

2017/03/13

Satoshi Masuda, IBM Research - Tokyo

---

# **Software Testing in Industry and Academia: A View of Both Sides in Japan**

---

# Contents



1. Introduction
2. Facts about Industry and Academia in Japan
  1. Facts about Industry
  2. Facts about Academic and Education
3. Challenges for Software Quality and Testing
4. Solutions and Activities in Software Testing
  - How industry and academia collaborate
5. Conclusion

# 1. Introduction

---

## Satoshi Masuda, IBM Research - Tokyo

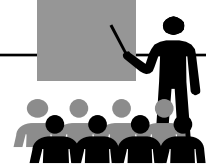
- My career about software testing in Academia-Industry

Year	Industry	Academia
2000	Test Engineer	
2010	Test Consultant ASTER director ISTQB member ISO/IEC member	
2017	Company researcher Ph.D. student	

ASTER: Association of Software Test Engineering, NPO in Japan  
ISTQB: International Software Testing Qualification Boards  
ISO/IEC: International Organization for Standardization/ International Electrotechnical Commission

# 1. Introduction

---



- **This session is**

- “Software Testing in Industry and Academia: A View of Both Sides in **Japan**”
  - from **my experiences, researches**
  - **updates** on “Challenges in Japanese Software Testing Industry and Test Automation”(2011masuda)

- **Contributions for TAIC-PART to provide information from real-world**

- “*TAIC PART is a unique event that provides a stimulating platform to facilitate **collaboration** between **industry** and **academia** on **challenging** and exciting **problems of real-world software testing.***”

---

## 2. Facts about Industry and Academia in Japan

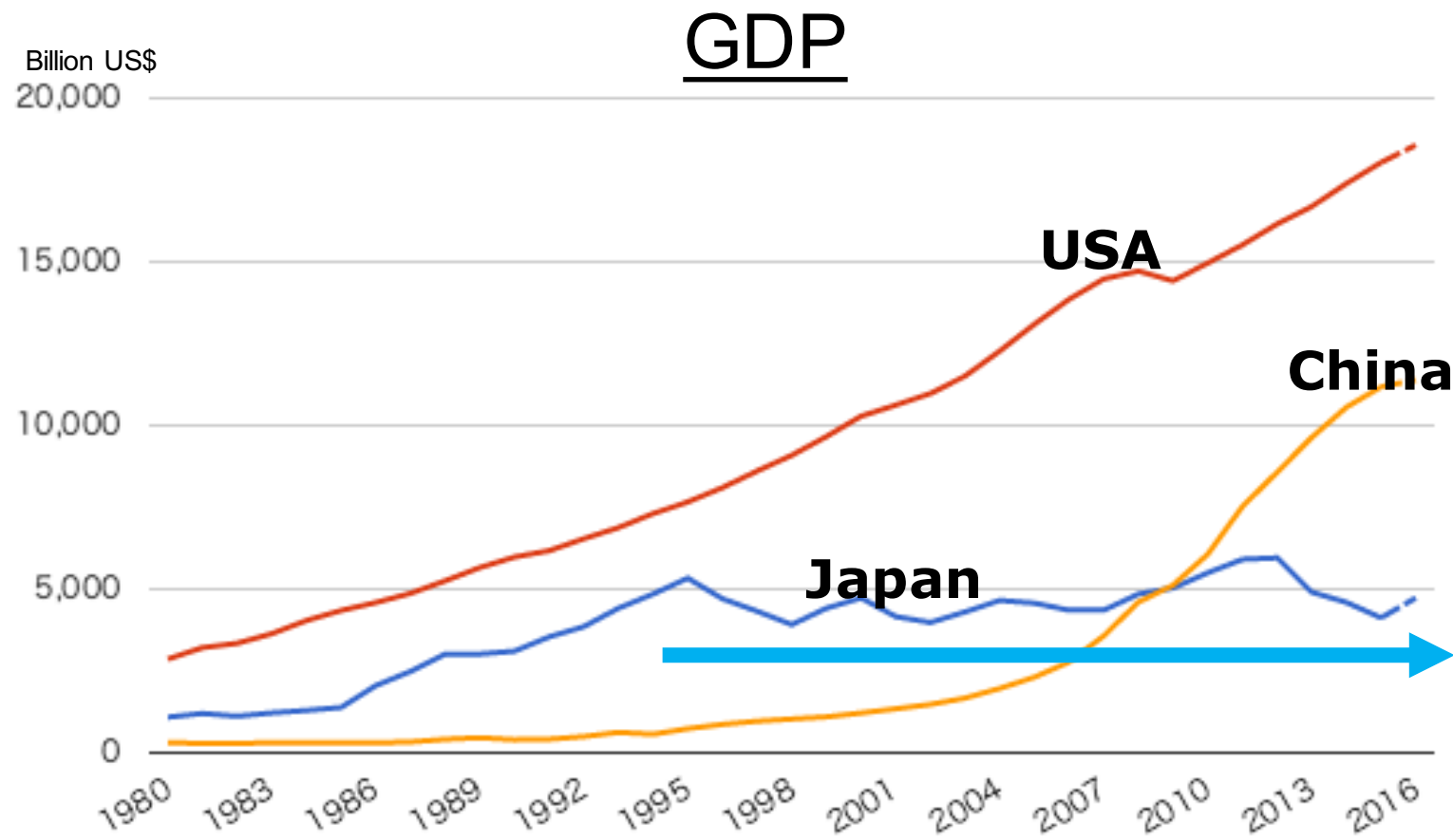
### Industry

## 2. Facts about Industry and Academia in Japan

### 2.1 Facts about Industry



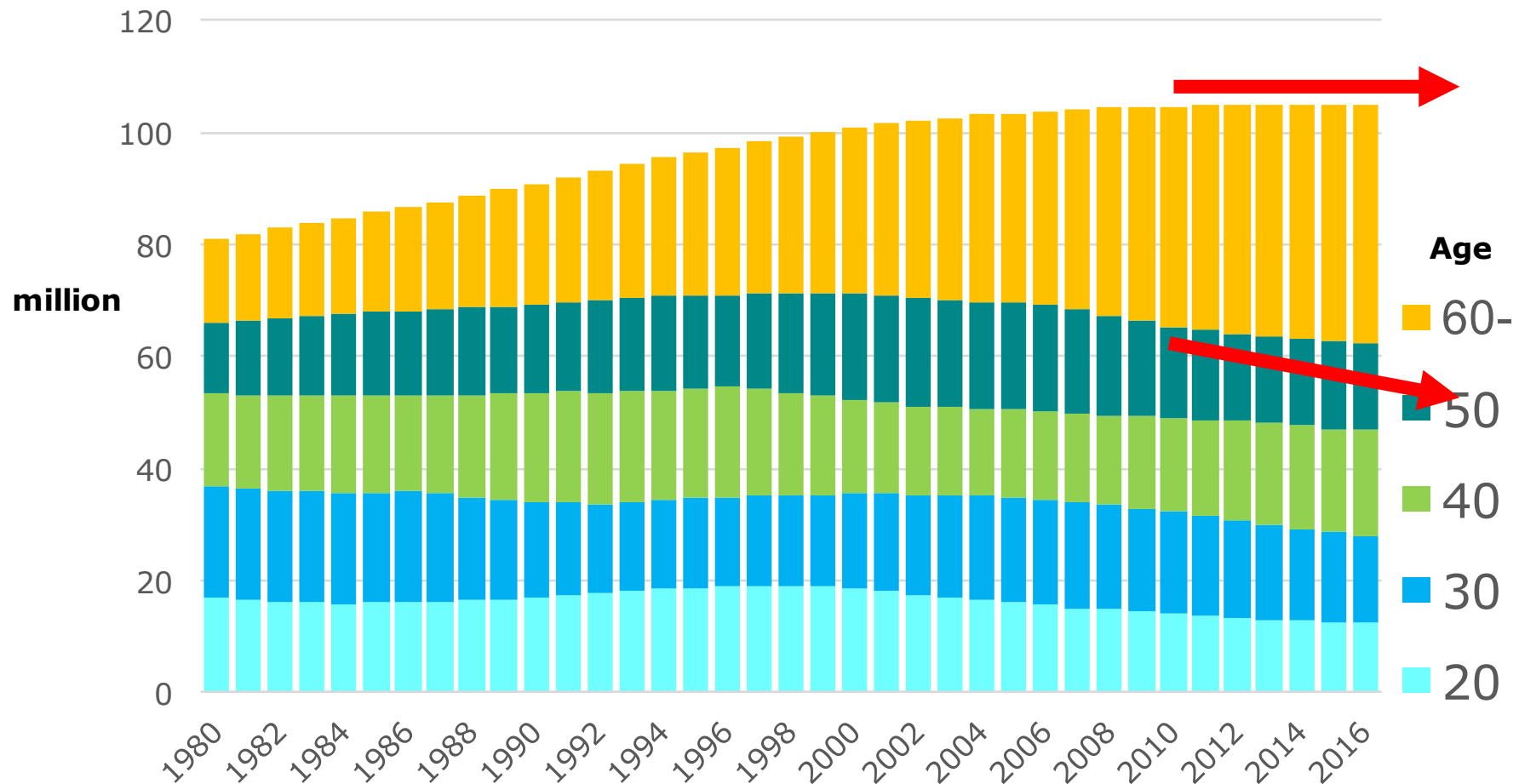
- “Great Flat” about Japanese economy



## 2. Facts about Industry and Academia in Japan

### 2.1 Facts about Industry

- Atmospheres in Japanese industry
  - Number of workers not Grow
  - Workers Getting Old



---

## 2. Facts about Industry and Academia in Japan

### 2.1 Facts about **Industry**

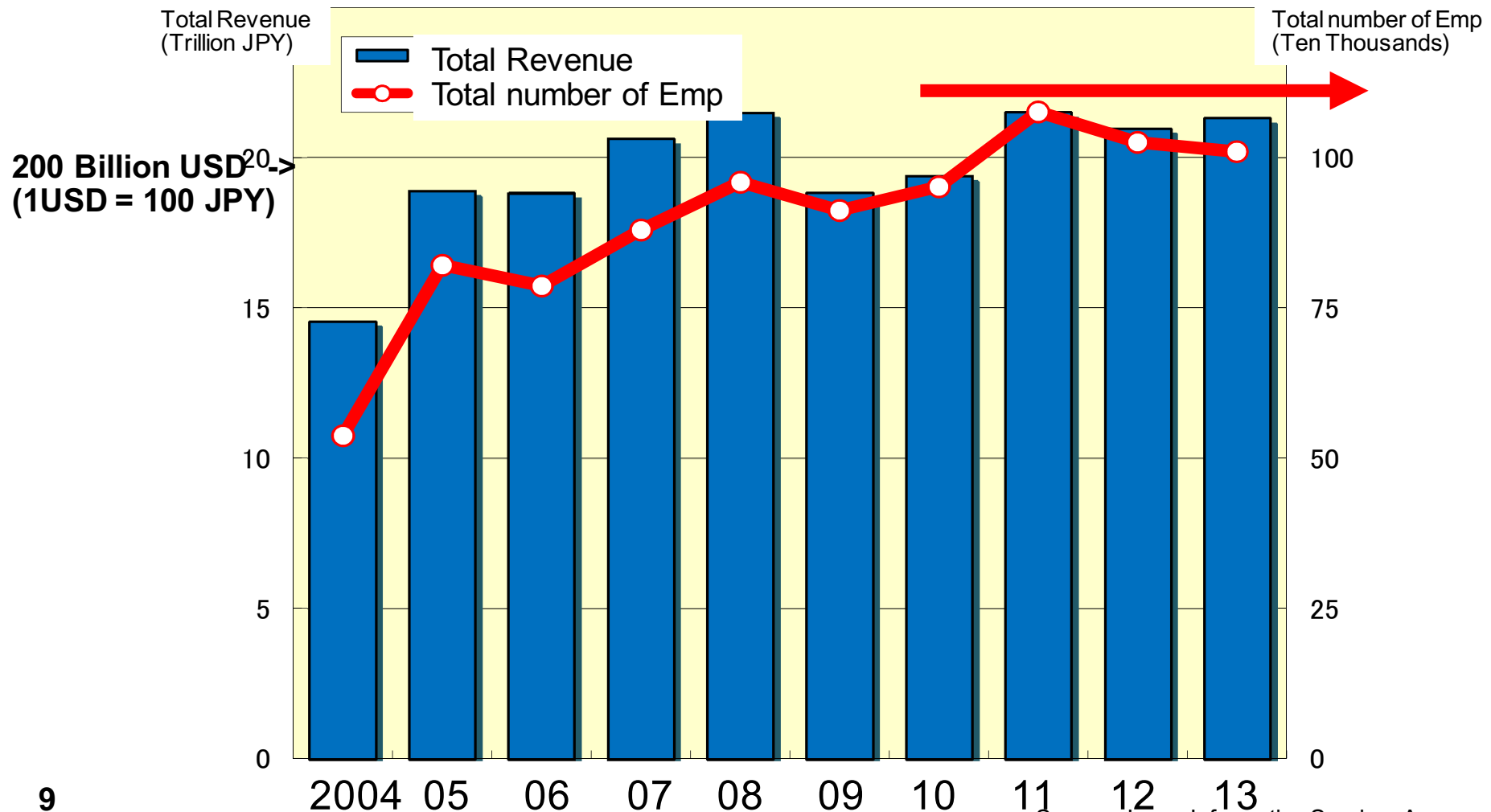
- Information Services Industry Facts
  - Industry population
  - Industry structure
    - Vendor Structure
    - Contract Structure
    - Embedded Systems, Enterprise Systems
    - Out Source



## 2. Facts about Industry and Academia in Japan

### 2.1 Facts about Industry

- Total number of information services Employee and Revenue

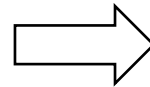


## 2. Facts about Industry and Academia in Japan

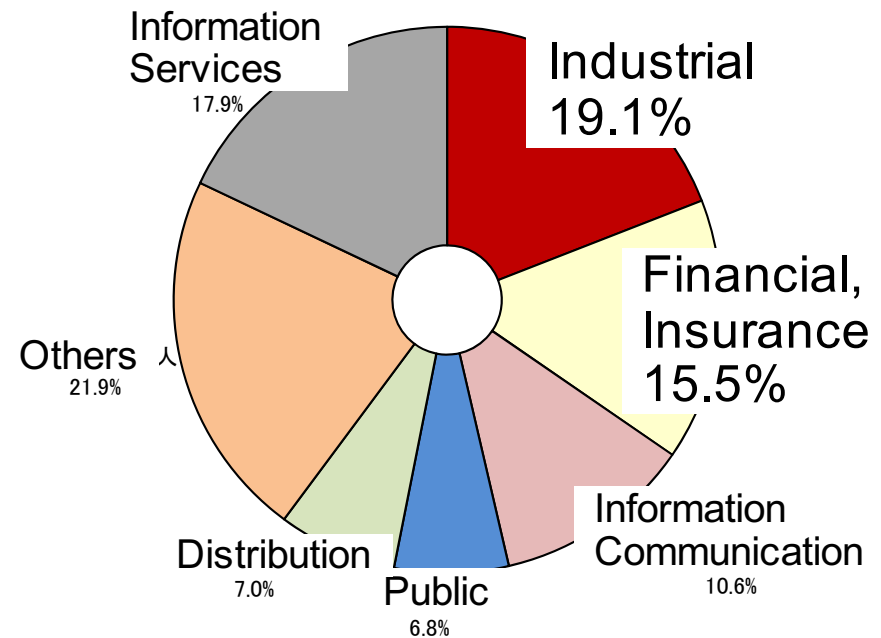
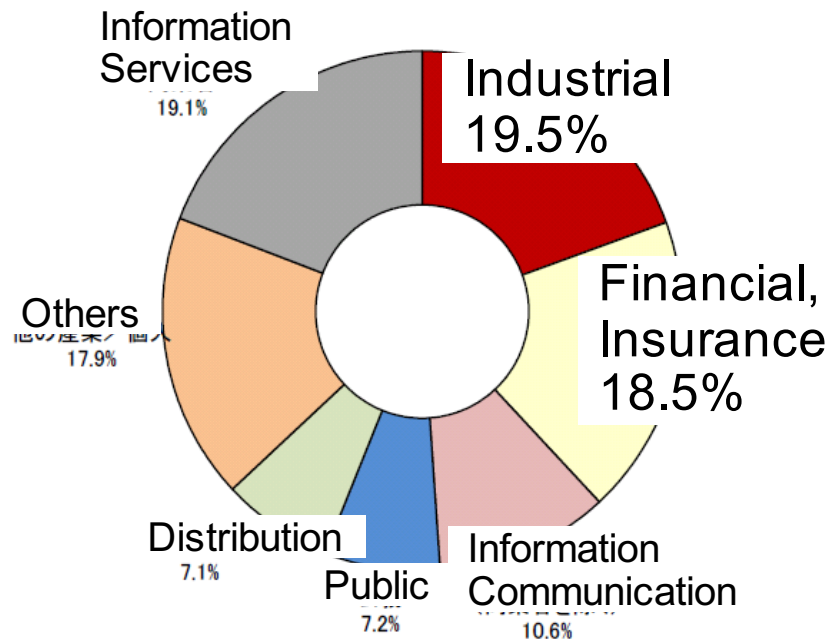
### 2.1 Facts about Industry

#### ■Types of Industry

2010



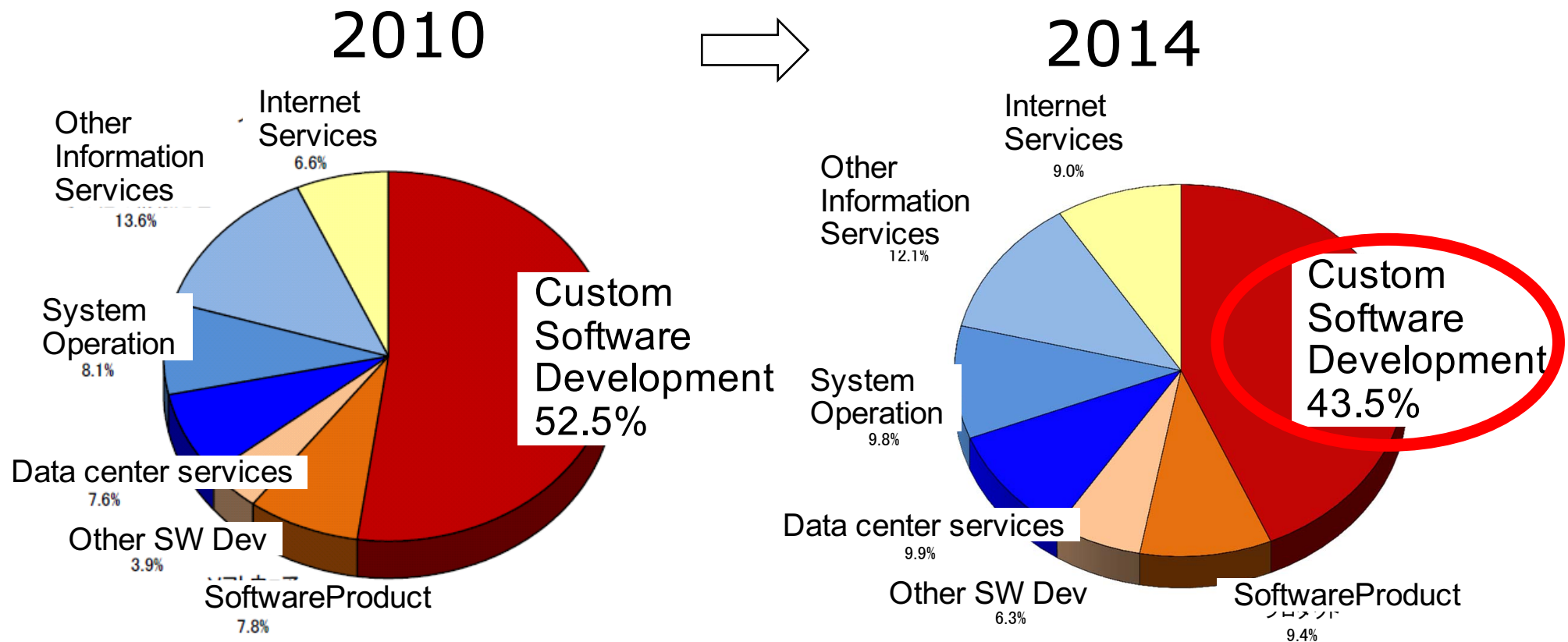
2014



## 2. Facts about Industry and Academia in Japan

### 2.1 Facts about Industry

#### ■Types of software in Japan



## 2. Facts about Industry and Academia in Japan

### 2.1 Facts about Industry

- Structure of software industry

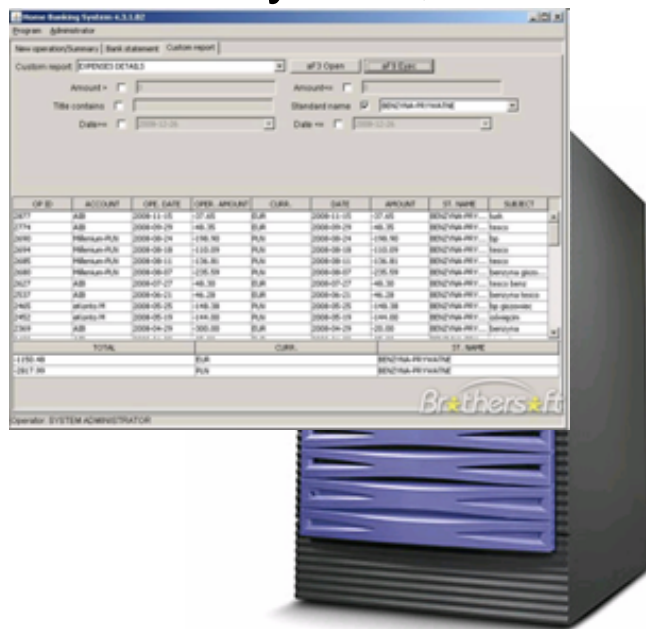
- Enterprise software and Embedded software

Enterprise system

e.g.

Banking system

SCM system, etc.

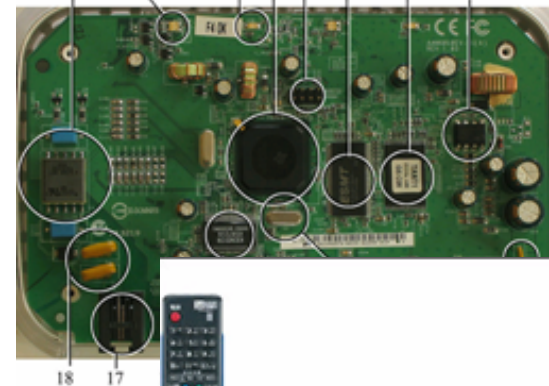


Embedded system

e.g.

Video recorder

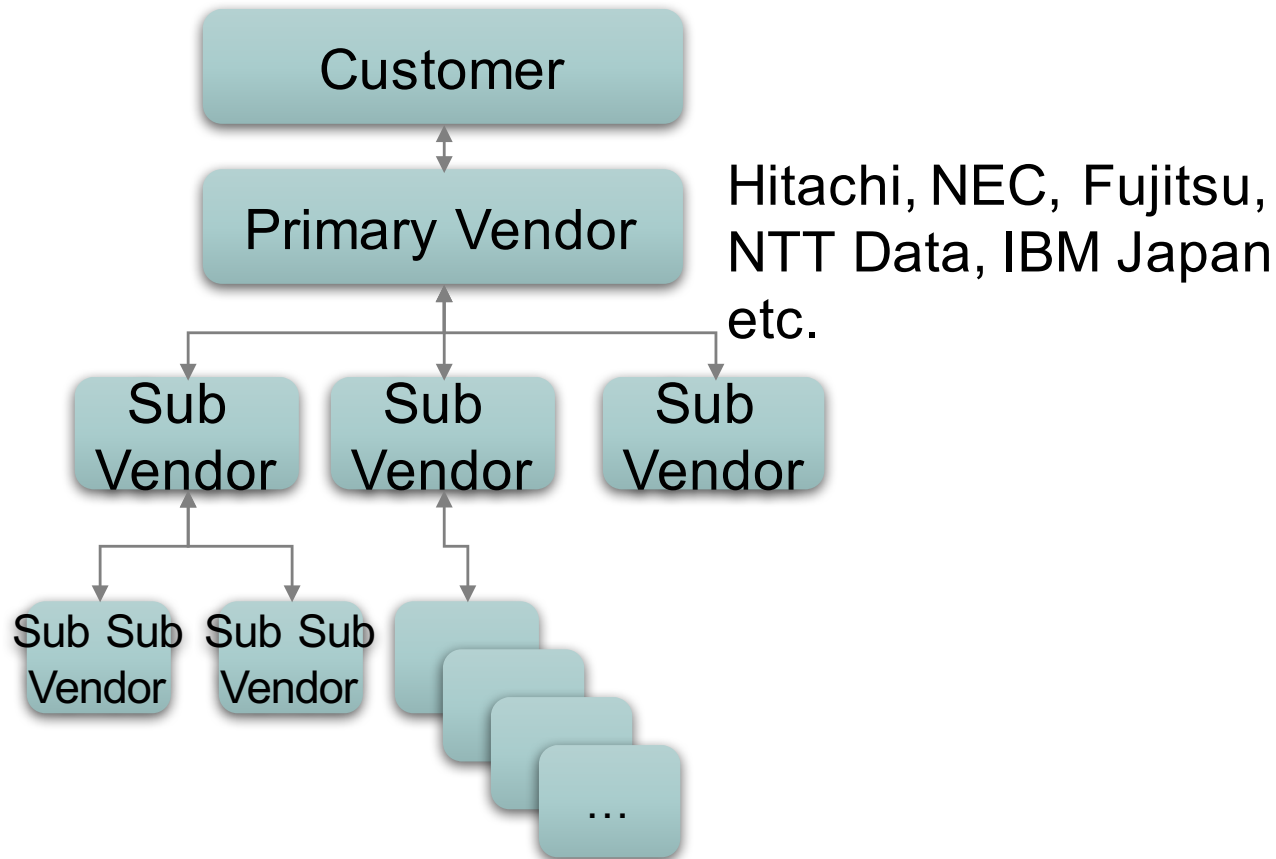
Car navigation system, etc.



## 2. Facts about Industry and Academia in Japan

### 2.1 Facts about Industry

- Structure of Information Services Vendor 
  - Multiple Vendor Structure



## 2. Facts about Industry and Academia in Japan

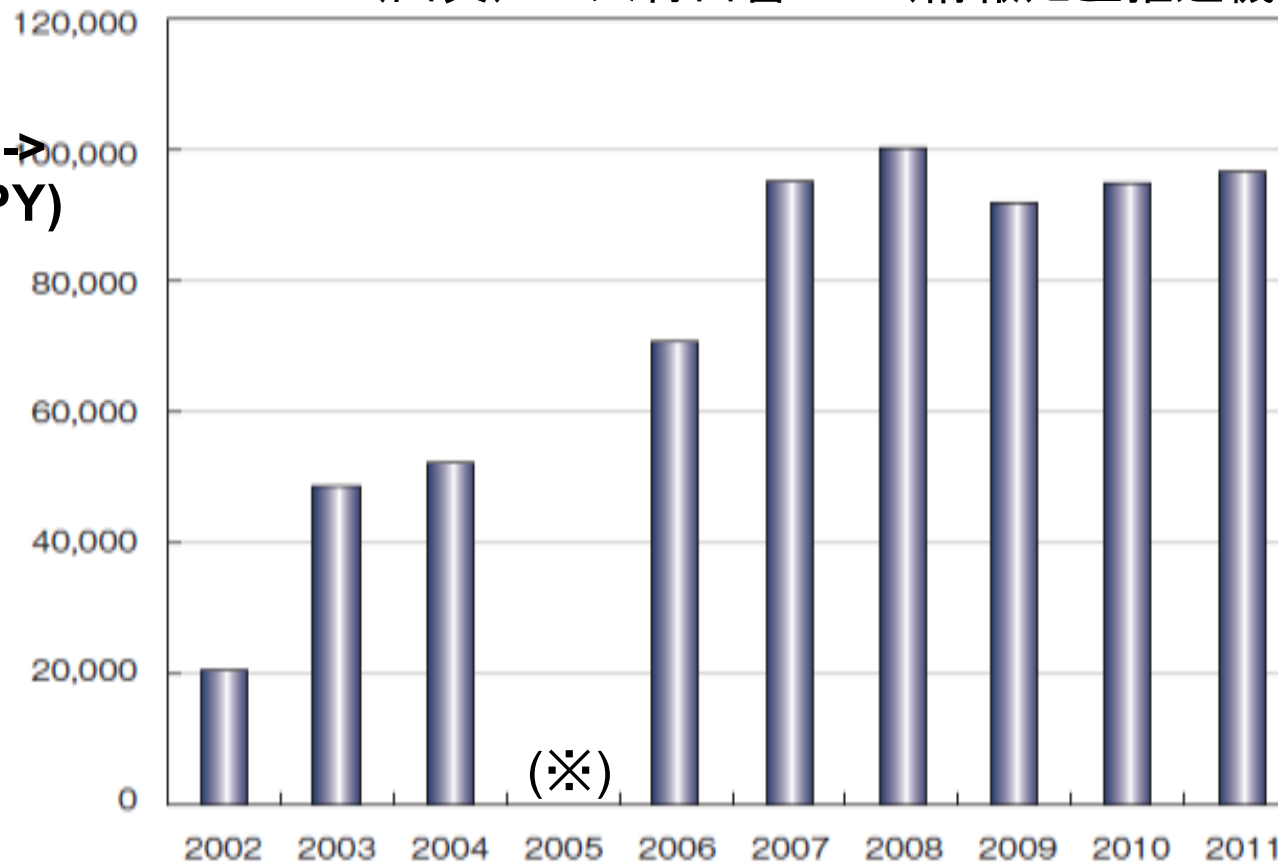
### 2.1 Facts about Industry



#### ■ Off shore Out Sourcing

(Million JPY) **Total Amount of Off shoring (in 288 Companies)**

1 Billion USD →  
(1USD = 100JPY)

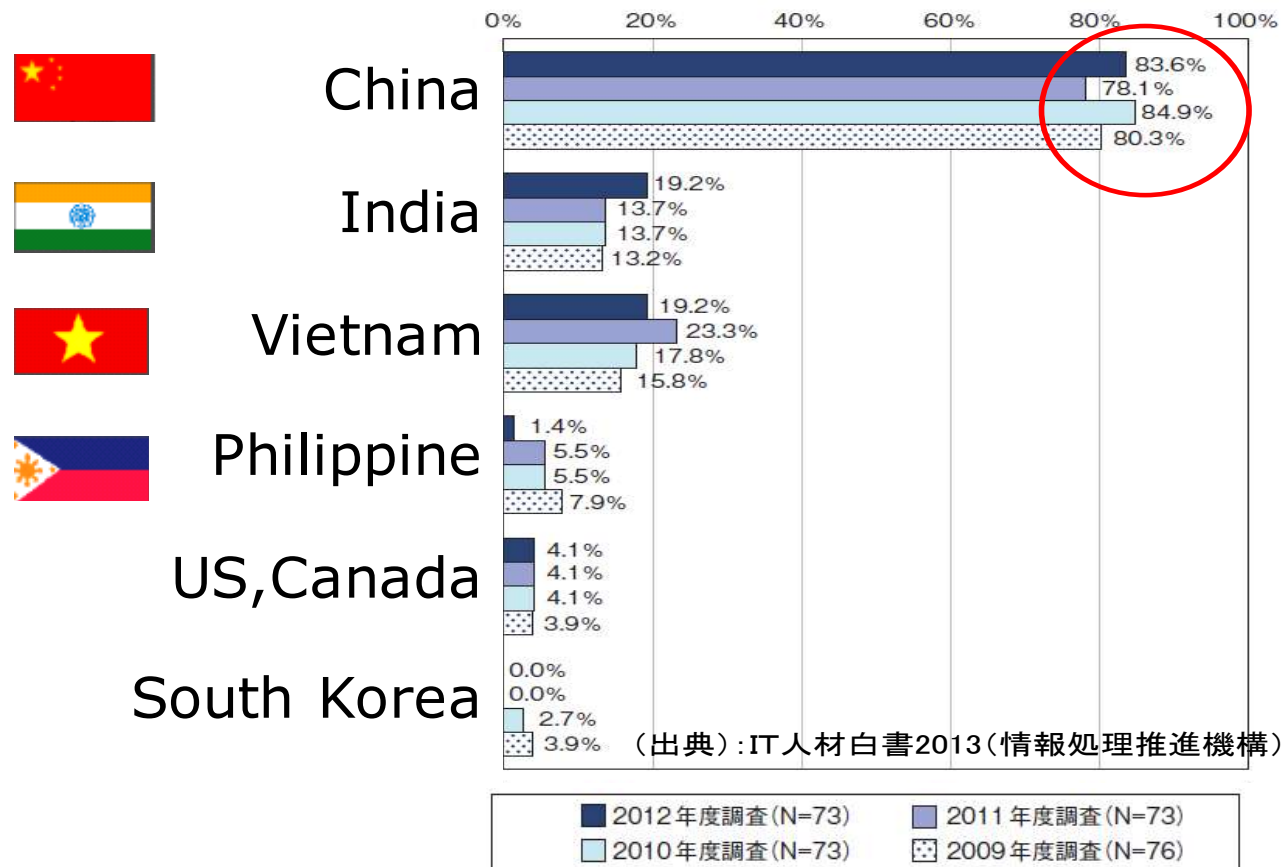


## 2. Facts about Industry and Academia in Japan

### 2.1 Facts about Industry

#### ■ Off shore Out Sourcing

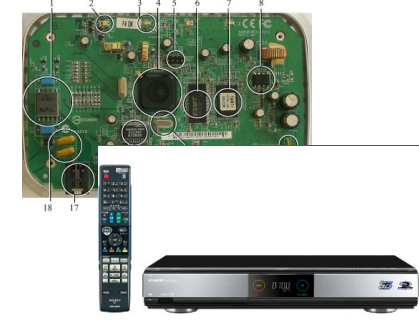
**Percentage of offshore countries (in 288 Companies)**



## 2. Facts about Industry and Academia in Japan

### 2.1 Facts about Industry

- Software Testing Market Perspective
  - In enterprise, market exists over testing and development
  - In embedded, some market exists on testing



	Enterprise Software	Embedded Software
Testing	market	market market
Development	market	market market



---

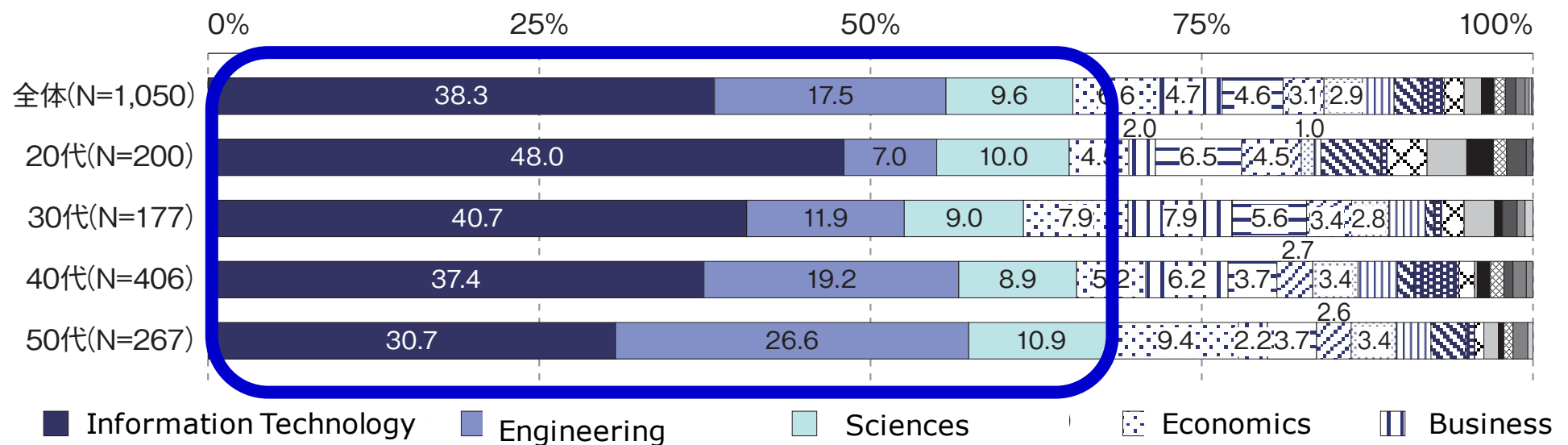
## 2. Facts about Industry and Academia in Japan

### **Academic and Education**

## 2. Facts about Industry and Academia in Japan

### 2.2 Facts about Academic and Education

- About 70% of information technology (IT) engineers graduated from the department of information technology, science, and engineering in their respective universities.



Source: "Information Technology Education in University"  
Kazuki Kawamura et al, 2016, Nikkei BP.

---

## 2. Facts about Industry and Academia in Japan

### 2.2 Facts about Academic and Education

- About 50% of the syllabus for basic IT education was developed using lectures under the policies outlined in reference.

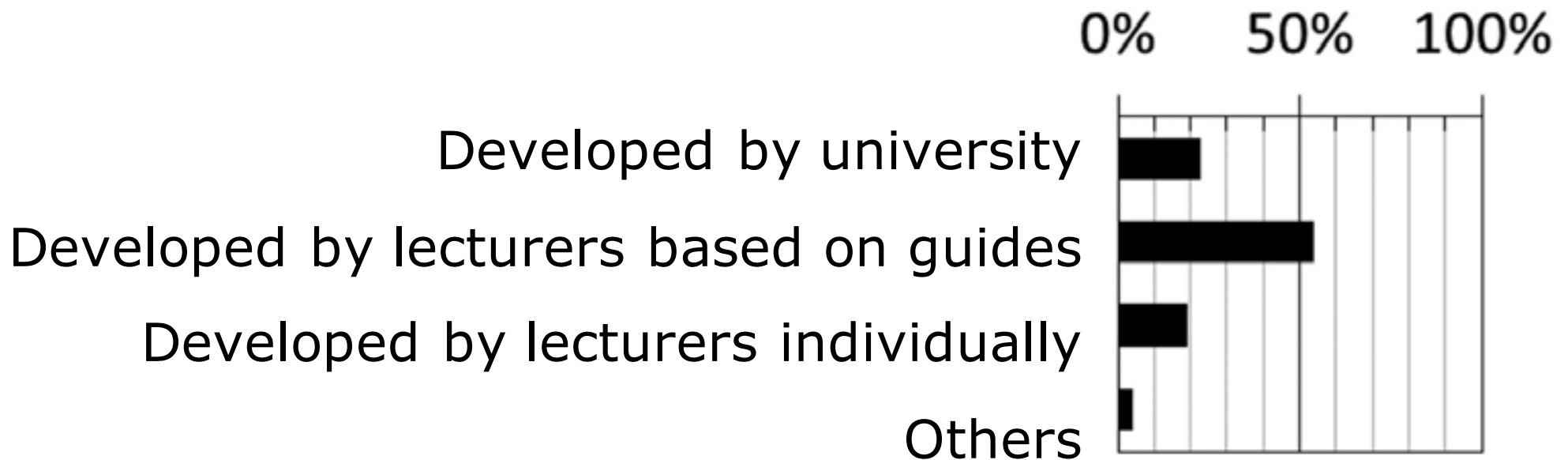


fig. Syllabus development types

## 2. Facts about Industry and Academia in Japan

### 2.2 Facts about Academic and Education

#### GEBOK

- The Information Processing Society of Japan (IPSJ) established the General Education Body of Knowledge (GEBOK) for general IT education.
- There are nine areas in the GEBOK covering information and communication, algorithm and programming, information network, and information security.

エリア	ユニット
GUI 科目ガイダンス[1]	GUI1 当該大学のネットワーク環境と情報倫理規定[1]
ICO 情報とコミュニケーション	ICO1 情報と人間のかかわり[1] ICO2 コミュニケーションの基礎概念とモデル[1] ICO3 ICT 概論 ICO6 グラフィカルユーザインタフェース ICO7 3次元ユーザインタフェース
DIG 情報のデジタル化	DIG1 符号化の原理[1] DIG4 符号圧縮 DIG5 情報理論
CEO コンピューティングの要素と構成[4]	CEO1 コンピュータの構成[1] CEO2 コンピュータの動作原理[1] CEO4 コンピュータの動作原理[1] CEO5 論理代数と論理回路 CEO6 オペレーティングシステム CEO7 プログラミング言語とプログラミング方式
ALP アルゴリズムとプログラミング[1]	ALP3 アルゴリズムの良し悪し ALP4 扱いにくい問題 DMO1 モデル化の考え方[1]
DMO データモデリング	DMO3 状態遷移モデル DMO5 グラフ DMO6 データ構造とアルゴリズム
INW 情報ネットワーク	INW1 情報ネットワークでできること[1] INW4 ネットワークの仕組み[1] INW5 インターネットサービス[2]
INS 情報システム[6]	INS1 情報行為と情報システム[1] INS2 情報システム構築 INS4 社会問題としての情報システム[1]
ISS 情報倫理とセキュリティ[7]	ISS1 社会で利用させる情報技術[1] ISS2 インターネット社会における問題[1] ISS3 情報倫理のマナー[1] ISS6 パソコンのセキュリティ管理[1]
CLI コンピュータリテラシー[4]	CLI1 コンピュータの基本操作 CLI2 表計算によるデータ処理 CLI3 プレゼンテーション CLI5 WWW による情報検索

表-3 GEBOKの骨子

---

## 2. Facts about Industry and Academia in Japan

### 2.2 Facts about Academic and Education

- IT education classes consist of 10% at an elementary level, 50% at a basic level, and 20% at an advanced or professional level.

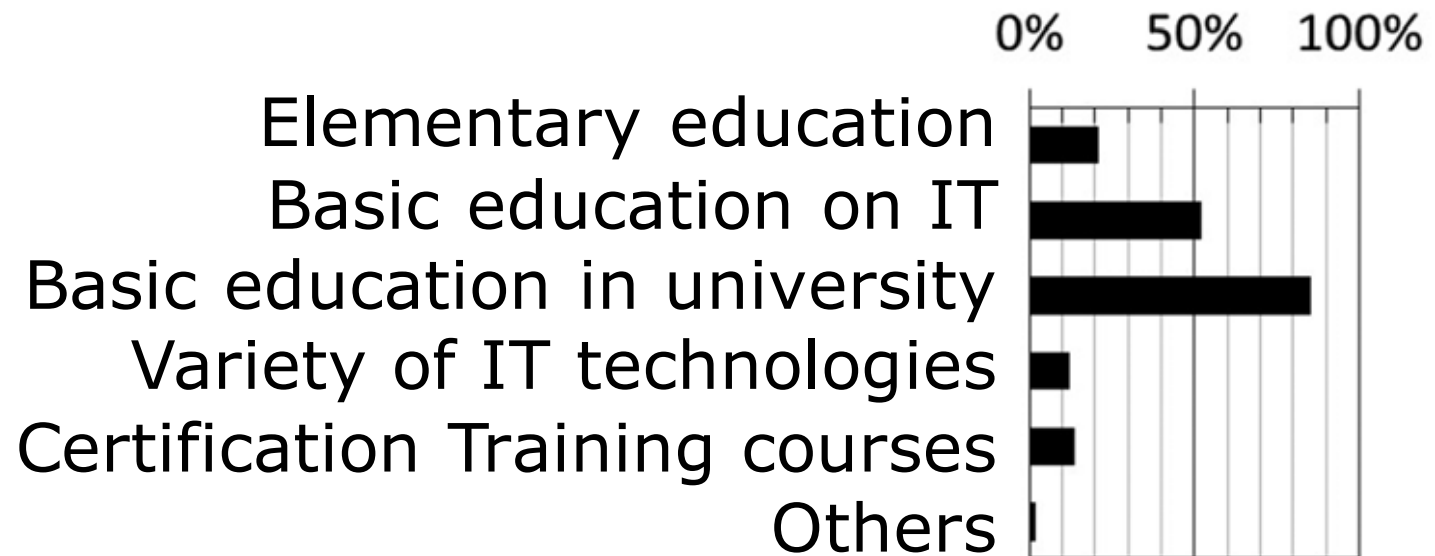


fig. Objectives of IT education courses

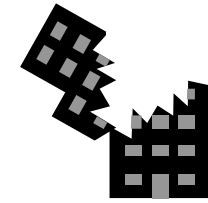
---

## **3. Challenges for Software Quality and Testing**

### 3. Challenges for Software Quality and Testing

---

#### A System down



- The system was forced to suspend all morning. (2005)
- computer system malfunction stemming from a trading capacity expansion

Blank

### 3. Challenges for Software Quality and Testing

---

#### A System down



- A glitch in the system led to the cancellation of 46 domestic flights, affecting about 6,700 passengers.

Blank



### 3. Challenges for Software Quality and Testing

---

Systems down..

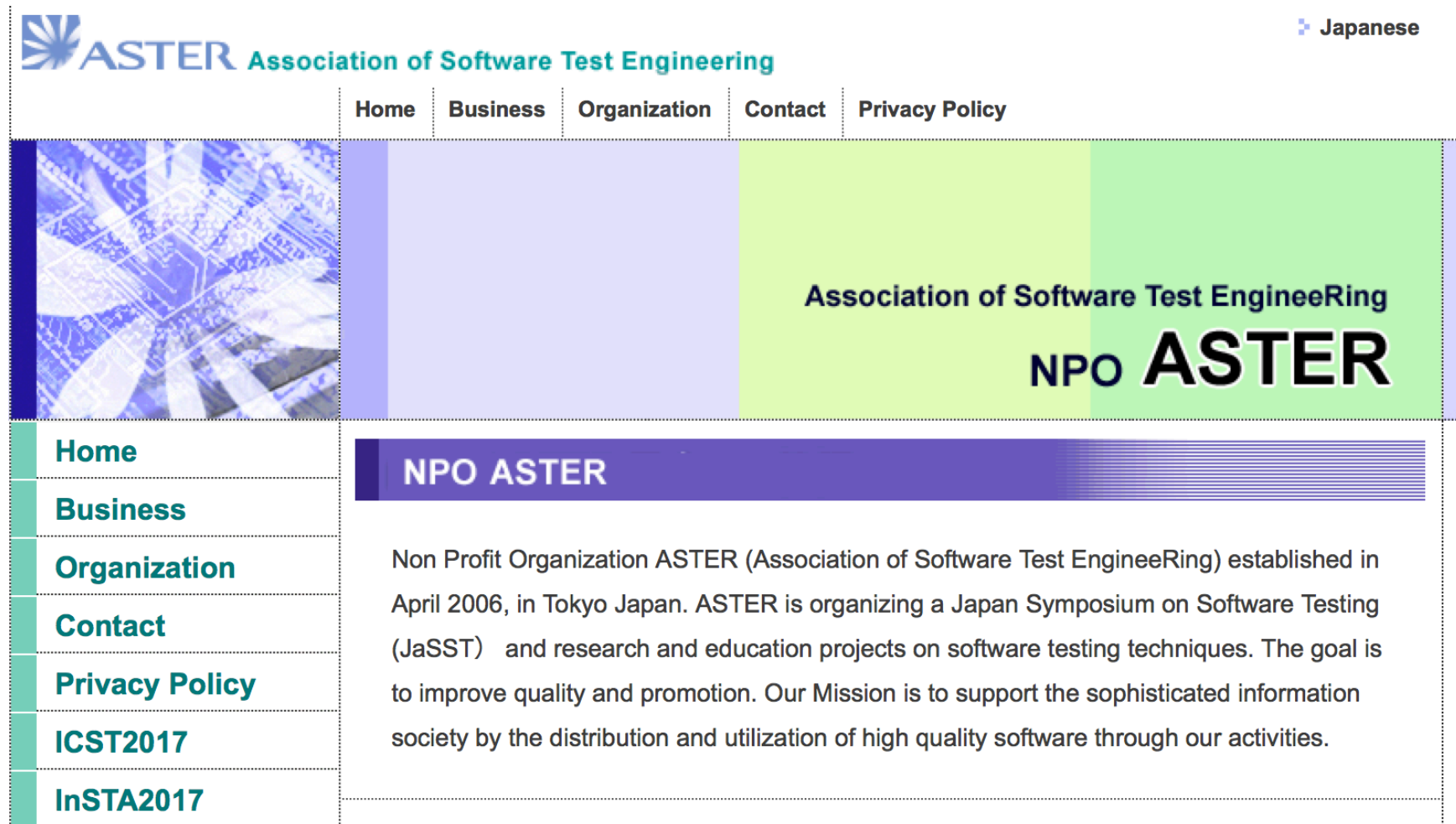
Blank

---

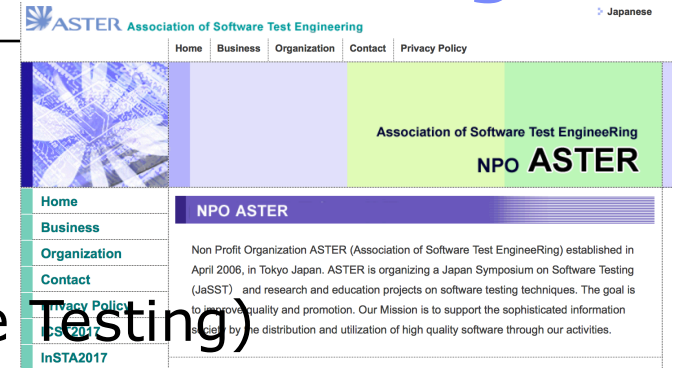
# **4. Solutions and Activities in Software Testing**

## 4. Solutions and Activities in Software Testing

- Software Testing awareness-raising in Japan
  - ASTER (Association of Software Test Engineering) established 2006



## 4. Solutions and Activities in Software Testing

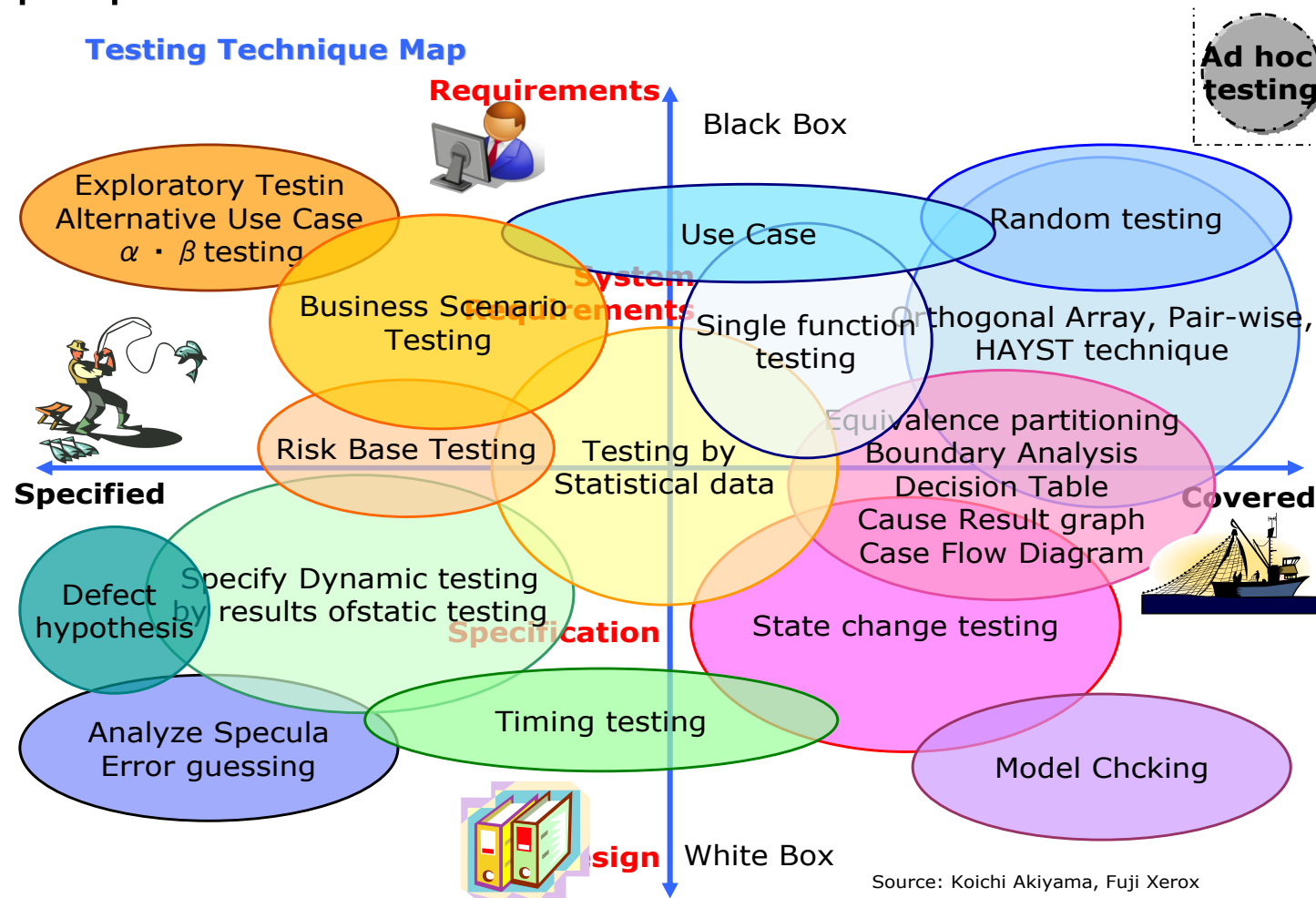


- NPO Aster activities:
  - Software testing event organization
    - JaSST (Japan Symposium on Software Testing)
  - Certification
    - JSTQB (Japan Software Testing Qualifications Board)
  - Research & Development
    - Testing Skills Standardization: Test.SSF
    - Citation of best paper: Zengo Award
  - International Research
    - InSTA (International Workshop on Software Test Architecture)
    - ISO/IEC JTC1/SC7/WG26 (Software Testing Standardization)
    - ASTA (Asia Software Testing Alliance)
    - to International Conferences.
  - Education
    - Supporting Seminars and Workshops in the community

# 3. Solutions and Activities in Software Testing



- 1. Innovations in software testing area
  - Mapping software testing technique for us to select appropriate ones



Source: Koichi Akiyama, Fuji Xerox

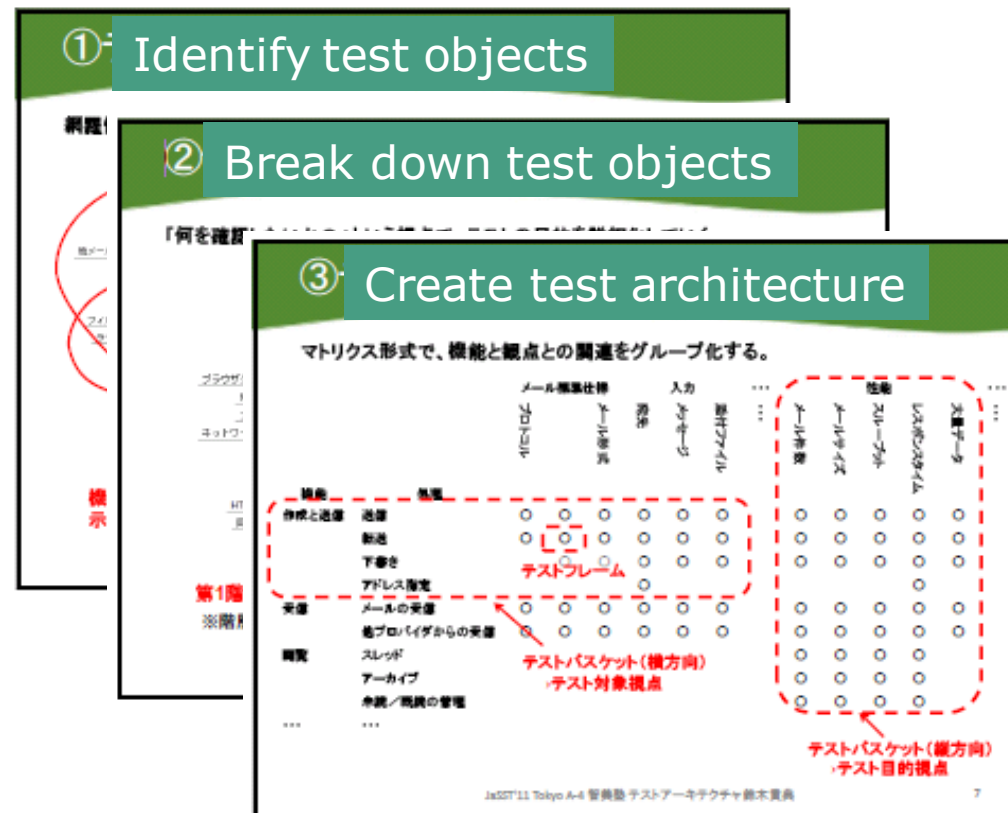
© 2017 IBM Corporation

### 3. Solutions and Activities in Software Testing

- Solutions in software testing area
  - Developing Software Testing Methodologies to get testing efficiently and effectively.



- A example of methodologies
  1. Identify test objectives
  2. Break down into details
  3. Create test architecture

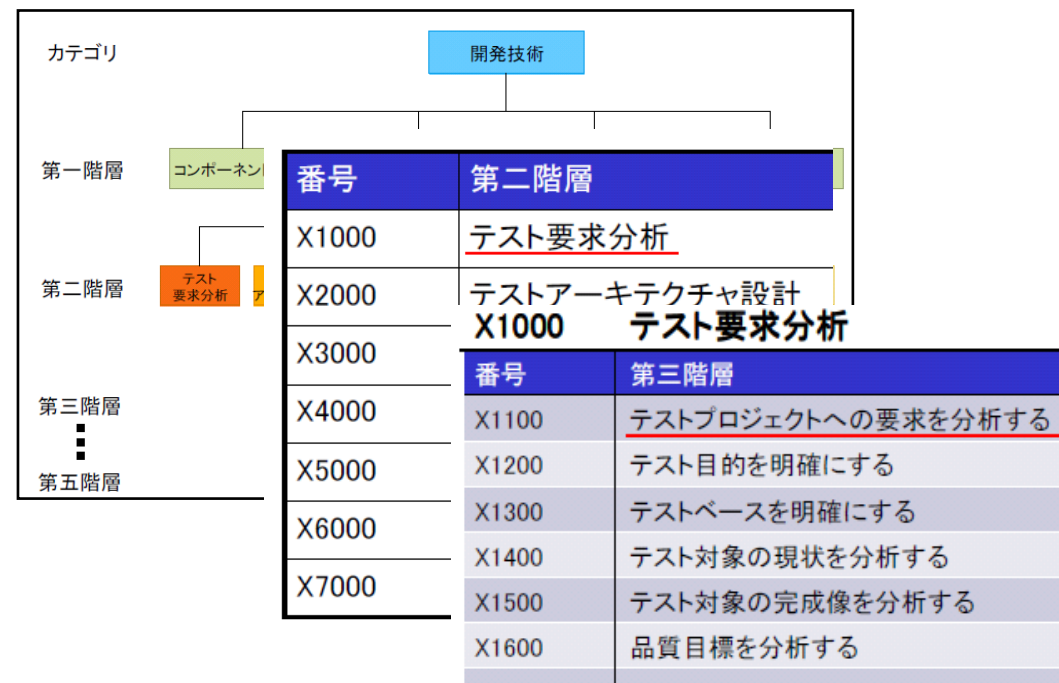


### 3. Solutions and Activities in Software Testing

- Solutions in software testing area
  - Develop software testing skills standard for education.  
“Test.SSF”(Test Skill Standard Framework)

- Test.SSF consists of
  1. Layers of software testing knowledges
  2. Break down into detail skills

#### Test.SSF



### 3. Solutions and Activities in Software Testing

---

- How do industry and academia collaborate?
- Gaps in their attitude
  - “Industry want to solve the problems now” by business needs
  - “Academia interest about something new (ways to solve the problems)” by academic requirements

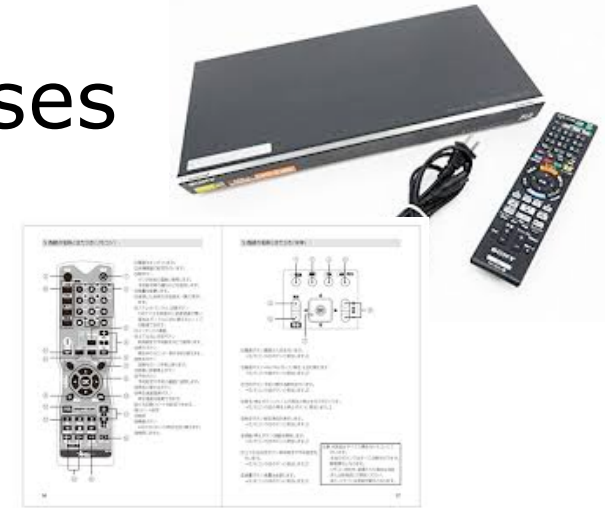


---

# **\* My case collaboration Industry and Academia**

### 3. Solutions and Activities in Software Testing

- My example about the Gap
  - Business requirements:
    - Automatic generation test cases from user guides in natural language for video recorder series in this autumn.



- Research approach:

- “Semantic Analysis Technique of Logics Retrieval for Software Testing from Specification Documents”, (2015, Masuda et al.)

**Algorithm 1** The analysis technique algorithm

**Input:** documents which have been morphological analyzed and dependency parsed

```
1: for each  $D_m$  do
2:   for all  $P_d(i)$  do
3:     if  $P_d(i) = KI$  then
4:        $CEi = i$ 
5:        $P_d(i) = CE$ 
6:       if  $P_m(Dep_d(i)) \in D_m$  and  $P_m(Dep_d(i)) \in T$  then
7:          $AEi = i$ 
8:          $P_d(Dep_d(i)) = AE$ 
9:       else next  $D_m$ 
10:    end next  $D_m$ 
11:  end for
12:  for all  $P_d(i)$  do
13:    if  $Dep_d(i) = CEi$  and  $max(i)$  then
14:       $P_d(Dep_d(i)) = AS$ 
15:    else next  $D_m$ 
16:    if  $Dep_d(i) = AEi$  and  $max(i)$  then
17:       $P_d(Dep_d(i)) = CS$ 
18:    else next  $D_m$ 
19:  end for
20: end for
```

## \* Decision Table Testing

"Semantic Analysis Technique of  
Logics Retrieval for Software Testing  
from Specification Documents"

### ■ Requirement

– *"If the age is more than twelve, the fee will be five dollars."*

### ■ ISO/IEC/IEEE 29119-4 Decision Table Testing

– Step 1: Identify Feature Sets (TD1)

• *"If the age is more than twelve, the fee will be five dollars."*

– Step 2: Derive Test Conditions (TD2)

Conditions

• TCOND1(C1): *"If the age is more than twelve"*

• TCOND2(A1): *"the fee will be five dollars"*

## \* Decision Table Testing

"Semantic Analysis Technique of  
Logics Retrieval for Software Testing  
from Specification Documents"

### –Step 3: Derive Test Coverage Items (TD3)

		Test Coverage Item	
	Decision Rules	1	2
Condition	(C1): <i>If the age is more than twelve</i>	T	F
Action	(A1): <i>the fee will be five dollars</i>	T	F

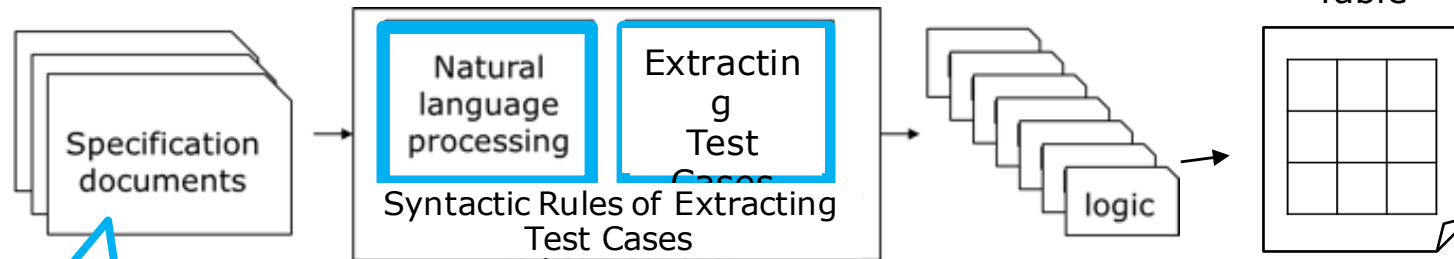
### –Step 4: Derive Test Cases (TD4)

	Input	Output	
Test Case	age	fee	Test Coverage Item
1	20	five dollars	1
2	8	Not five dollars	2

# \* Applying Natural Language Processing Techniques to Decision Table Testing

"Semantic Analysis Technique of Logics Retrieval for Software Testing from Specification Documents"

## \*\* Decision Table Testing Technique



**Stakeholders** often **use their natural language** to exchange their idea, business processes, business rules and other specifications and **describe the specifications into documents.**

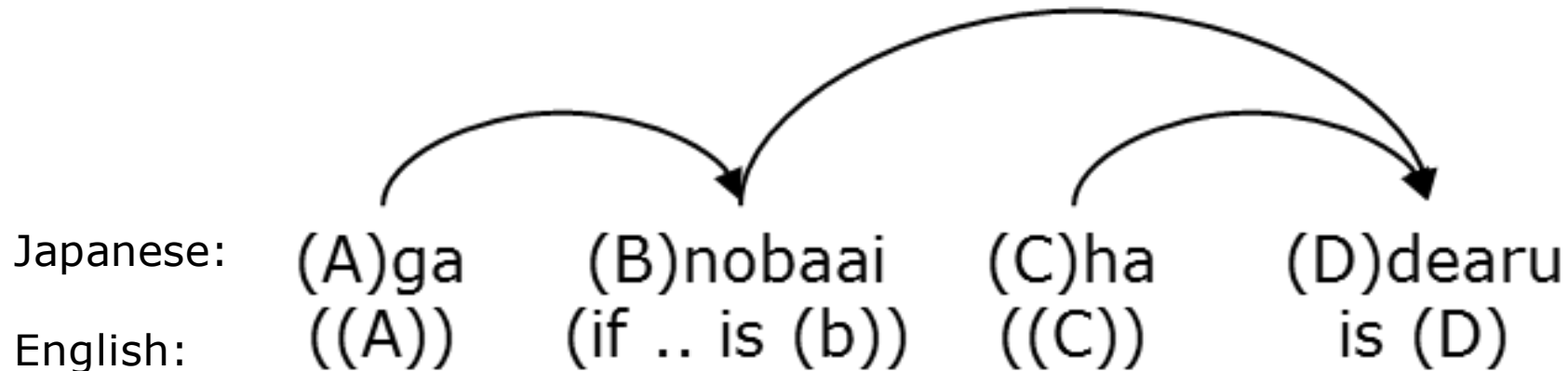
logic

*if (A) is (B), (C) is (D).*

Decision Table

Condition stub (A)	Condition entry (B)
Action stub (C)	Action entry (D)

### ■ Logic retrieval



### ■ Sample specification sentence

1. Japanese:

*"Miraini betsuno detaga haitteitabaai, sono jitenngo tyokuzennwo shuuryoubitosurukoto."*

2. English:

*"If another data exists in a future field, set a date just before the data as end date."*

## \* Experiments

TABLE IV. RESULTS THE ANALYSIS TECHNIQUE VS. EVALUATION

The analysis technique	<i>Positive</i>		<i>Negative</i>	
Evaluations	<i>Positive (a)</i>	<i>Negative (b)</i>	<i>Positive (c)</i>	<i>Negative (d)</i>
A	31	1	15	2
B	15	1	4	3
C	43	2	17	4
D	62	5	33	21
E	35	1	19	6
F	107	8	40	26

TABLE V. RESULTS OF RECALL AND PRECISION

	<b>Document Groups</b>					
	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>
Precision	0.97	0.94	0.96	0.93	0.97	0.93
Recall	0.67	0.79	0.72	0.65	0.65	0.73

### 3. Solutions and Activities in Software Testing

---

- Collaboration Industry and Academia

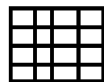
		Academia's solutions	
		Current	New
		Now	Late
Solve Industry problems	Now	Good collaboration	Research approach
	Late	Difficult problems	Grand challenges



## 5. Conclusion

---

- Software Testing in Industry and Academia:  
A View of Both Sides in Japan
  - Facts about Industry and Academia in Japan
  - Challenges for Software Quality and Testing
  - Solutions and Activities in Software Testing



धन्यवाद  
Hindi

多謝  
Traditional Chinese

Thank You  
English

Спасибо  
Russian

Gracias  
Spanish

תודה  
Hebrew

شكراً  
Arabic

ขอบคุณ  
Thai

Obrigado  
Brazilian Portuguese

Danke  
German

Grazie  
Italian

多谢  
Simplified Chinese

Merci  
French

நன்றி  
Tamil

ありがとうございました  
Japanese

감사합니다  
Korean