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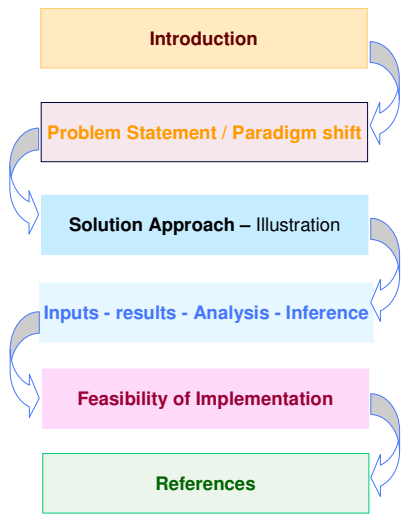
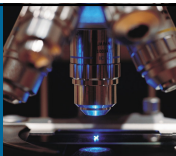
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Design of experiments - Using Orthogonal array technique

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Agenda



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graph TD; A[Introduction] --> B[Problem Statement / Paradigm shift]; B --> C[Solution Approach – Illustration]; C --> D[Inputs - results - Analysis - Inference]; D --> E[Feasibility of Implementation]; E --> F[References];
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Introduction

Problem Statement / Paradigm shift

Solution Approach – Illustration

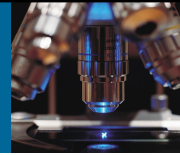
Inputs - results - Analysis - Inference

Feasibility of Implementation

References

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Introduction



DOE – Design of Experiments

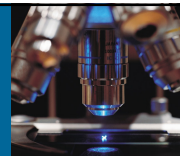
- Statistical approach to test case design.

Introduction to Orthogonal Array

- Most popular method adopted in in the world of DOE
- Invented by Copeland monks (early 19th century)
- Dr. Genechi Taguchi (1986) first proponent of OA often referred as Taguchi's methods.

Math – behind OA

Introduction – Theory of OA



Test of Orthogonality : summation (Σ) of dot product of any 2 columns should equate to zero (0).

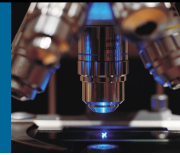
$$\text{Dot product of Col 1 \& 2} = (+1 \times +1) + (-1 \times -1) + (+1 \times -1) + (-1 \times +1) \rightarrow 1 + 1 + (-1) + (-1) = 0$$

$$\text{Dot product of Col 3 \& Col 1} = (+1 \times +1) + (+1 \times -1) + (-1 \times +1) + (-1 \times -1) \rightarrow 1 + (-1) + (-1) + 1 = 0$$

Col 1	Col 2	Col 3
+ 1	+ 1	+ 1
- 1	- 1	+ 1
+ 1	- 1	- 1
- 1	+ 1	- 1

Popular – Problem statements

Popular problem statements . . .



From Project manager : Lot of defects are reported by Customer which is not found by the Quality control / validation team.

QA finding defects late in the cycle and makes it difficult to deliver the software in time !!!

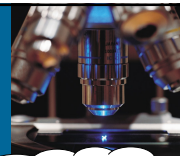
Voice of the test team :

- Very Little time allotted to testing for each release
- There are close to 500 test cases in the repository which one to execute.



Paradigm Shift (Efficiency to Effectiveness)
i.e. Effort based > Quality based

Paradigm shift (Efficiency to Effectiveness)



Efficiency driven metrics

Test efficiency	No. of test cases executed per unit of time.
Test coverage	No. of tc's executed per release / Total no. of tc's
Test case efficiency	No of defects excavated / Total no of test cases

Hard work /
Effort driven

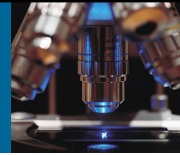
Effectiveness driven metrics

Test effectiveness	No. of defects detected / Total test effort.
Defect leakage	No. of defects raised by customer / No. of defects raised by QA team

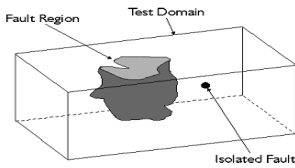
ROI driven /
smart working

Lets have a small illustration

Solution approach - Illustration

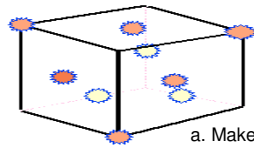


Region / Isolated fault



- a. Minor section of fault / defect existing in the application.
- b. High probability that this section getting missed out (during cons / test phase)

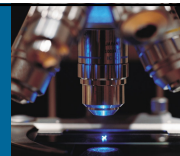
Test case – based on OA



- a. Makes sure test cases are evenly / thoroughly distributed

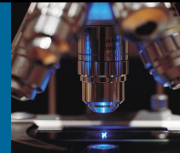
Entering in to OA.....

Solution Approach - Data grid (for F-XXXX)



Parameters (Grouping of factors)	Value (levels)
No. of requirements (system requirements)	6
Feature Complexity	Medium
No. of states – the feature needs to be implemented	11
Interfaces to be tested	5
No. of schemas	2
Types of service (Business & residential)	2
No. of transfer indicator	4
No. of field identifiers	2
Types of request (Single / Bulk arrangement)	2

Solution Approach - Results of tool

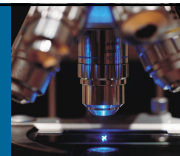


Parameters	Value
Total no. of test case combinations	121
No. of invalid combinations [Legend : red]	10
No. of valid test combinations	111
No. of test cases (the tester had designed – without OA) : Original test suite [Legend : yellow]	53
Delta Test suite (updated based on result of OA) [Legend : Tan]	53 + 15 = 68
Redundant test conditions [Legend : blank]	43

Analysis / Results



Solution Approach - Inference



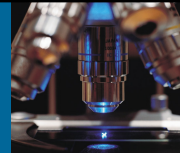
Improved defect coverage / effectiveness

No. of defects excavated based on Org. test suite	6 defects
Defects excavated based on the updated test suite	6 + 2 = 8 defects
Improved defect coverage / effectiveness	33.4 %

Overall effort reduction

Improved Test coverage (53 → 68 Nos)	28.34 %
Test case design effort - per estimates	218 hrs
Test case design effort (without tool)	200 hrs
Test case design & effort (with tool) : Data grid preparation effort + Test case identification + Redundant tc removal effort + review effort	152 hrs
Overall effort reduction	31.5 %

Tools - references



JENNY : JENNY is a freeware available in
<http://burtleburtle.net/bob/math/jenny.html>

Jenny is a time tested tool for generating test conditions.

Author : Bob Jenkins

Features :

1. Coded in C language
2. Guarantees pair wise testing for all the features paired together

JWRAP : Open source wrapper for JENNY.

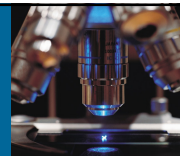
<https://sourceforge.net/projects/jwrap>

JWrap has 2 components

JWrap Engine : Converts all the Jenny format to Human understandable form

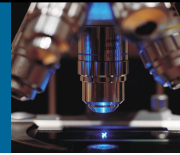
TWrap template : Populates all the values in the spread sheet.

Advantages & Features



- > Few / Less test cases, uncovering most of the defects
- > High probability of earlier detection
- > Better test efficiency and lower defect leakage ratio
- > Reduction in overall test effort
- > Improvement in organization level consistency (cultural shift in org rather than isolated effort)
- > Easy to understand and approach.

Reference- tools



Pro – Test tool (Sigma Zone) <http://www.sigmazone.com/protest.htm>

AETG tool : Telcordia <http://aetgweb.argreenhouse.com/>

T – Config (author – Alan Williams) Asst. prof – University of Ottawa
<http://www.site.uottawa.ca/~awilliam/>

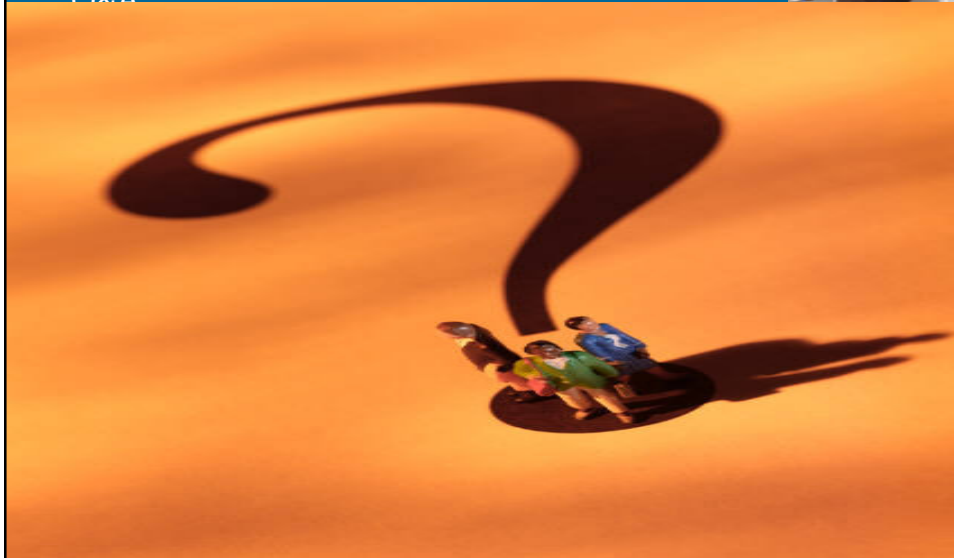
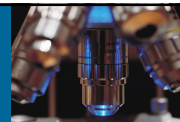
Test cover : <http://www.testcover.com/>

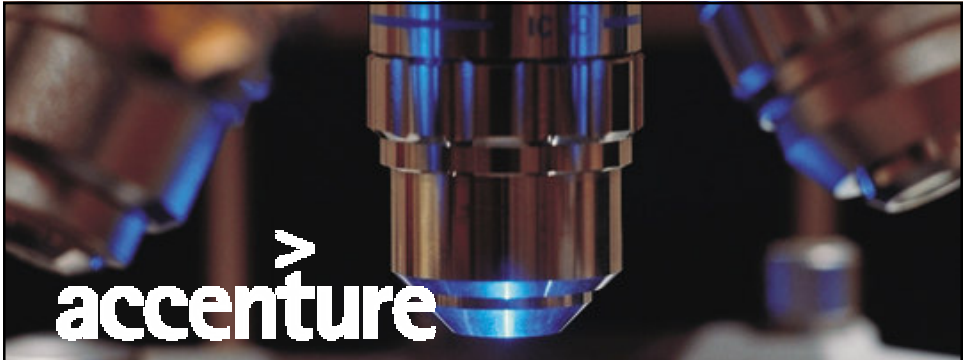
Test vector generator Free source <http://sourceforge.net/projects/tvg/>

Approach to testing based on combinatorial design
<http://www.argreenhouse.com/papers/gcp/AETGieee97.shtml>

References from Madhav Phadke
http://www.phadkeassociates.com/index_files/contactus.htm

Q&A





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Thank You

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