An Approach to Deliver Quality Design by Designers Themselves

- How to Leverage Test Engineer's Viewpoints -

November 02, 2011

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Overview and Objectives

- Approach to Improve Quality of Function Specifications and Design -

Problems in Embedded Software Development

■**Defect analysis for the current project:**

- “Missing spec.” in function spec. cause “missing test items,”
- 53% of all defects

Defect details:

Defects found
in Test Designing

Causes for missing test items
Specification defects：86%

Test design defects：14%

Cause
for Missing Test Items

To improve design quality…

Improve quality of function specifications!

Quality Improvement with Test Engineer's View points

■**Recent trends:**

- Test engineers participate in design reviews
- Leverage test engineer's viewpoints for better quality

■**Previous studies…**

- Find defects with test engineer's viewpoints in reviews
- Design function specs and test specs by one person
- Realize incorrect specifications and defects

Both leveraging the point of testability

Our Question:

Why designers could not find what test engineers could find while designing test specifications?

How to Leverage the Test Engineer’s Viewpoints

-Test Engineer’s Viewpoints and Viewpoints Designers Tend to Lack-

Test Engineer's Viewpoint: Hypothesis 1

■ **From earlier studies…**

Find defects with test engineer's viewpoints in reviews

■ **Hypothesis 1:**

If test engineer can find defects in function specifications, the testing point of view would be automatically supplemented when they design function specifications by themselves.

■ **Experiment 1:**

Test engineer writes function specifications

Test Engineer Writes Function Specifications

■**Experiment object: Shredder**

- Easy to imagine its functions
- Write functions specifications as an experiment

■**Experiment subject**:

- 1 test engineer (middle level)

■**Objectives:**

- Understand the designer's mindset
- Find out true cause for missing specifications

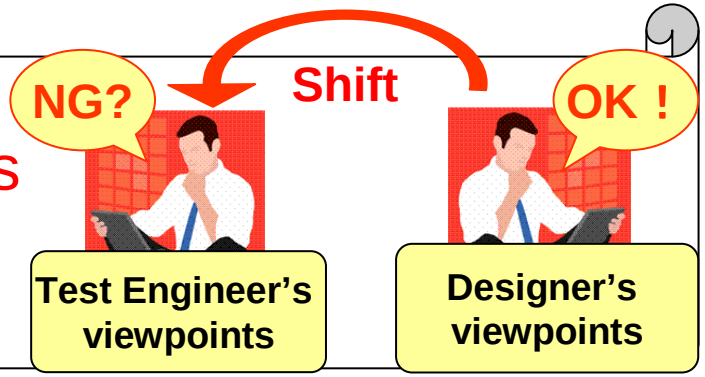
What We Found Out（Results）

■Designer’s mindset / cause of missing specifications

- Narrowing minds：
  - Focus only on “how it works correctly”
- Use of ambiguous expressions:
  - No hesitation for ambiguous words, such as “etc”
- Not enough time:
  - Write only the very minimum; causes missing specifications

But, defects found in designing tests

⇒Mind (viewpoints) shifted



Hypothesis 1 -- Verification

■**Hypothesis 1**:

If test engineer can find defects in function specifications, the testing point of view would be automatically supplemented when they design function specifications by themselves.

■**Verification 1:**

From the experiment result…

Difficult to automatically supplement test engineer's viewpoints when writing function specifications!

How to consciously supplement ?

Test Engineer's Viewpoints: Hypothesis 2

■ **From earlier studies…**

If one person designs both function specs and test specs at the same time, he/she could recognize incorrect specifications and defects.

■ **Hypothesis 2**:

If one person could recognize incorrect specifications and defects by designing function specs and test specs in parallel, designers could recognize the viewpoints they tend to lack.

■ **Experiment 2**:

Parallel design based on W-model by designers themselves

Parallel Designing Based on W-model

■What is W-model?

- Process model where development and testing are performed in parallel in upper phases
- Design tests in upper phases, detect missing specifications, ambiguous expressions, inconsistency, etc. before testing
- Defects fixable quickly

■What is Parallel Designing?

- Design function specs and test specs in parallel
- Prevents missing test items by clear links between two specs

Parallel Designing Based on W-model

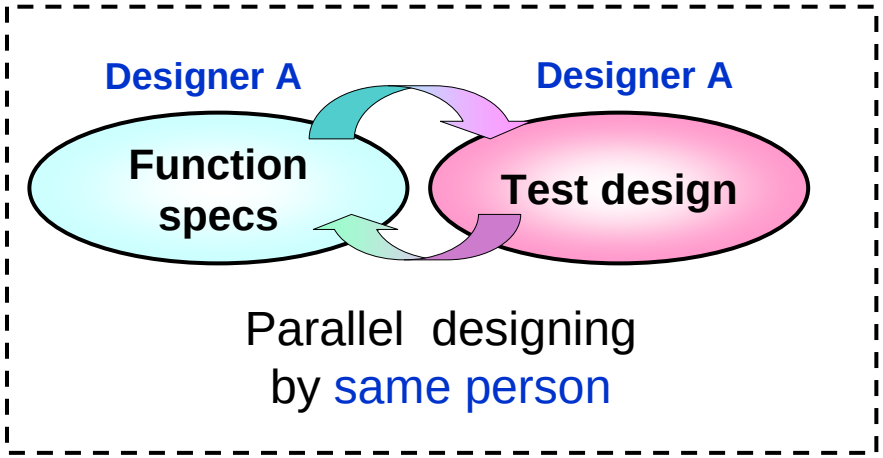
■Difference from previous parallel designing:

- Design function specs and test specs in design phase
- By different people; one designs function specs, other designs test specs

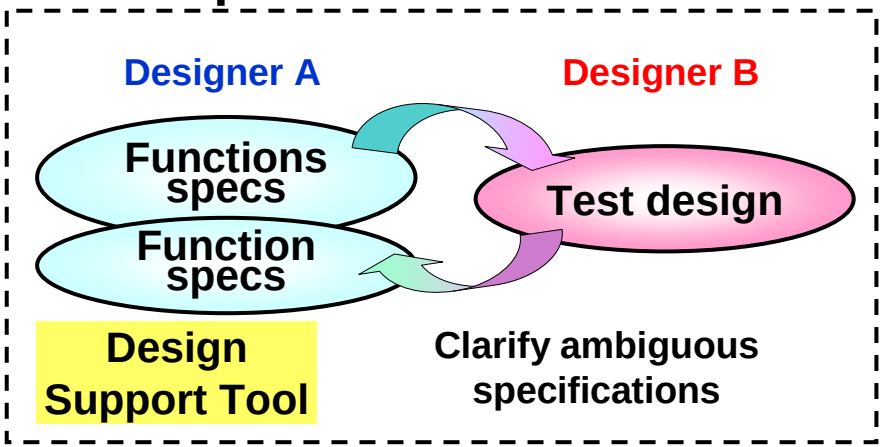
  ➡ Find out: Viewpoints designers tend to lack
- Feedback defects found in test designing into function specs

  ➡ Improve: Function specs to deliver quality design

Previous:

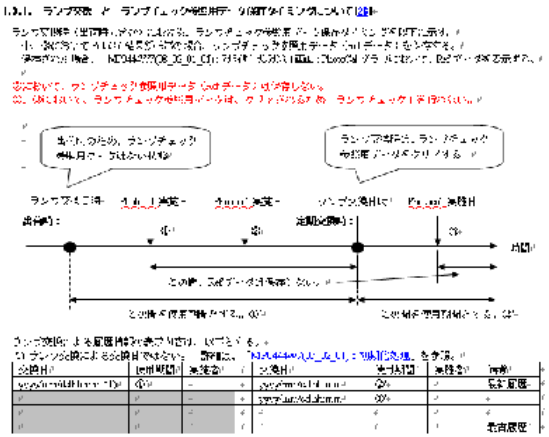


This experiment:



Features of Design Support Tool

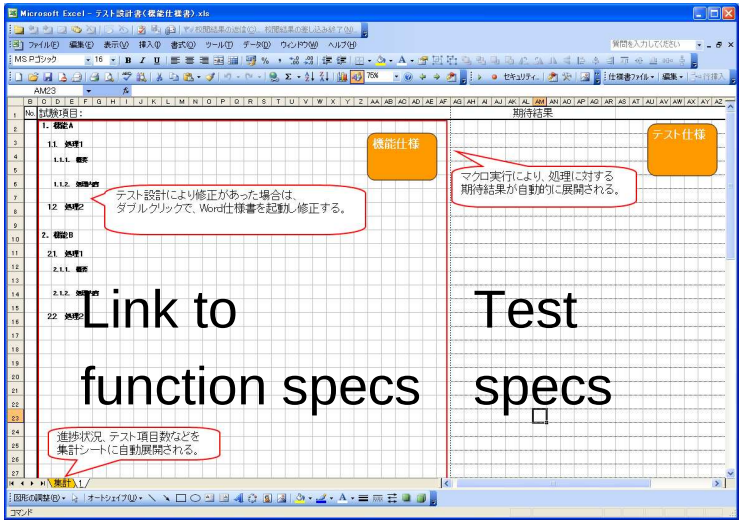
■Based on the function specifications written on Microsoft Word, write both function specifications and test specifications



Write function specs on Microsoft Word

Run Excel macro

Design Support Tool



Clear links between function specs and test specs

■**Effects of design support tool:**

Tool development cost: 5 person-day

・Traceability between function specs and test specs

・Feedback into function specs

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Parallel Designing: Example 1

■Parallel designing on one function specifications:

- Clear links between function specs and test specs
- Prevent missing test items for function specs

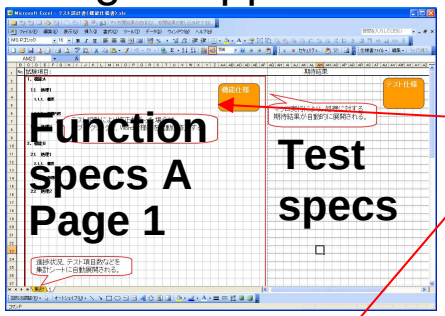
Function spec A

Write on Microsoft Word

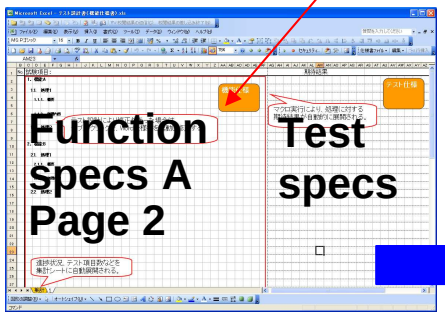
Microsoft Excel Macro

Auto-generate

Design Support Tool



Sheet1



Sheet2

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Key Points:

- **Review test specs**
- **Perform function testing**
- **Read through test specs more than 3 times**

Count test items of each sheet in Summary sheet

Manage testing

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Parallel Designing: Example 2

■**Parallel designing to multiple function specifications:**

- Visualize change requests and functions
- Apply parallel designing to functions specs to be affected
- Enables cross-functional testing

Screen specs

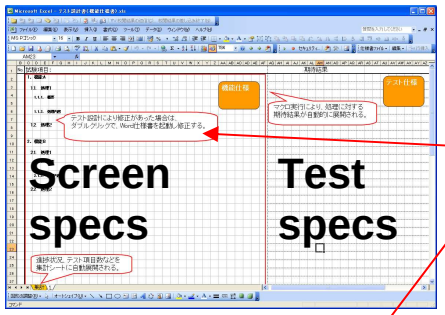
Communication specs

Write function specs on Microsoft Word

Microsoft Excel macro

Auto-generate

Design Support Tool



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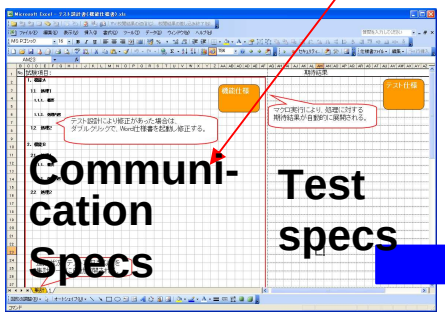

Sheet2

Key Points:

- **Test spec review**
- **Perform functional tests**
- **Perform functional tests**
- **Read through specs more than 3 times**

Change Request Matrix

Transform defined specs

要件定義書			基本設計書		詳細設計書
変更要求(大項目)	変更要求(小項目)	項目No.	変更仕様(概要)	設計書(設計)	変更モジュール
別装置と接続できるよう新しいI/Fを追加する 変更理由: ○○○のため 前提条件: △△△であること	接続をユーザが任意に止めることができること	A-1	ボタンを追加する	画面仕様書	○○モジュール
		A-2	ボタンにより，他装置へメッセージを送信すること	通信仕様書	△△モジュール
	AとBの間の通信を記録できること	A-3	通信ログを保存する	ファイル仕様書	□□モジュール
	エラー発生時にユーザに告知すること	A-4	警報メッセージを追加する	警報仕様書	XXモジュール

Change Requests

Function

Count test items of each sheet in Summary sheet

Manage testing

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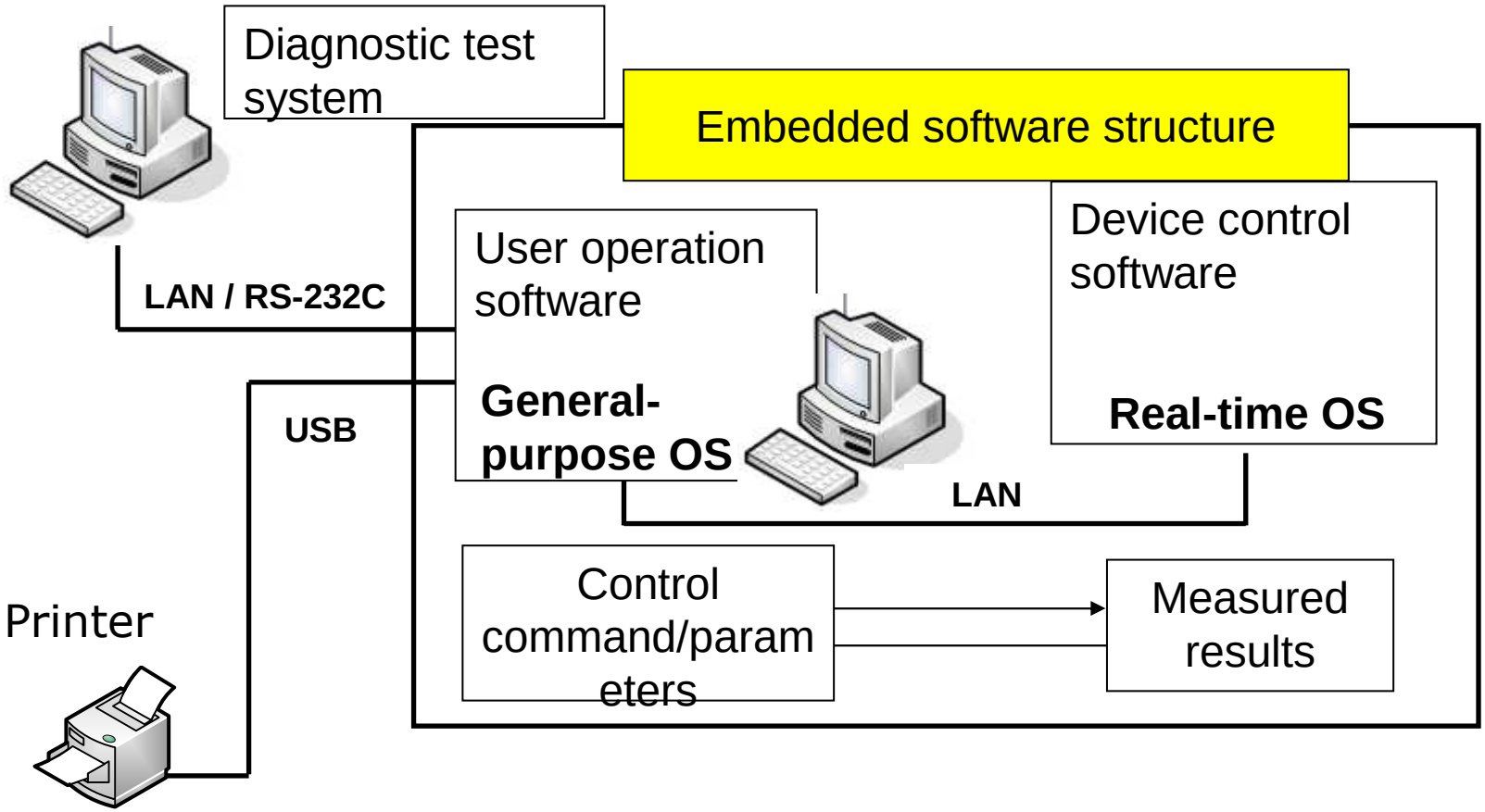
Objective Development Area and Environment

- Measurement instrument on medical device
- Development Scale:
  Base program: About 1,000KSteps
  Change scale: About 50～100KSteps
- Experiment Subjects:
  2 middle-level designers
  3 entry-level designers



Results

■After parallel designing…

- Found about 50 defects found per specification

Defects Found in Function Specifications in Lower Phase Before / After Parallel Designing

	Missing Test Cases: Missing Specifications	Missing Test Cases: Ambiguous Specifications	Test case Written Mistakes in Specifications	Total
Before	**15**	**8**	**5**	**28**
After	**0**	**3**	**0**	**3**

Preventing missing test items caused by missing specification could prevent missing functions specifications.

Hypothesis 2 -- Verification

■**Hypothesis 2**:

If one person could recognize incorrect specifications and defects by designing function specs and test specs in parallel, designers could recognize the viewpoints they tend to lack.

■**Verification 2:**

From the experiment result…

Designers found defects in function specs in designing test specifications, not in writing specifications.

Parallel designing helped to recognize viewpoints designers are tend to lack

How to Leverage Test Engineer’s Viewpoints

–Experiment Result–

Viewpoints That Designers Tend to Lack

■ **When writing function specifications:**

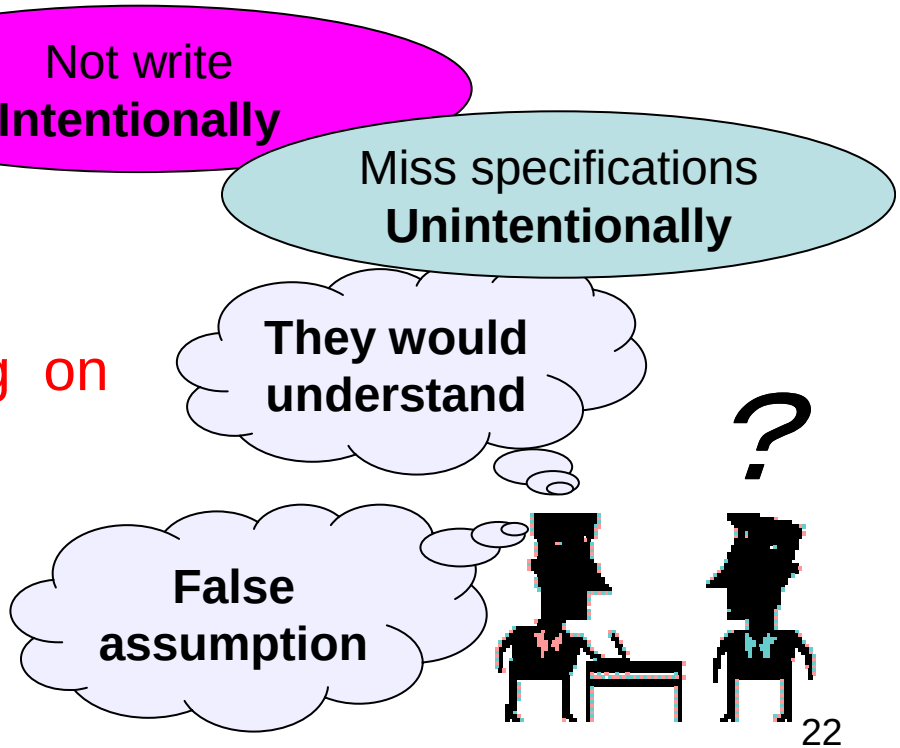
- Focus on transforming requirements to functions

■ **Designers are:**

- Knowledgeable about what to develop
- Likely to think with their own standard of values

■ **Thus, designers tend to:**

- Focus mainly on "normal" cases
- Narrow their mind scope focusing on functions
- Overlook the relations with other functions



Experiment Results

Experiment 1: Test engineer writes function specifications

Verification1: Difficult to automatically supplement testing perspective when writing functions specs

Experiment 2: Designer writes functions specification and test specifications in parallel based on "W-model"

Verification2: Parallel designing helped to recognize viewpoints designers are tend to lack

To automatically supplement testing point of view…

Parallel designing on function specs and test specs EFFECTIVE!

How to Leverage Test Engineer’s Viewpoints

-Discussion-

Leveraging Test Engineer's Viewpoints

■Mindsets that designers tend to have…

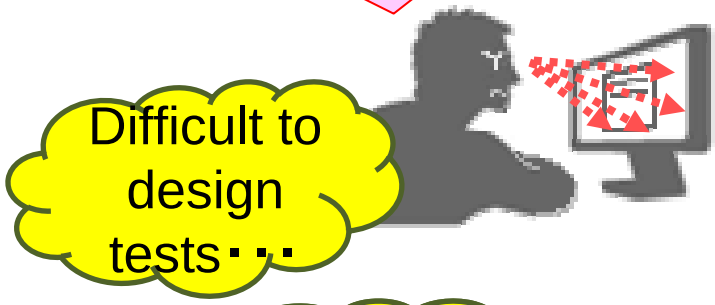
When writing function specifications

When designing tests

Transforming into functions

Shift mindset

Mistakes… missing specs...



Assumption based on the past experience

Test design by third party

Remove assumptions

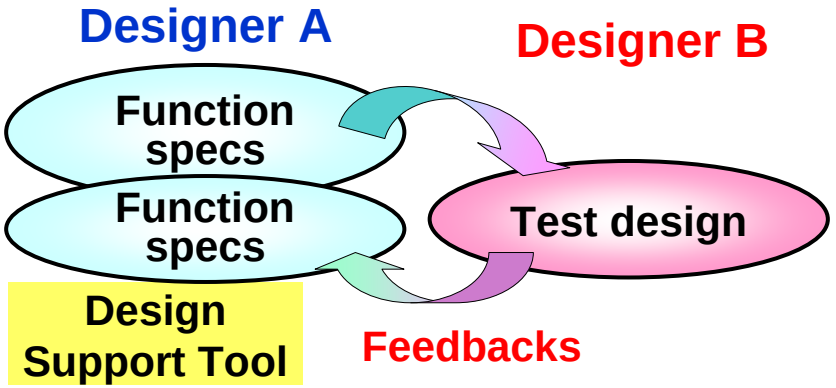
To consciously supplement testing perspective of view…

Parallel designing on function specs and test specs

EFFECTIVE!

Advantage of Parallel Designing

Parallel Designing by different people



- Resets the designer's mindset
- Consciously supplements testing point of view

- Thus…
  - Read thoroughly to understand
  - More graphics / illustrations

As a result…

- Bring awareness for specification defects

In addition…

- Provide feedbacks into function specifications
- Improve quality of function specs (from Design Support tool)

Parallel designing…

Synergistically improved quality of specifications and tests!

Advantages of Designers to Design Test

■ **Designers could:**

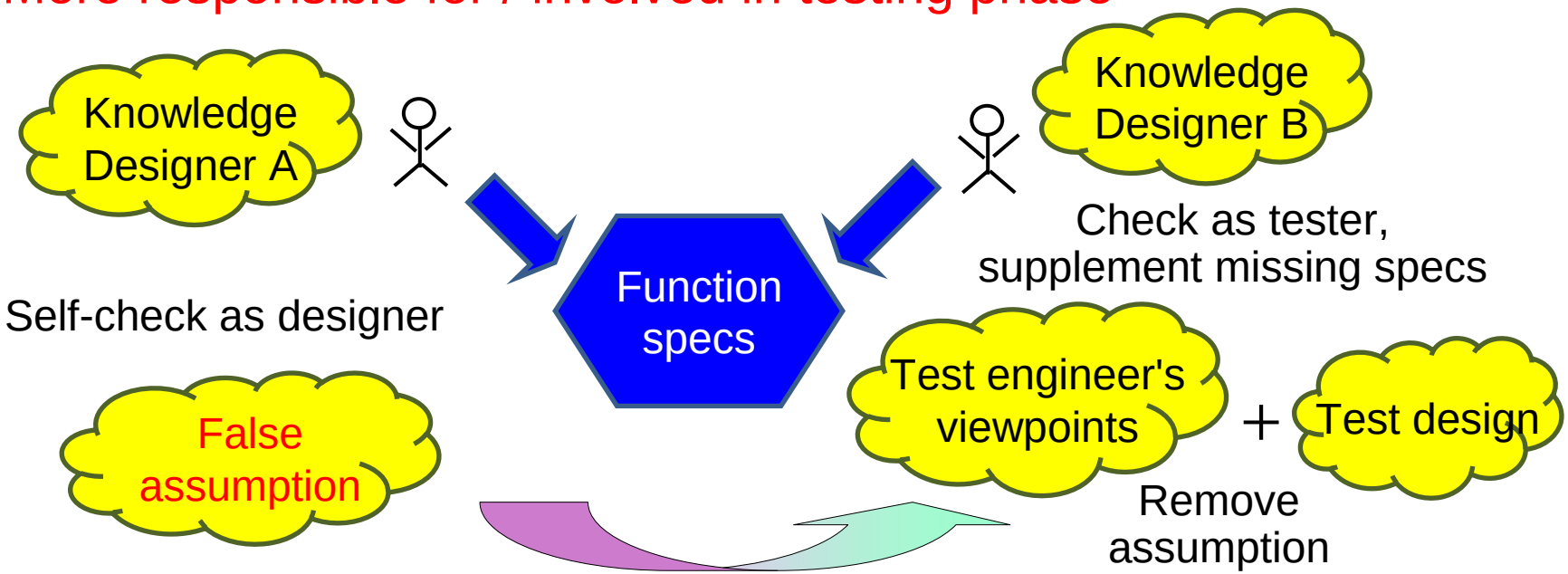
- Find defects by supplement with knowledge of each other

■ **Designers and test designers could:**

- Fix spec defects by themselves
- Re-design tests and improve function specification quality

■ **Designers became:**

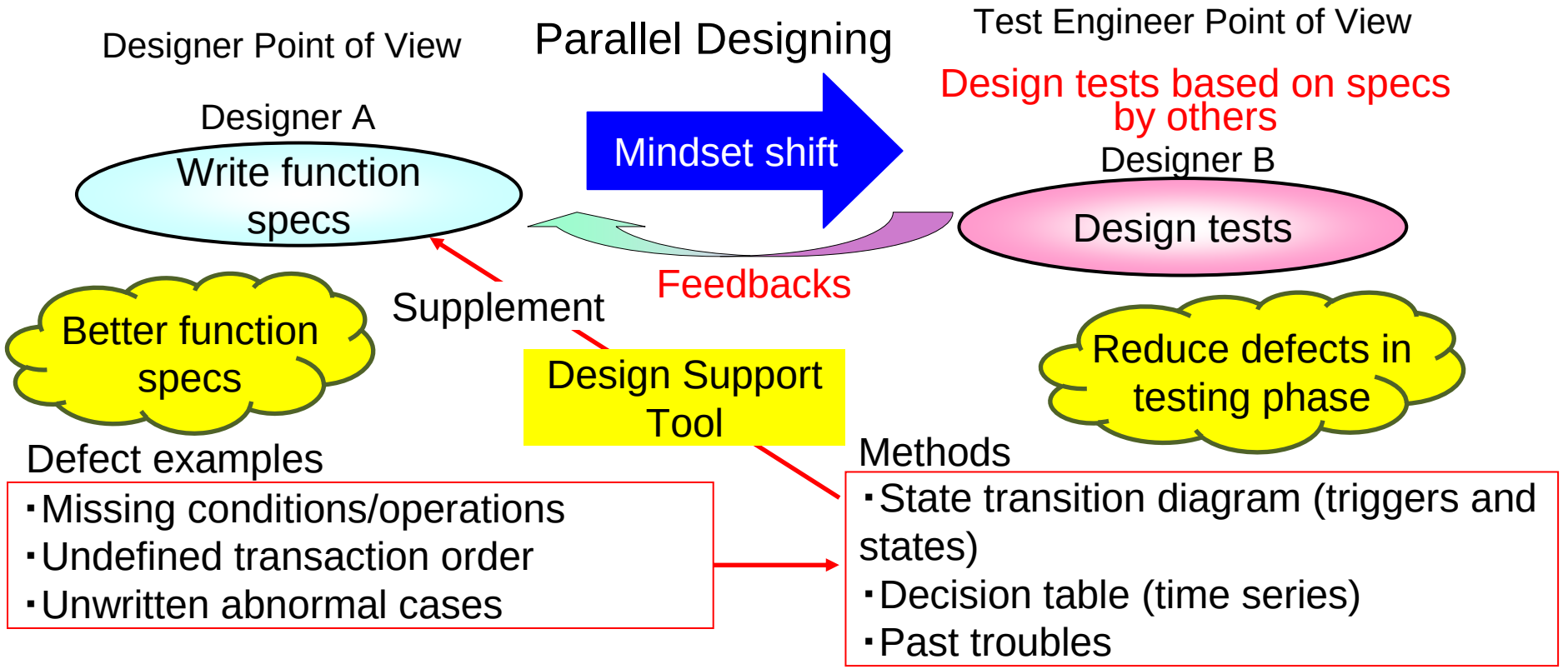
- More responsible for / involved in testing phase



Summary

■Parallel designing contributed to:

- Find defects in specifications
- Improve specification quality, reduce defects in testing phase
- Raise designers' awareness



Further Study

- Application know-how with following change factors
  - Description details of function specifications
  - Designers' skills
  - Product to be developed (that requires specialized knowledge)
- Continuous promotion for this approach

Thank you.