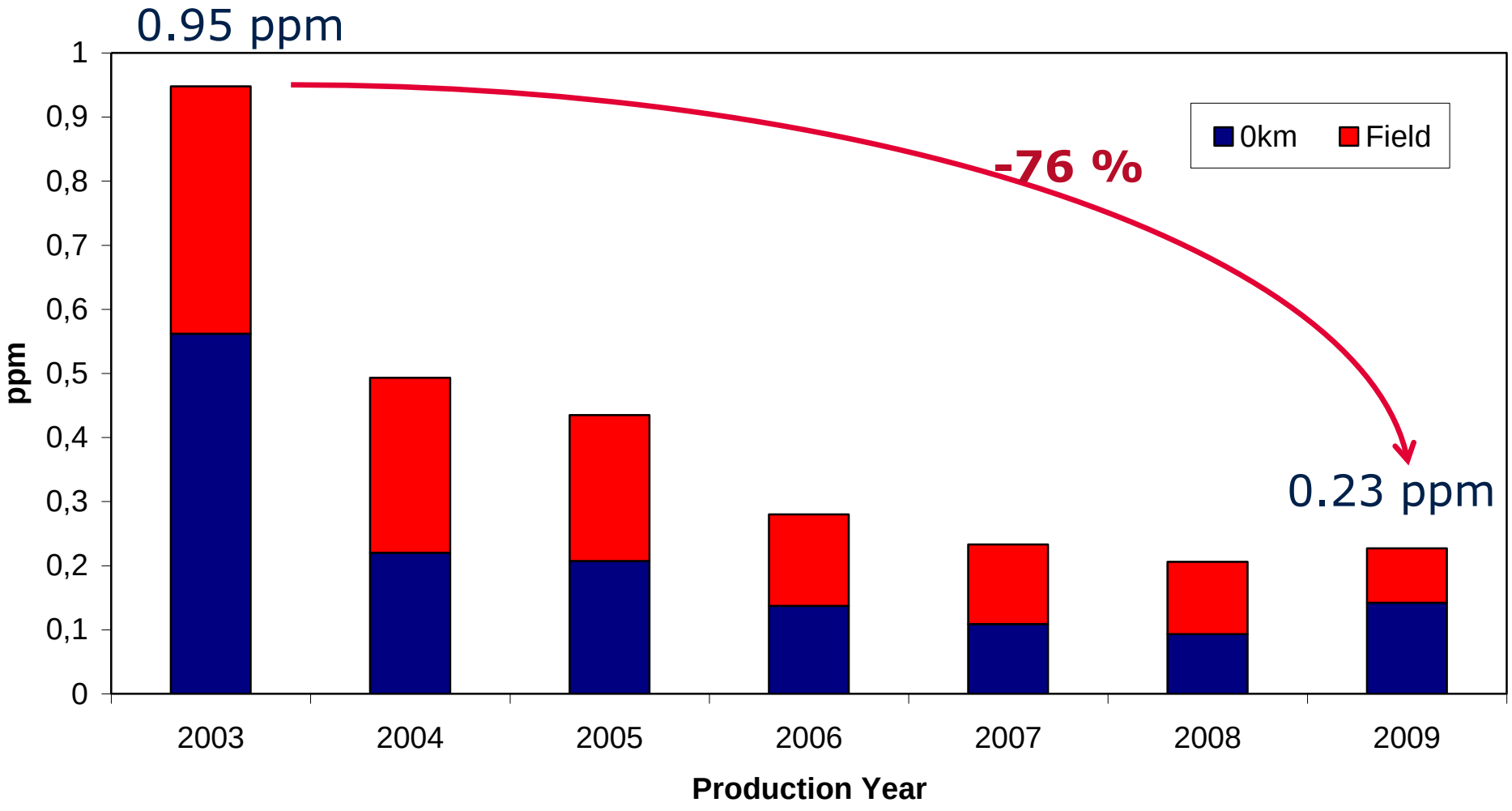


Implementation level all: 88 %
Implementation level suitable: 100 %

Content

- Motivation for “Zero Defect”
- Infineon “Automotive Excellence Program”
- Our Zero Defect Culture
- First Time Right in Product Development (examples)
- Excellence in Front End Wafer Production (examples)
- Excellence in Backend Production (examples)
- Our Quality is industry benchmark

Automotive Product Quality (0km + Field)



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Our customers appreciate our results

6 quality awards in 2004, 2006, 2007, 2008, 2009 and 2010 from Toyota's Hirose plant.

„Honor Quality Award Toyota Hirose" received in 2010 for zero defect quality for last four years. Infineon is the First non- Japanese company that received this honour in this highest level category.

"Automotive Supplier of the Year 2009" and "**Supplier Performance Award**" for the **Year 2008**

German "**TOPIT Award**" for the year 2008 for the Automotive Excellence Program

"**Hitachi Quality Award**" for the year 2006 for achieving customer satisfaction

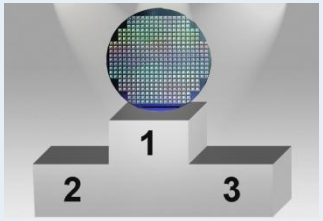
"**Bosch Supplier Award**" for the years 2005 and 2006

Automotive Excellence is the differentiator for your business success

Excellent Requirement Management

Zero Defect culture

Product Robustness



Intelligent Outlier Screening

No Rework

Infineon's Automotive Excellence Program is your competitive advantage

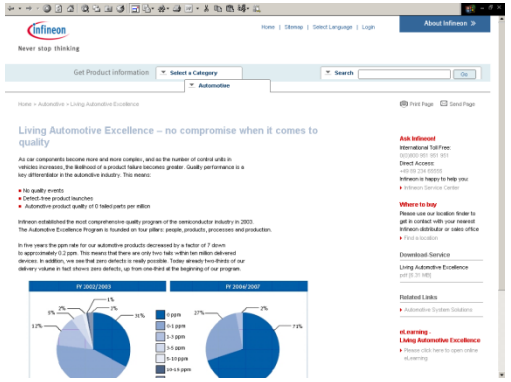
Our Quality is clearly seen as industry benchmark by almost all of our automotive customers.

Our target of Zero Defect means for you:

- no quality events
- defect-free product launches
- automotive product quality of 0 defect parts per million
- low non-conformance costs
- highest quality image in your market
- more business due to satisfied customers.

and finally …

Please visit our Automotive Excellence Webside

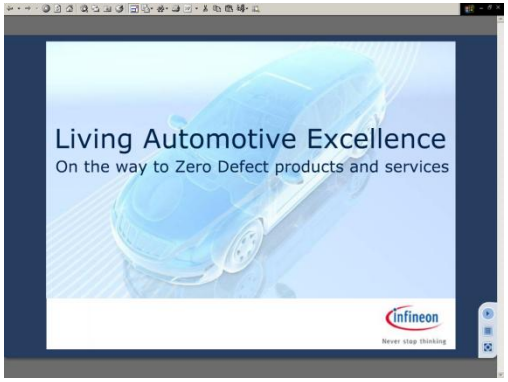


Homepage Hyperlink:

Living Automotive Excellence – no compromise when it comes to quality - Infineon Technologies

E-Learning Hyperlink (Flash Player):

Infineon Technologies –
Living Automotive Excellence



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"If there's a way to do something better, I'll find it."

Thomas Edison (1847-1931)