TRIZ シンポジウム 2008
The Fourth TRIZ Symposium in Japan

TEST POGO PINS REUSE PROGRAM

Paul Devaraj
INTEL Malaysia

Sept 10-12 2008, Japan

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Posted in "TRIZ Home Page in Japan", Jul. 2009

Intel World Wide Assembly Test Sites

MALAYSIA-PENANG
1972: Assembly Plant
1978: Test Operations

MALAYSIA-KULIM
1996: Kulim Plant Started

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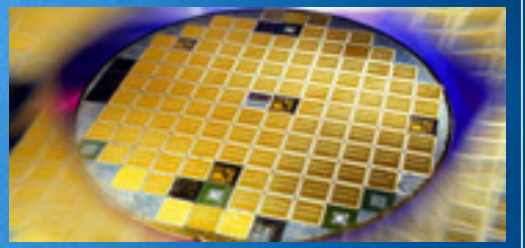
Intel – Manufacturing Overview



Assembly

↓

TEST

↓

BACK END

↓

DISTI

TEST

INTEL TEST TECHNOLOGY

Multiple Test Platform Environment

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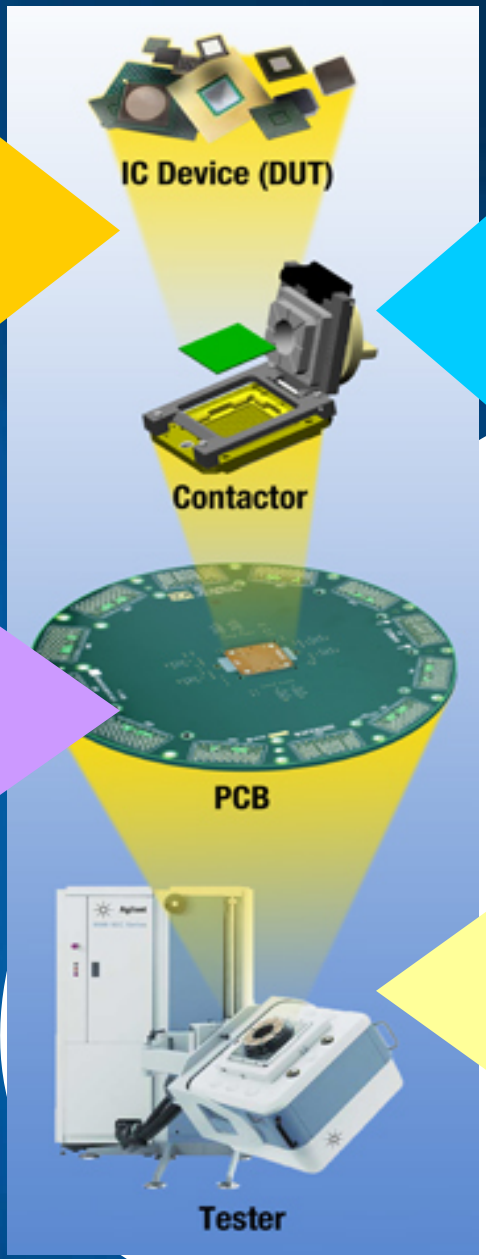
Intel – Generic Test Setup

At Intel Malaysia we're Assembling and Testing 1000's of Product Types – Ranging from Digital, RF and Mixed Signal Devices

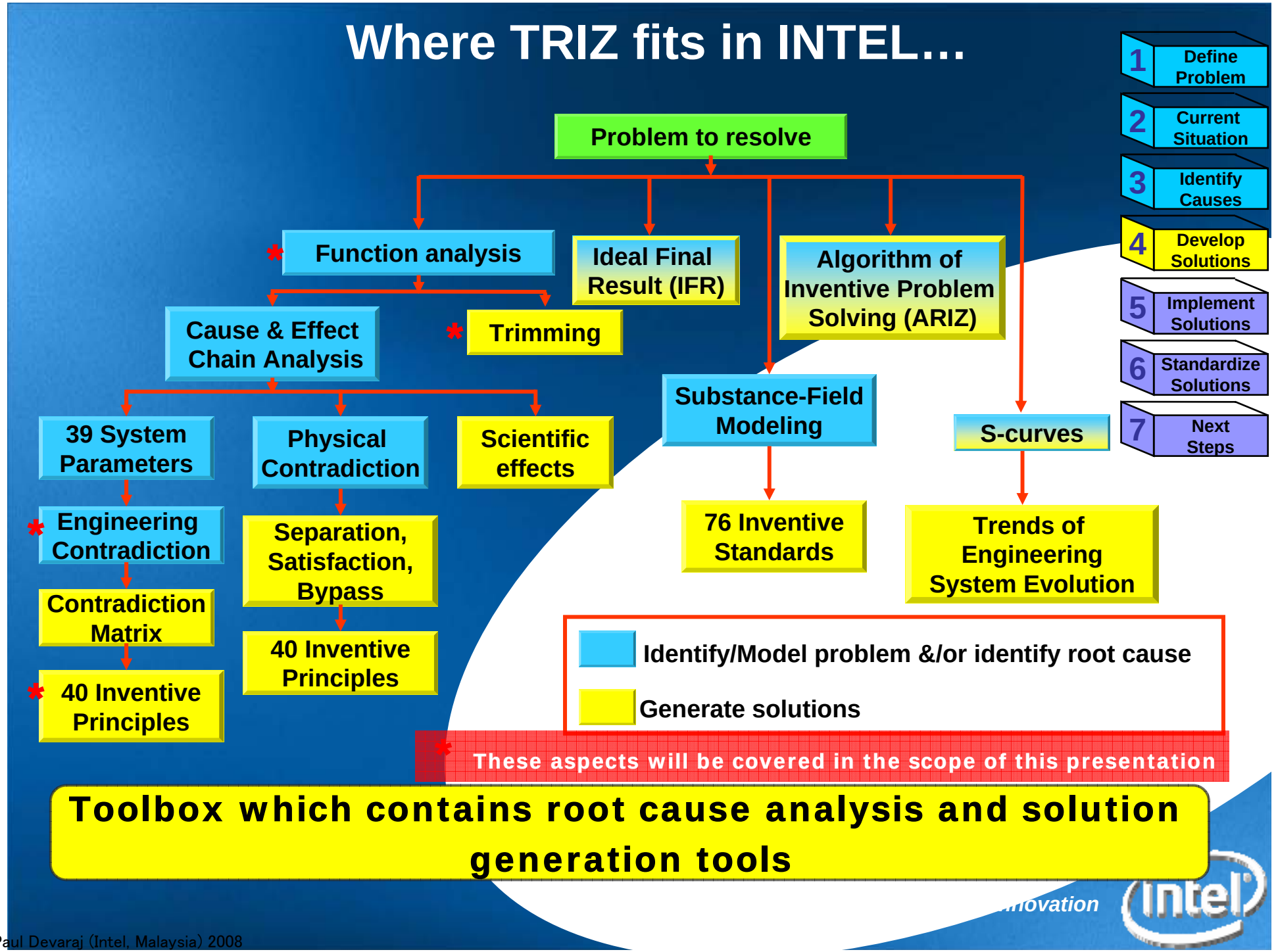
There are many different Test Contactors, depending on device Assembly Technology and Product form factor

There are many different types of TIU (Test Interface Unit), unique to the product

There are 3 different testers - RF, Mixed Signal and full digital high speed testers



Where TRIZ fits in INTEL…



Toolbox which contains root cause analysis and solution generation tools

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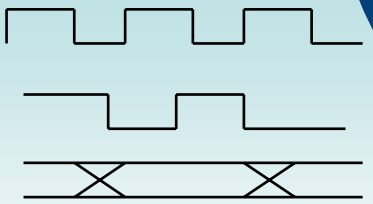
Test manufacturing - brief introduction

Test Program

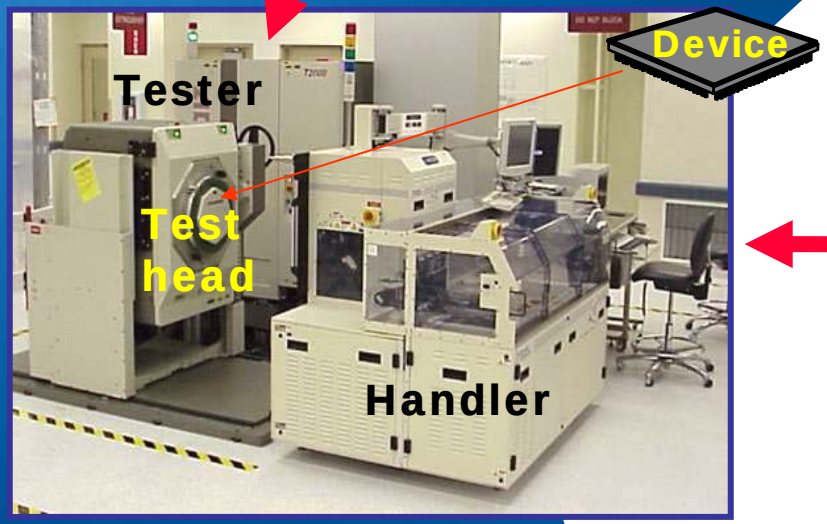


101001010000001
101000111111111

Code generation

Vector generation / validation

Software



Hardware

3.2.1.4 General Purpose Digital-to-analog Converter

The general purpose DAC is used for control functions.

Table 11. Monitor and Control DAC General Description

Parameter	Description
Resolution	
Output typ	
Reference	

Device Datasheet

Table 12. Monitor

Effective r				t
Conversion rate	0.1		10	Msps
DAC_VDD range (powered by the Intel® PRO/Wireless 5116's 3.3 analog VDD)	3		3.6	V
DAC digital voltage (powered by the Intel® PRO/Wireless 5116's 1.2 analog VDD)	1.1		1.3	V
Integral nonlinearity	-1		+1	LSB
Differential linearity	-0.5		+0.5	LSB
Zero code error			2	LSB
Output range without damage	0		DAC_VDD - 0.2	V
Output load compliance			10 10	kΩ pF
Maximum stable load			10 5	kΩ pF
Linear output range	GPDACX_REF_M		GPDACX_REF_P	V
High-reference range (GPDACX_REF_P)†	0.5		DAC_VDD - 0.2	V
Low-reference range (GPDACX_REF_M)†	0		DAC_VDD - 1.6	V
Settling time (to < 1% error)			100	ns

† GPDACX_REF_P > GPDACX_REF_M

...novation

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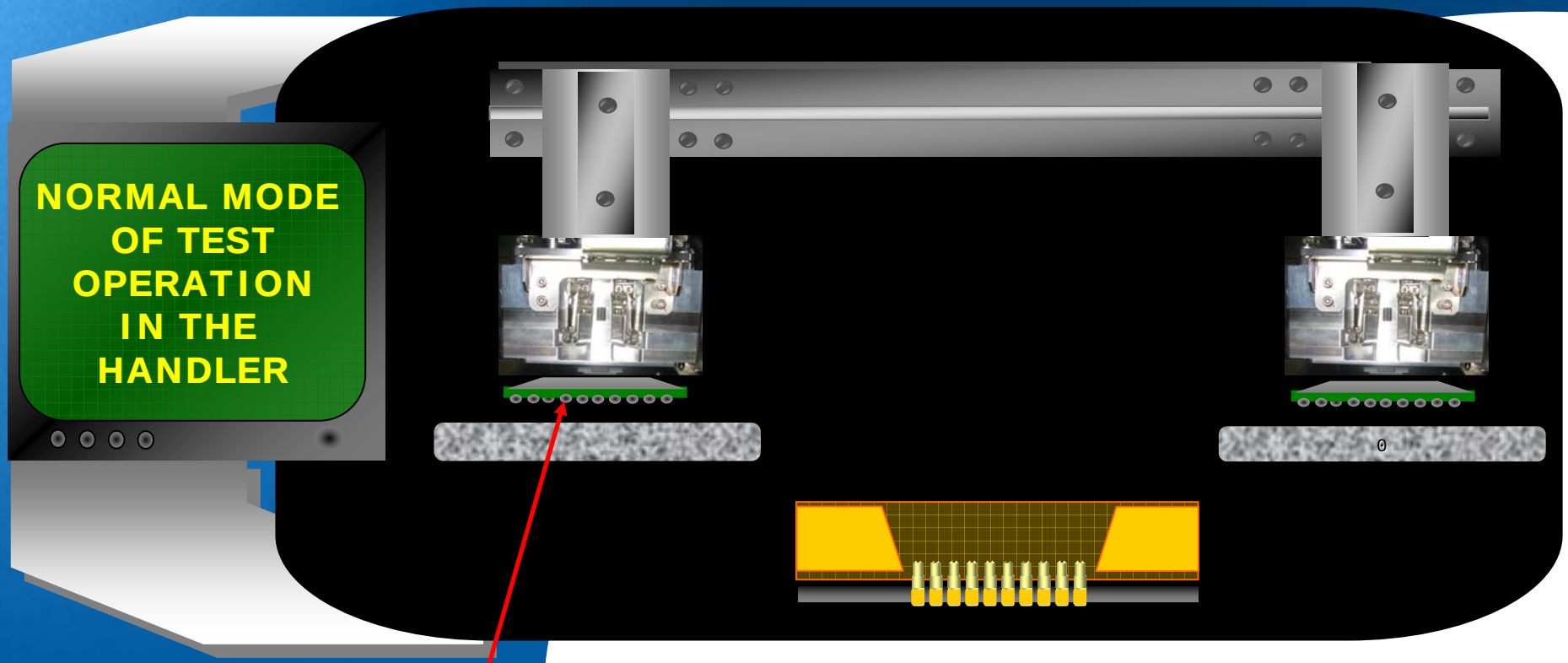
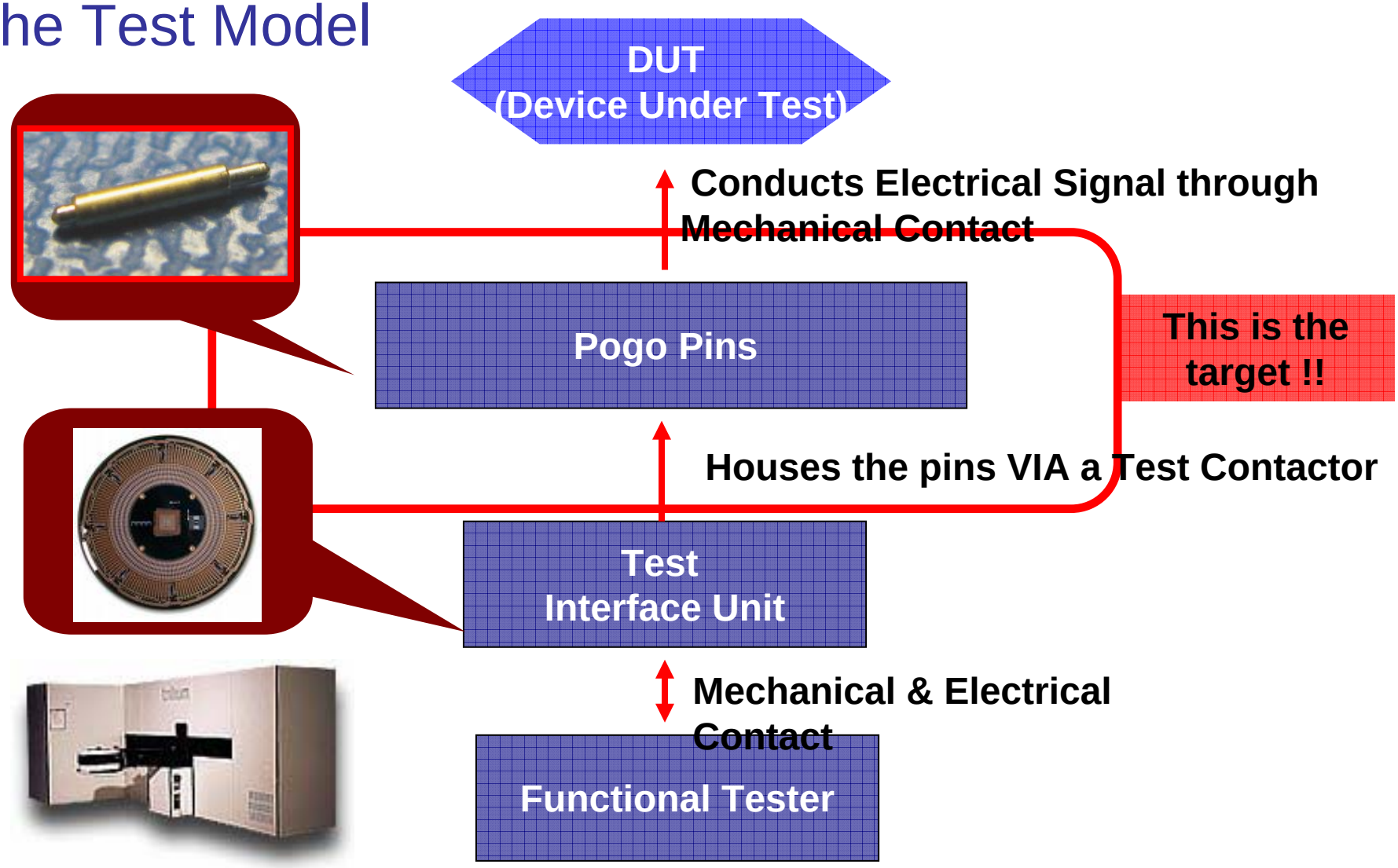
Introduction to Drop and Test Methodology

GENERAL HANDLER PICK AND PLACE MECHANISM



TRIZ – Problem Statement

The Test Model



Problem Statement

Original Problem Statement:

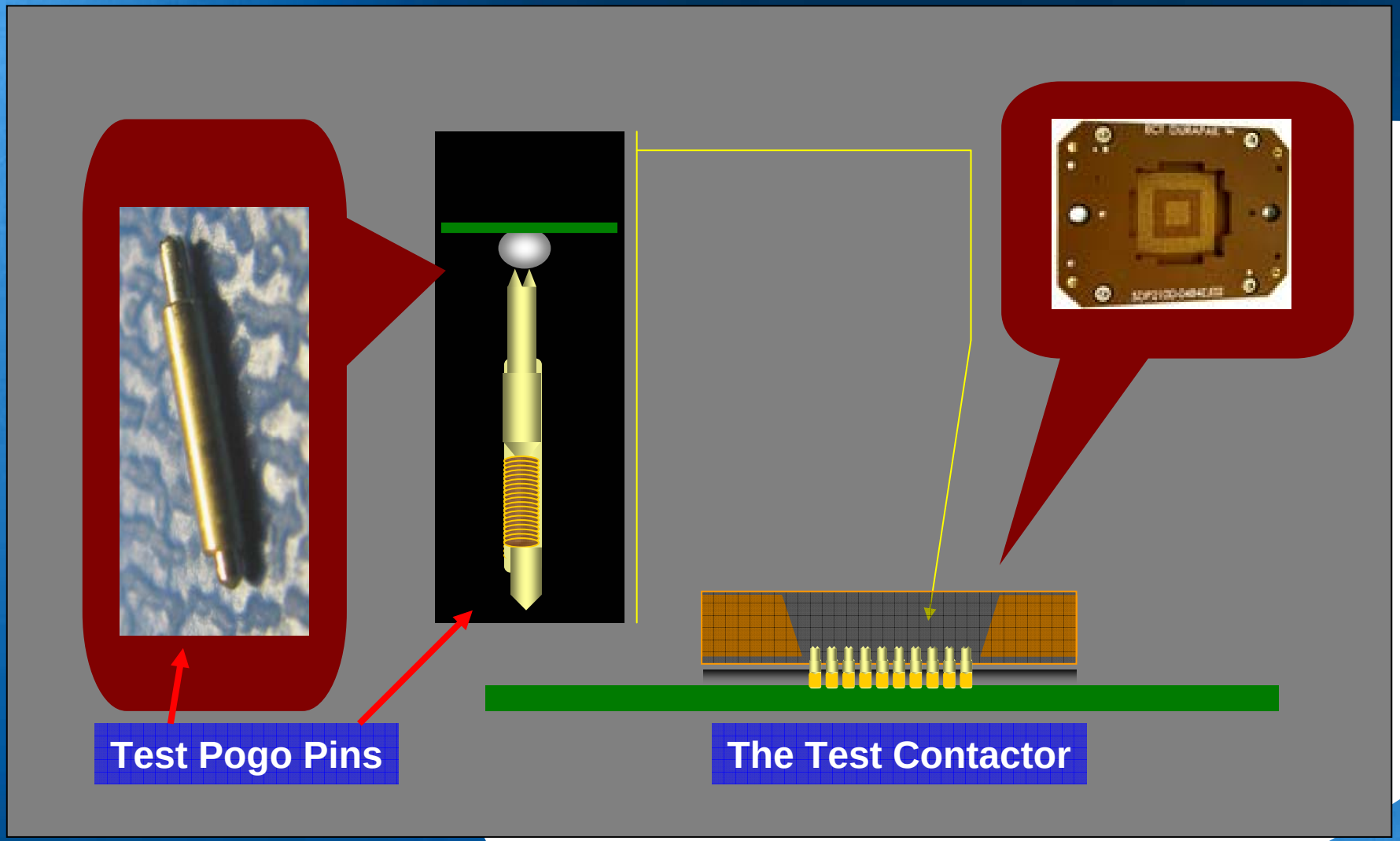
High Test Cost resulted by Pogo Pin

Actual Problem Statemen

Short Pin life and l

pins per socke

Test Pin Mechanics



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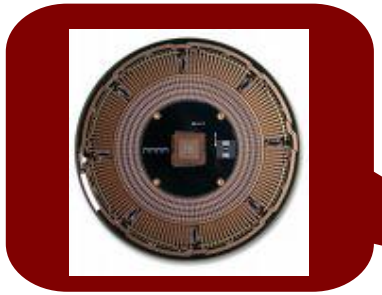
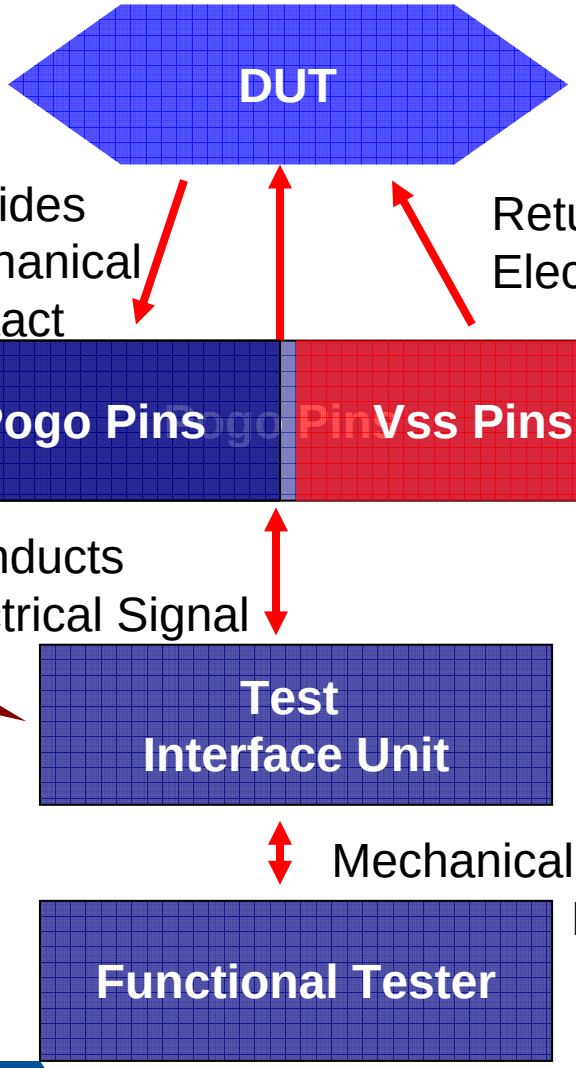
TRIZ – Problem Statement

The Test Model





List of the 40 Principles

Principle 1. Segmentation
Principle 2. Taking out
Principle 3. Local quality
Principle 4. Asymmetry
Principle 5. Merging
Principle 6. Universality
Principle 7. "Nested doll"
Principle 8. Anti-weight
Principle 9. Preliminary anti-action
Principle 10. Preliminary action
Principle 11. Beforehand cushioning
Principle 12. Equipotentiality
Principle 13. 'The other way round
Principle 14. Spheroidality - Curvature
Principle 15. Dynamics
Principle 16. Partial or excessive actions
Principle 17. Another dimension
Principle 18. Mechanical vibration
Principle 19. Periodic action
Principle 20. Continuity of useful action
Principle 21. Skipping
Principle 22. "Blessing in disguise" or "Turn Lemons into Lemonade"
Principle 23. Feedback
Principle 24. 'Intermediary'
Principle 25. Self-service
Principle 26. Copying
Principle 27. Cheap short living objects
Principle 28. Mechanics substitution
Principle 29. Pneumatics and hydraulics
Principle 30. Flexible shells and thin films
Principle 31. Porous materials
Principle 32. Color changes
Principle 33. Homogeneity
Principle 34. Discarding and recovering
Principle 35. Parameter changes
Principle 36. Phase transitions
Principle 37. Thermal expansion
Principle 38. Strong oxidants
Principle 39. Inert atmosphere
Principle 40. Composite materials

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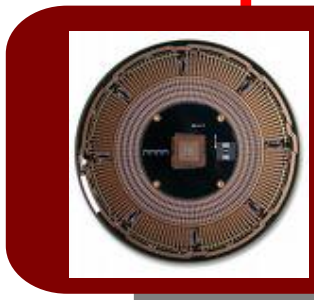
TRIZ – Problem Statement

The Test Model



DUT

Provides Mechanical Contact

Return path for Electrical Signal

Pogo Pins

Vss Pins

This is the target !!

Conducts Electrical Signal

Segmentation

List of the 40 Principles
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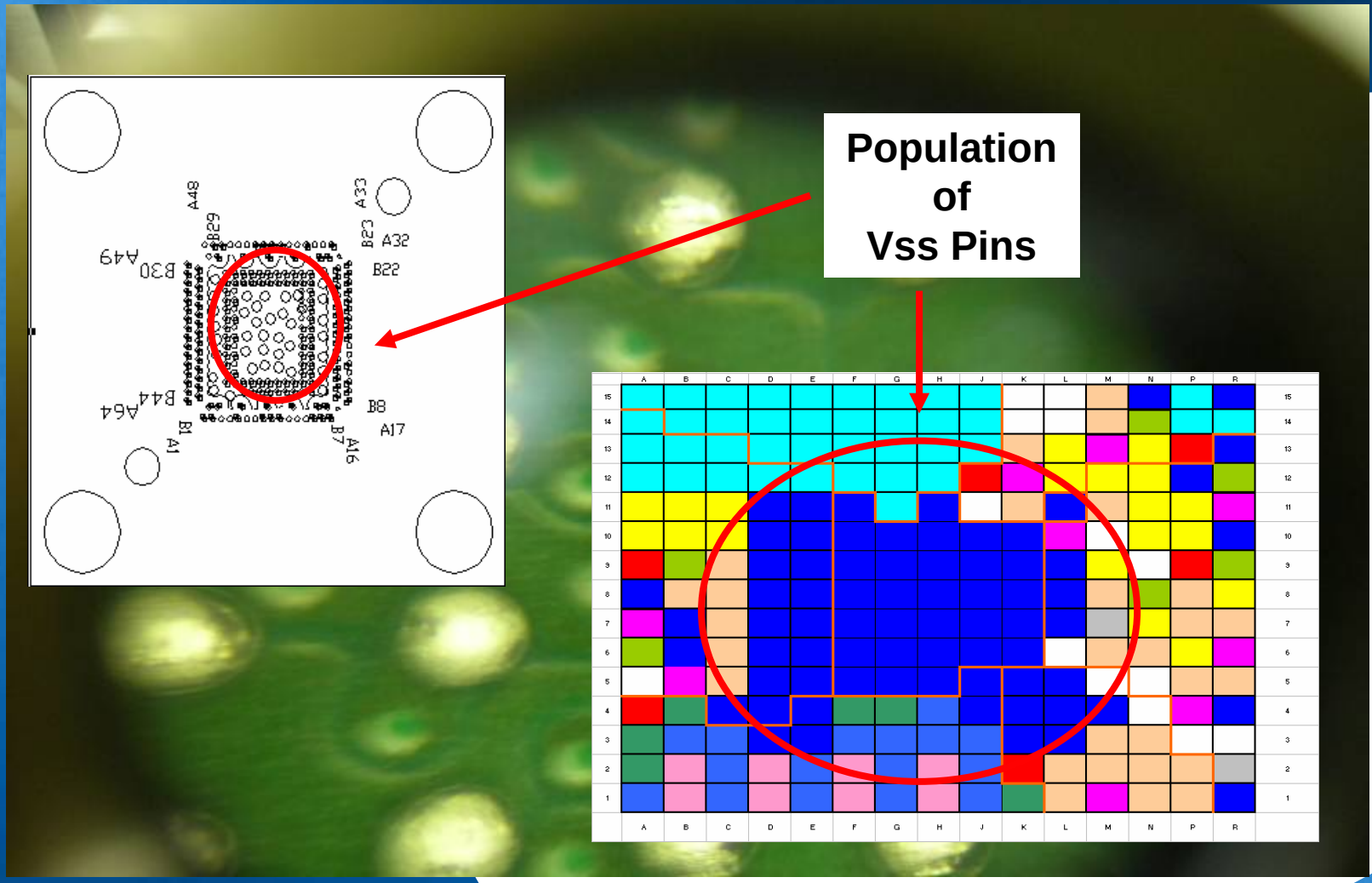
Principle 27. Cheap short living objects

Problem Statement:
High Cost of pins and high usage

Engineering Contradiction:
Extended usage of Pins will degrade the product yield

Sample of pin population for 2 products



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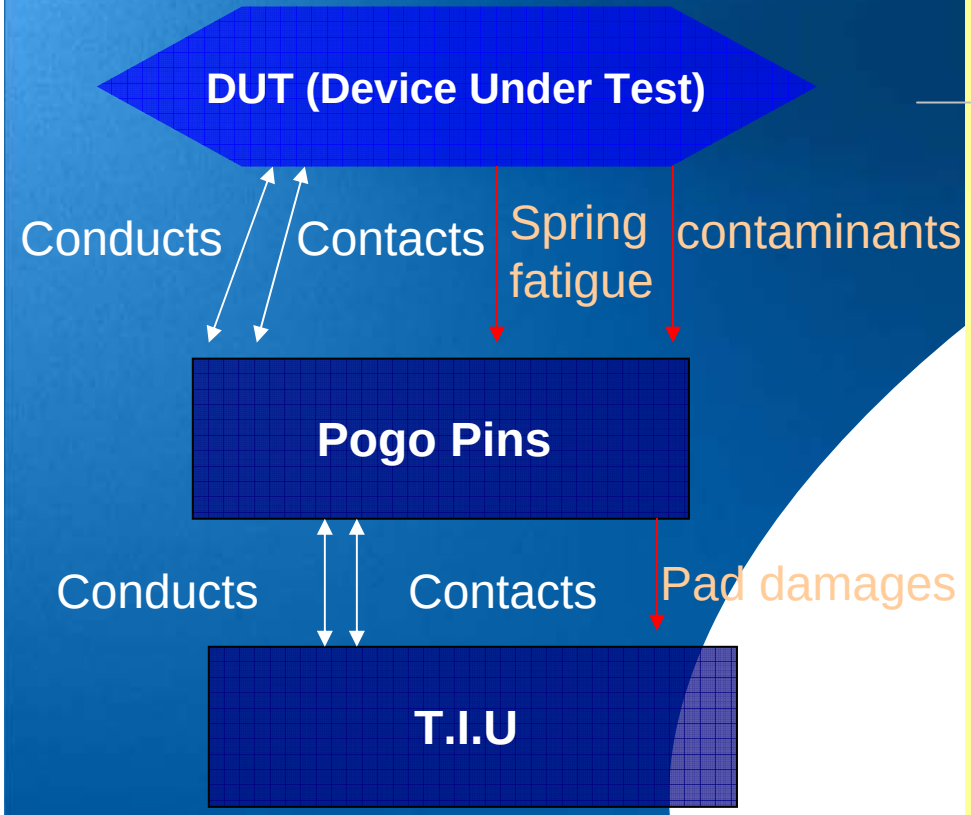
Test Pins – Its Function Model



No	Active Element	Action	Passive Element	Type	Problematic Function
1	DUT	Conducts	Pogo Pins	Standard	
2	DUT	Contacts	Pogo Pins	Standard	
3	Pogo Pins	Conducts	TIU	Standard	
4	Pogo Pins	Contacts	TIU	Standard	
5	DUT	Contaminants	Pogo Pins	Excessive	V
6	DUT	Spring Fatigue	Pogo Pins	Harmful	V
3	Pogo Pins	Pad damages	TIU	Harmful	

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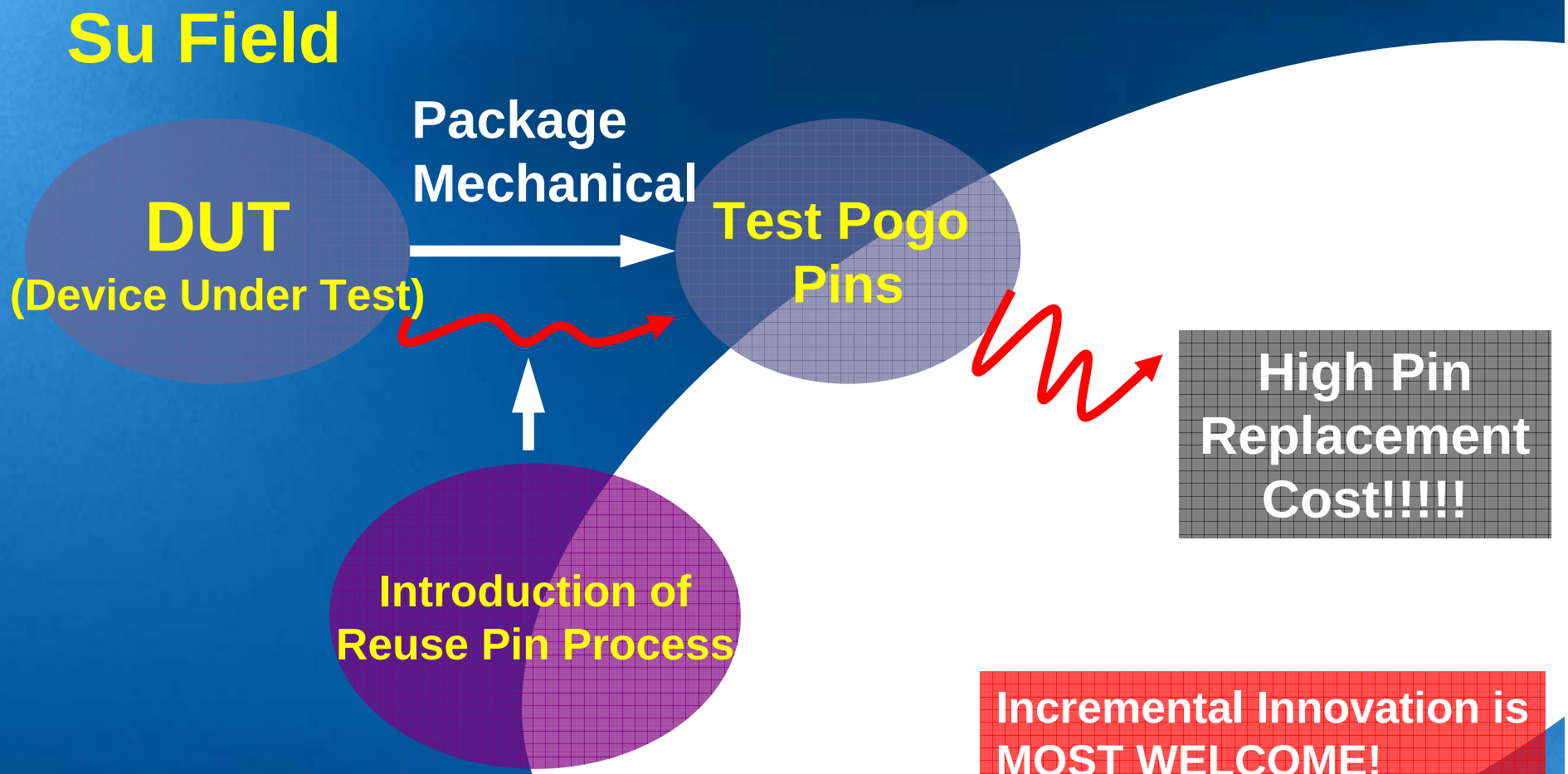
Problem Statement



Incremental Innovation is MOST WELCOME!

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Solution – The reuse Process

First Step *Preliminary action*

To determine the minimum Impedance |Z| tolerance.
We'll then use our tools (impedance checker) to verify
condition using this Tolerance.

Second Step *Preliminary action*

Run 100% of the impedance passi force gauge
Minimum of 15g per pin (or acc tolerances specified
by manufacturer)

Third Step *Mechanical vibration*

100% of the pins that pa above criteria's will go through
the sterilization and drying process.

Fourth Step

Pin Insertion - re-inser

novation

Solution – The reuse Process

First Step

To determine the minimum Impedance |Z| t
We'll then use our tools (**impedance check**
Tolerance.

Second Step

Run 100% of the impedance passing pins
Minimum of 15g per pin (or according

Third Step

100% of the pins that passes
and drying process.

Fourth Step

Pin Insertion - re-insertio

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Preliminary action

Mechanical vibration

...novation

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Solutions – New Tools

First Step

To determine the minimum Impedance |Z| t
We'll then use our tools **(impedance check**
Tolerance.

Second Step

Run 100% of the impedance passing pins
Minimum of 15g per pin (or according

List of the 40 Principles
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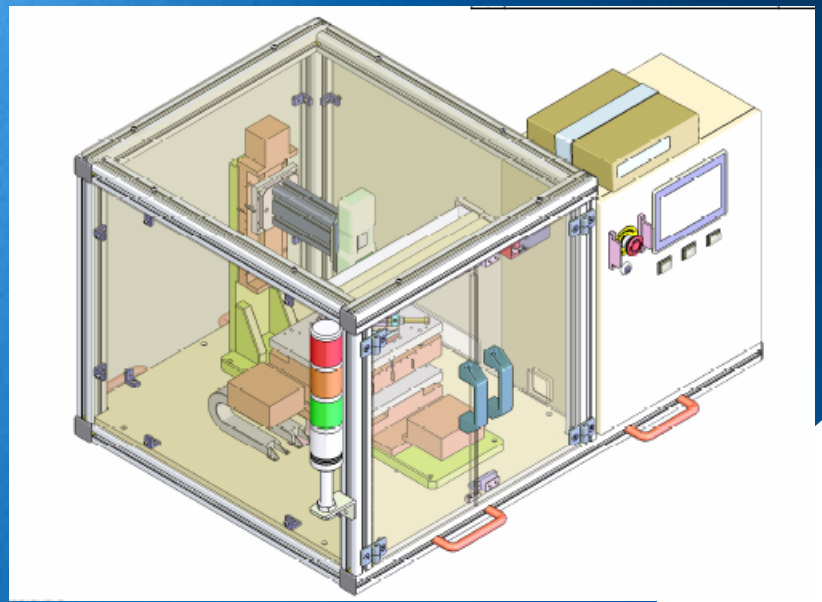
Merging

= TCCT (TEST CONTACTOR CHARACTERIZATION TOOL)

innovation

Solution - TCCT In the flesh!!

TCCT Tool at Intel



General Function:
a) Measures Pin Contact Resistance (CRES)
b) Measures Pin Spring Force
C) Measures Pin Mechanical deflection.

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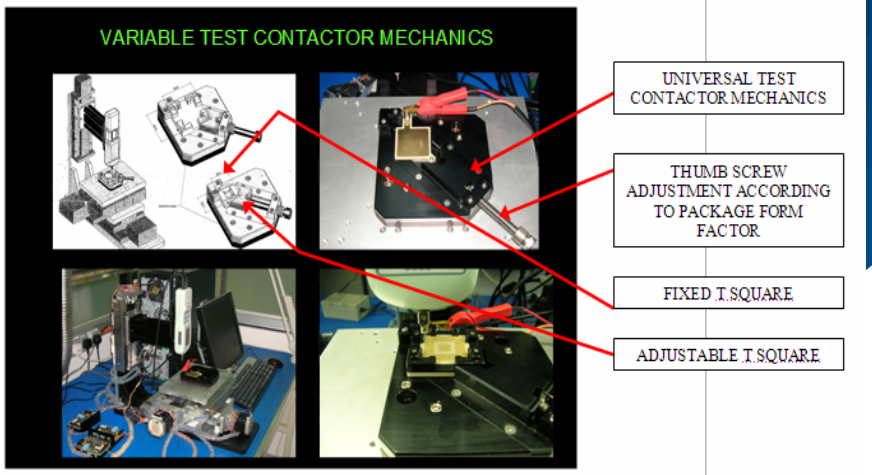
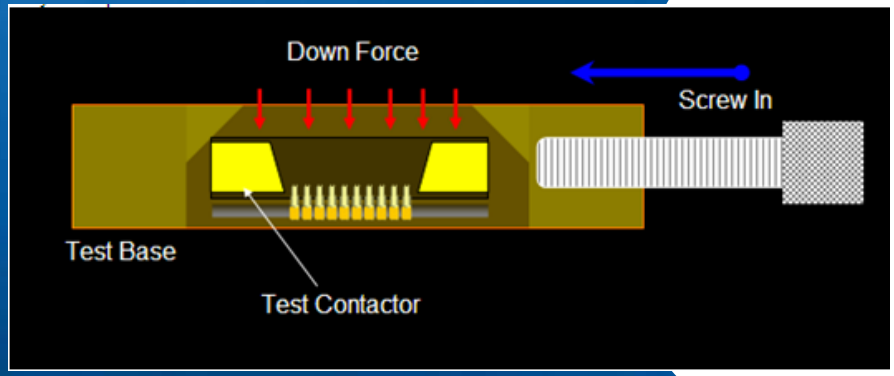
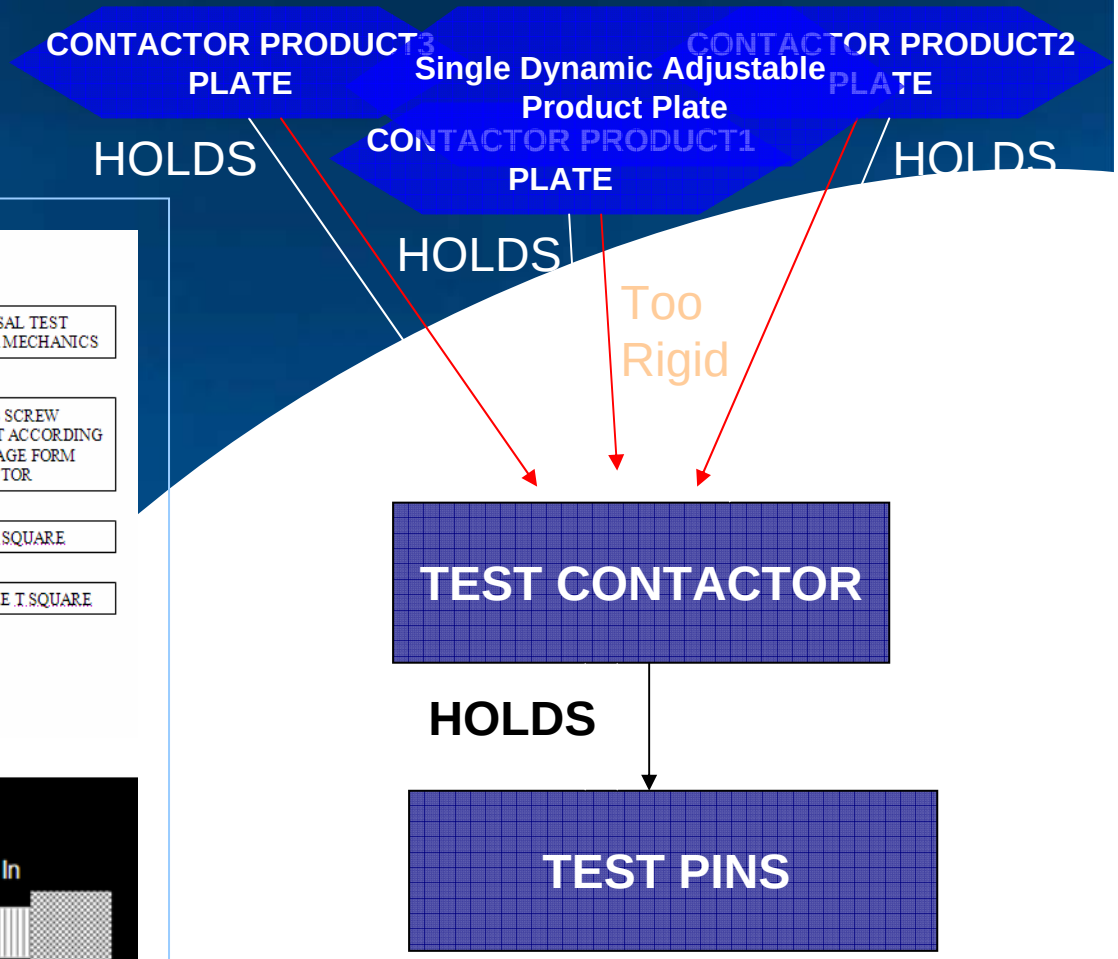
TRIZ Application in TCCT Designed itself – Pin Housing

TRIZ APPLIED!!







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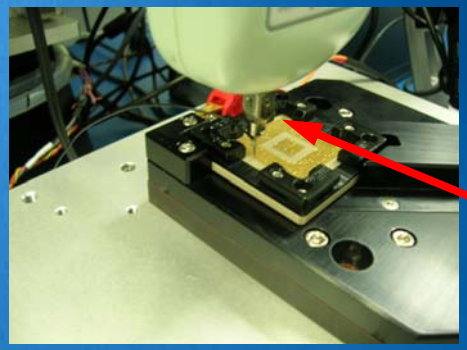
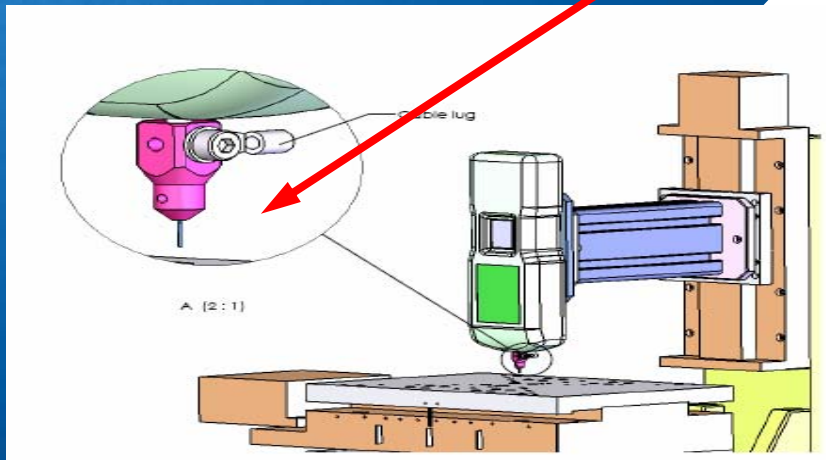
TRIZ Application in TCET Designed itself – 2 in 1 probe

TRIZ APPLIED!!



Dynamic Probe



Dynamic PROBE

CRES PROBE

Contacts

Spring fatigue

Pogo Pins

Contacts

Ground Pads (return path to meter)

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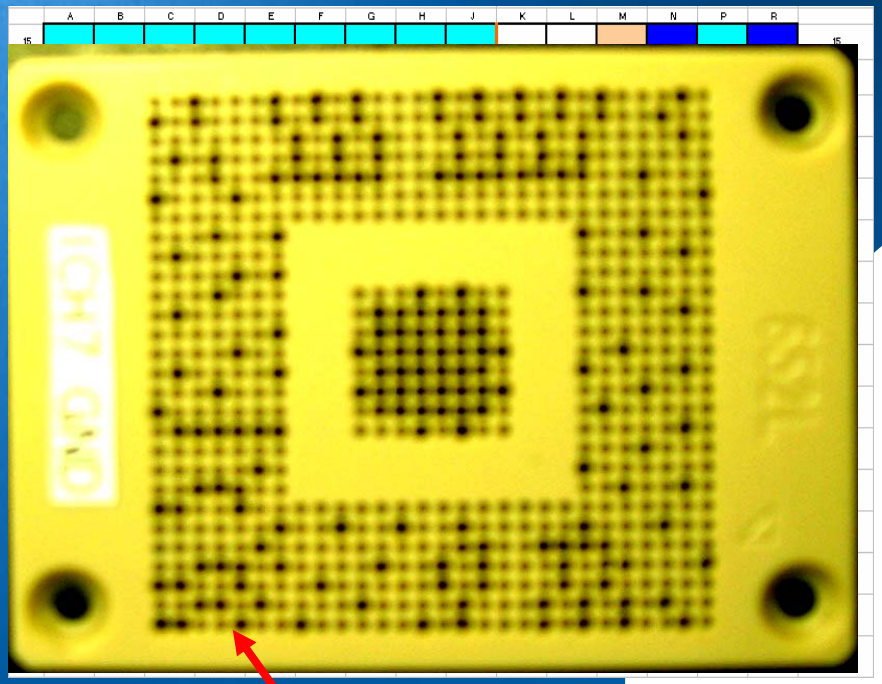
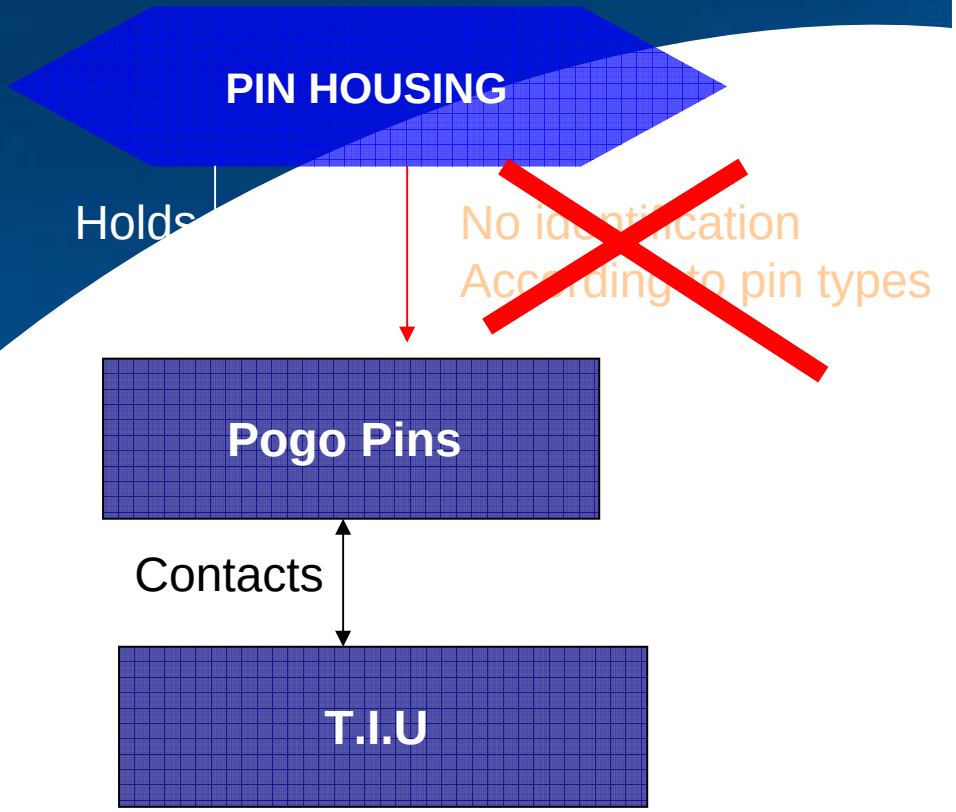
TRIZ Application in FCCT Designed itself – Quick Pin Isolator

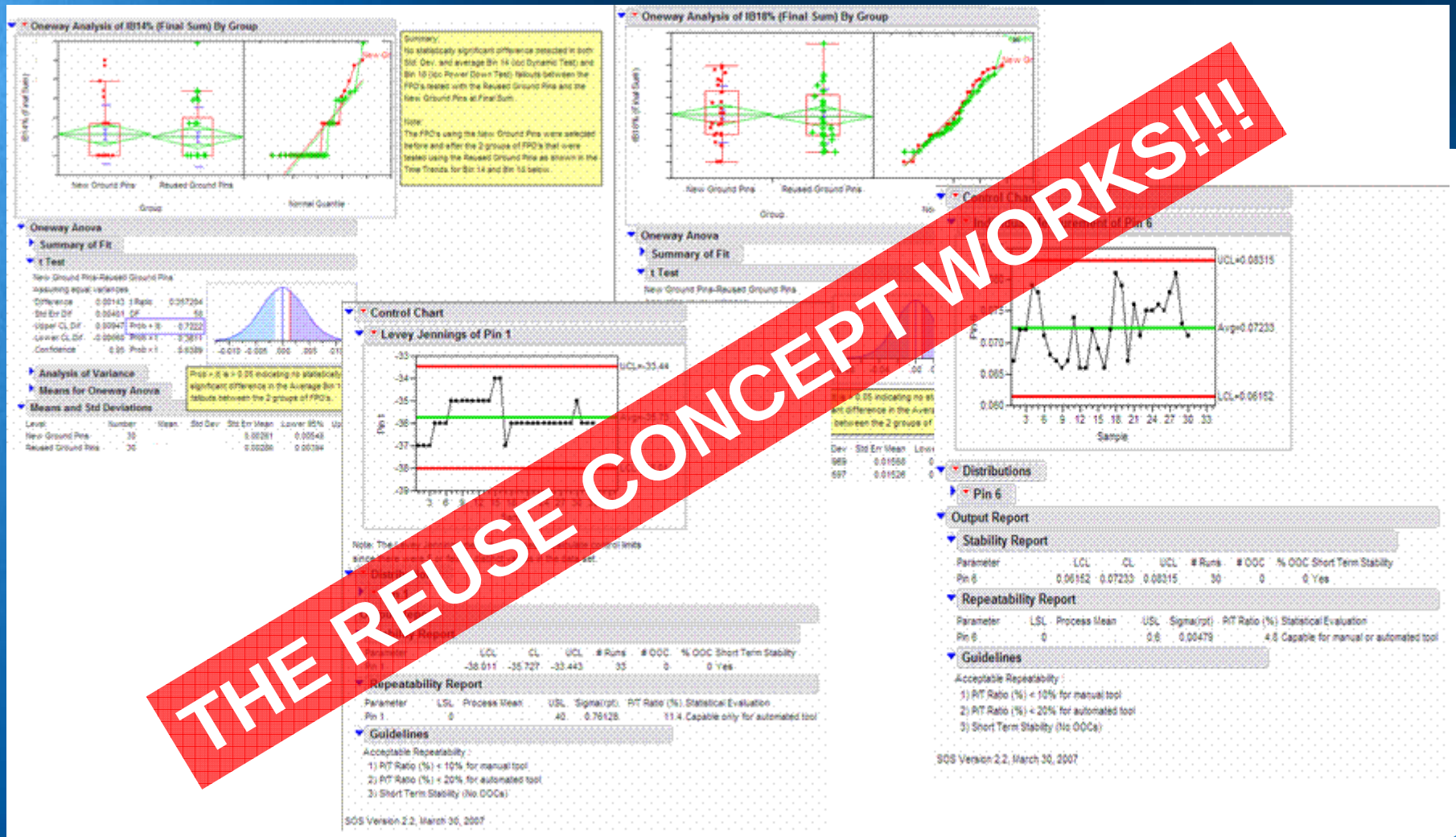
TRIZ APPLIED!!



Bigger Holes



Result Orientation



Result Orientation – ROI

FINANCE VERIFIED SAVINGS OF > USD1Million IN THE NEXT 4 YEARS UPON PROLIFERATION TO ALL PRODUCTS IN JUST ONE OF THE ATM FACTORIES

- THANK YOU TRIZ!!!!

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Summary

- TRIZ WORKS! – The innovative principle and problem and relationship analysis helps us ‘see’ the problem without distracti
- In this project we applied:
  - Merging
  - Dynamics
  - Preliminary Action
  - Mechanical Vibration
  - Multifunction
  - Feedback
  - Taking out

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Acknowledgement

- CTSoon – Project Sponsor
- Paul Chung – Reuse Idea Contributor
- Si Wai Chiang – TCCT Co-Inventor
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- Kam, Boon Lee – Yield Analysis
- Damien Chee – Statistician
- Letchumi/Jason – Finance
- Lakshmanan, Vishva – IP Consultant
- Dr.Michael Fahy/Dr.TSYeoh – Project Mentors

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