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Satoshi Masuda, IBM Research - Tokyo

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

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 – How industry and academia collaborate

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1. Introduction

Satoshi Masuda, IBM Research - Tokyo

- My career about software testing in Academia-Industry

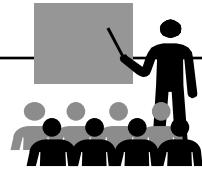
Year	Industry	Academia
2000	Test Engineer	
2010	Test Consultant ASTER director ISTQB member ISO/IEC member	
2017	Company researcher Ph.D. student	

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

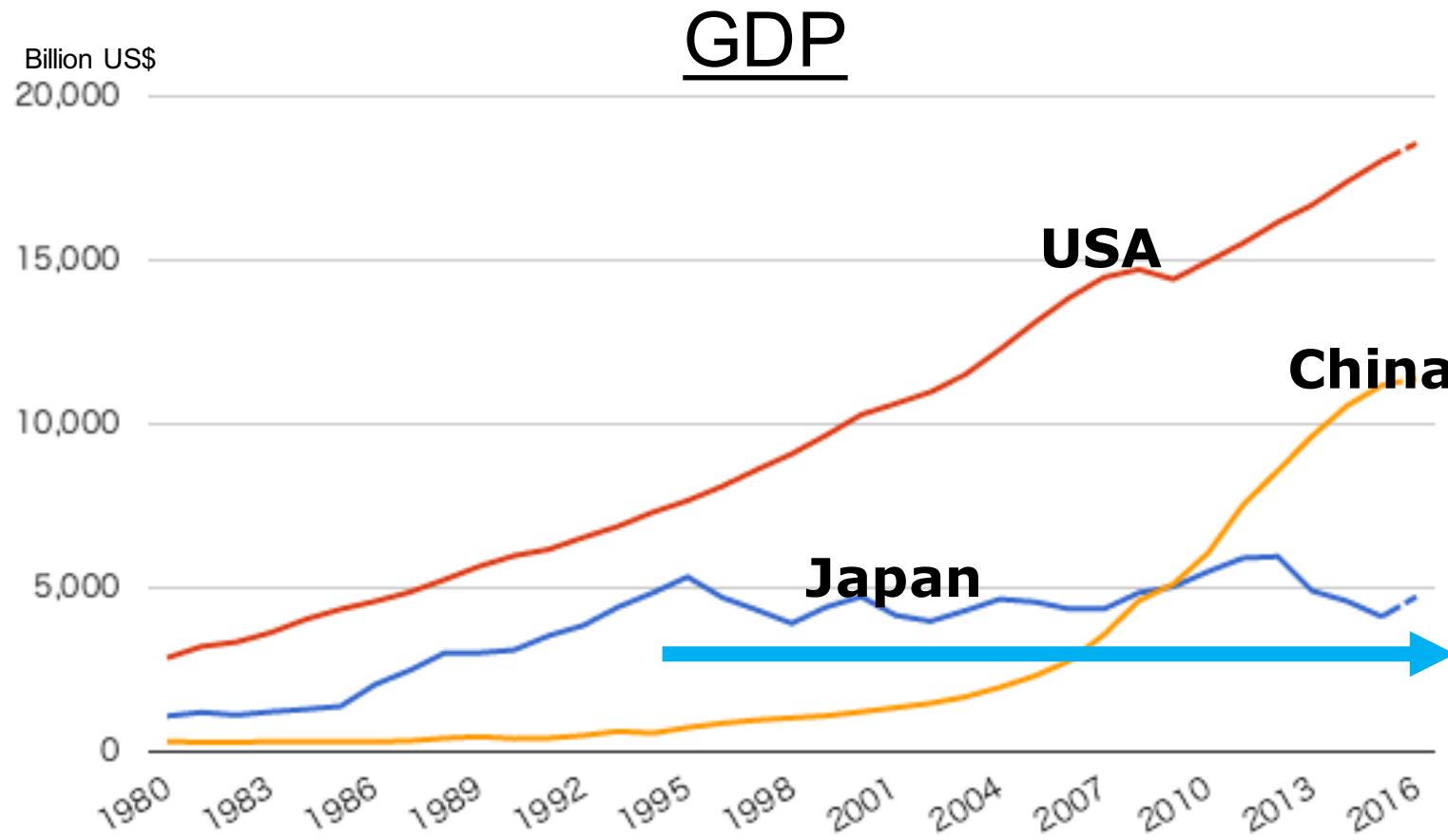
Industry

2. Facts about Industry and Academia in Japan

2.1 Facts about Industry



- “Great Flat” about Japanese economy

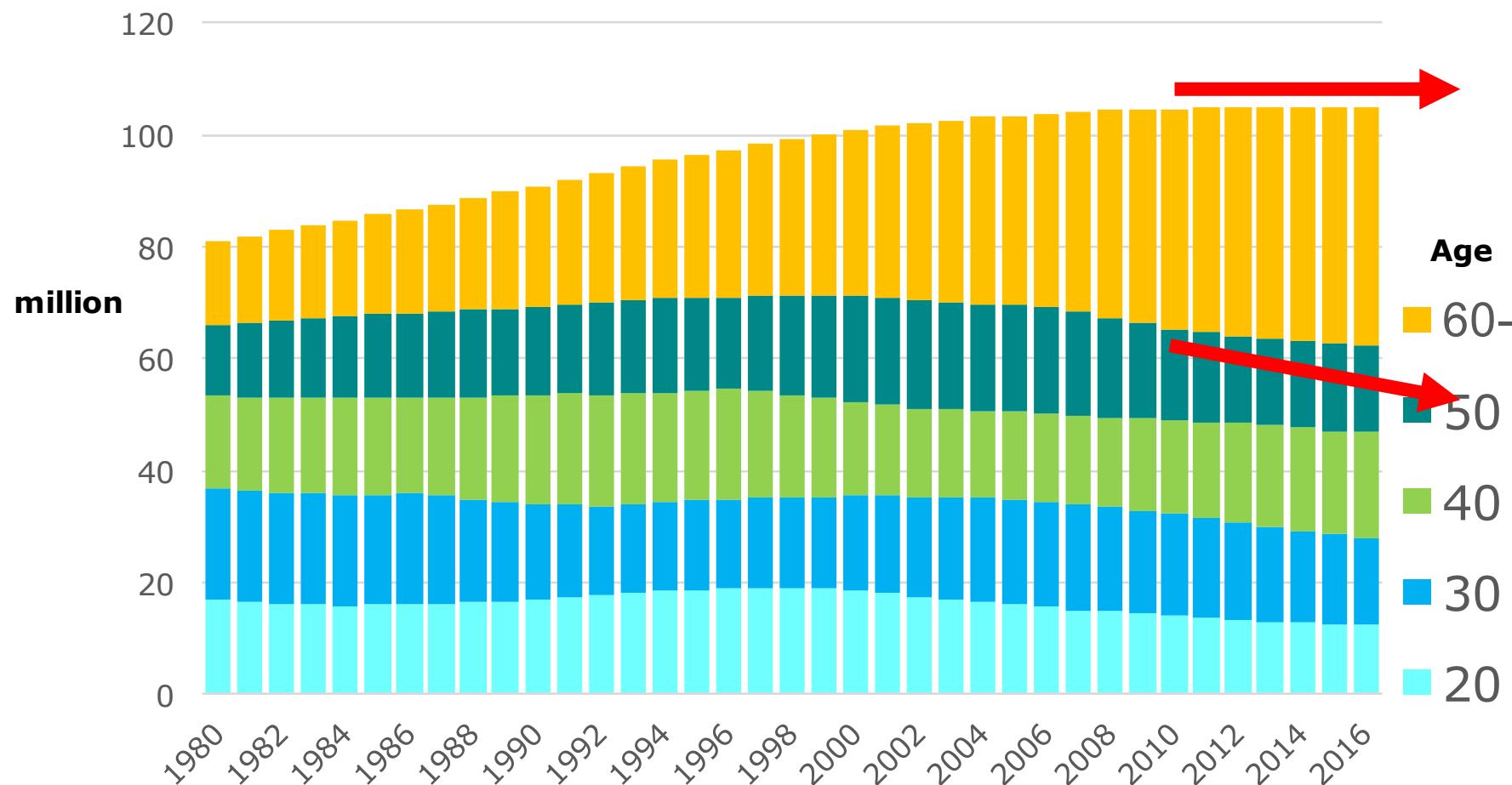


2. Facts about Industry and Academia in Japan

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

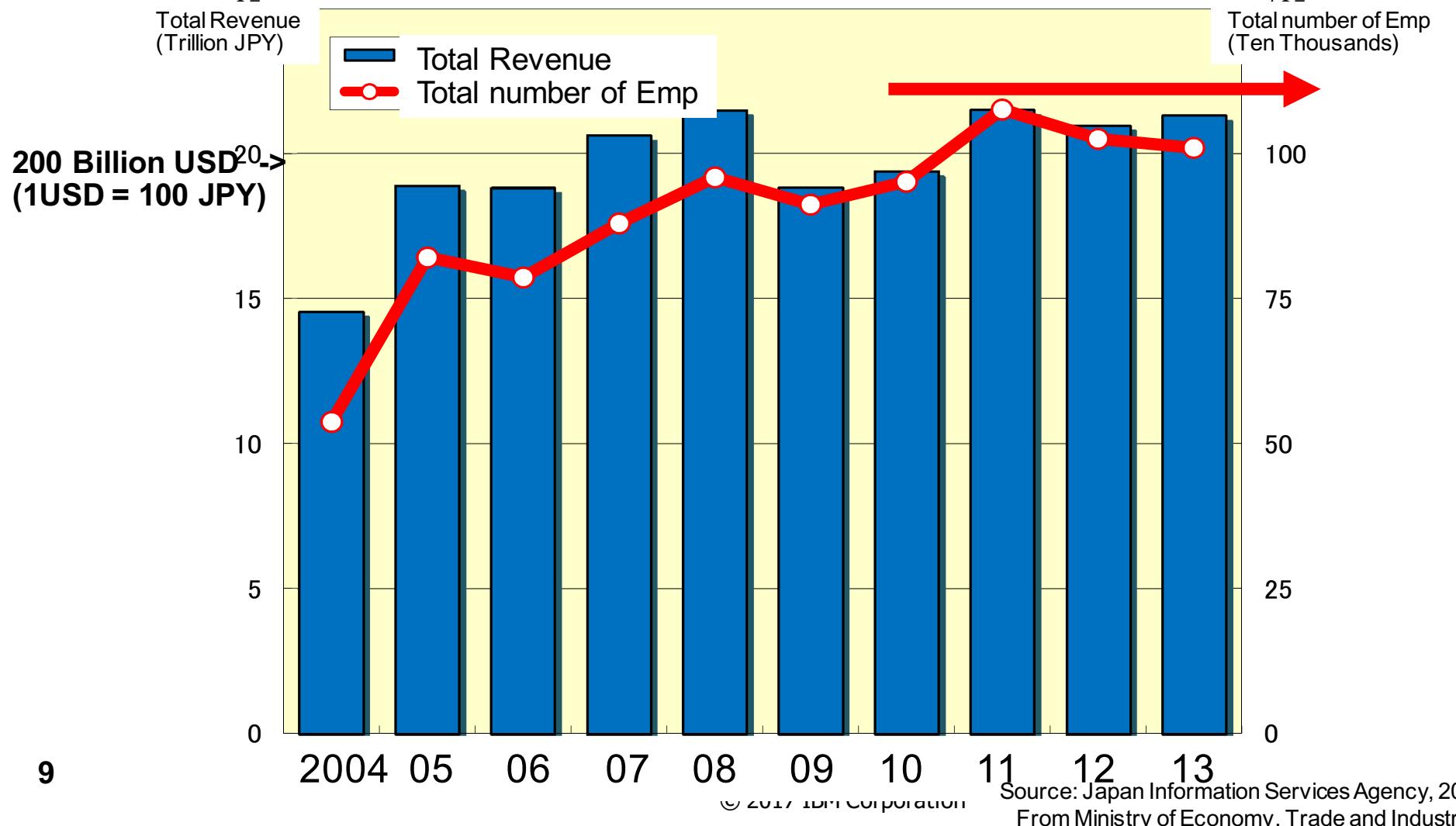
2.1 Facts about **Industry**

- 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

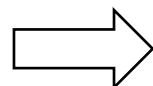


2. Facts about Industry and Academia in Japan

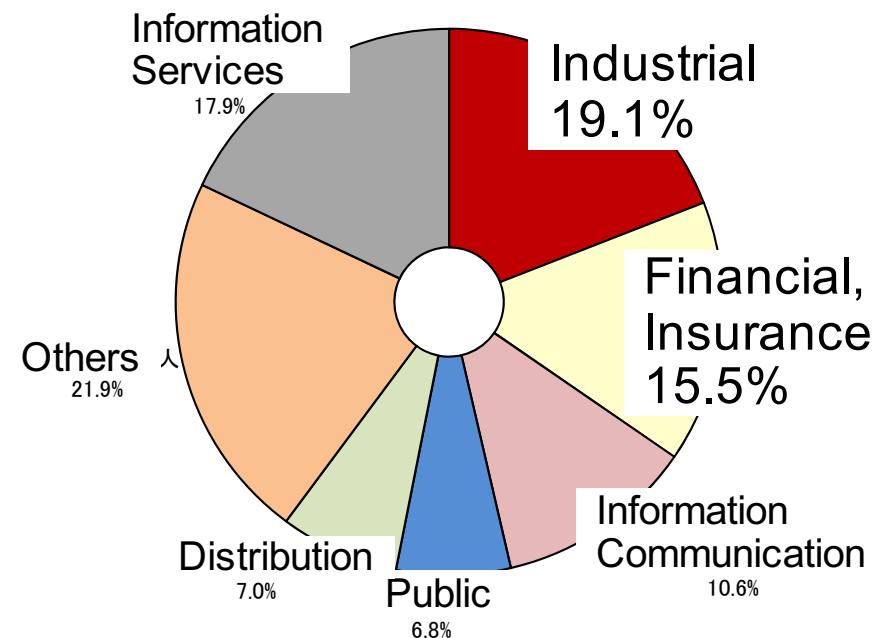
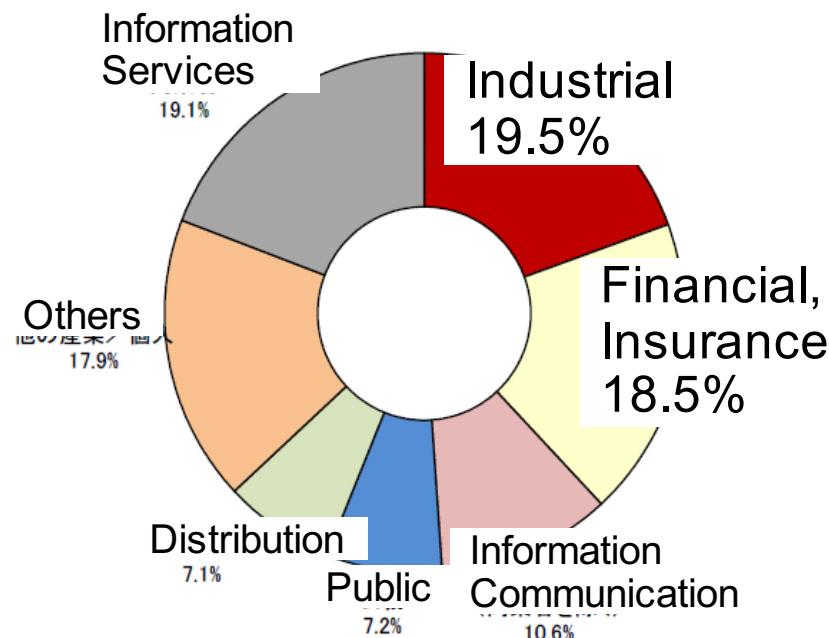
2.1 Facts about Industry

■ Types of Industry

2010



2014



Source: Japan Information Services Agency, 2011 and 2016

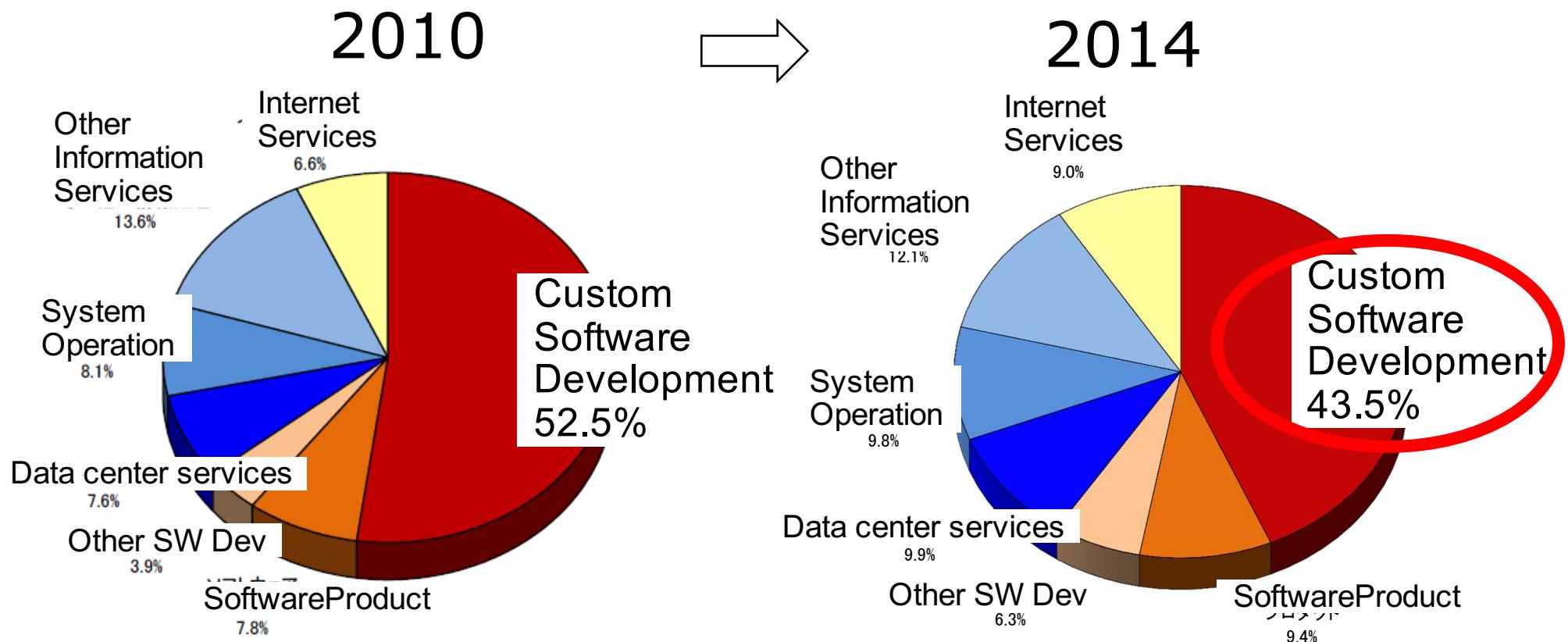
From Ministry of Economy, Trade and Industry

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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

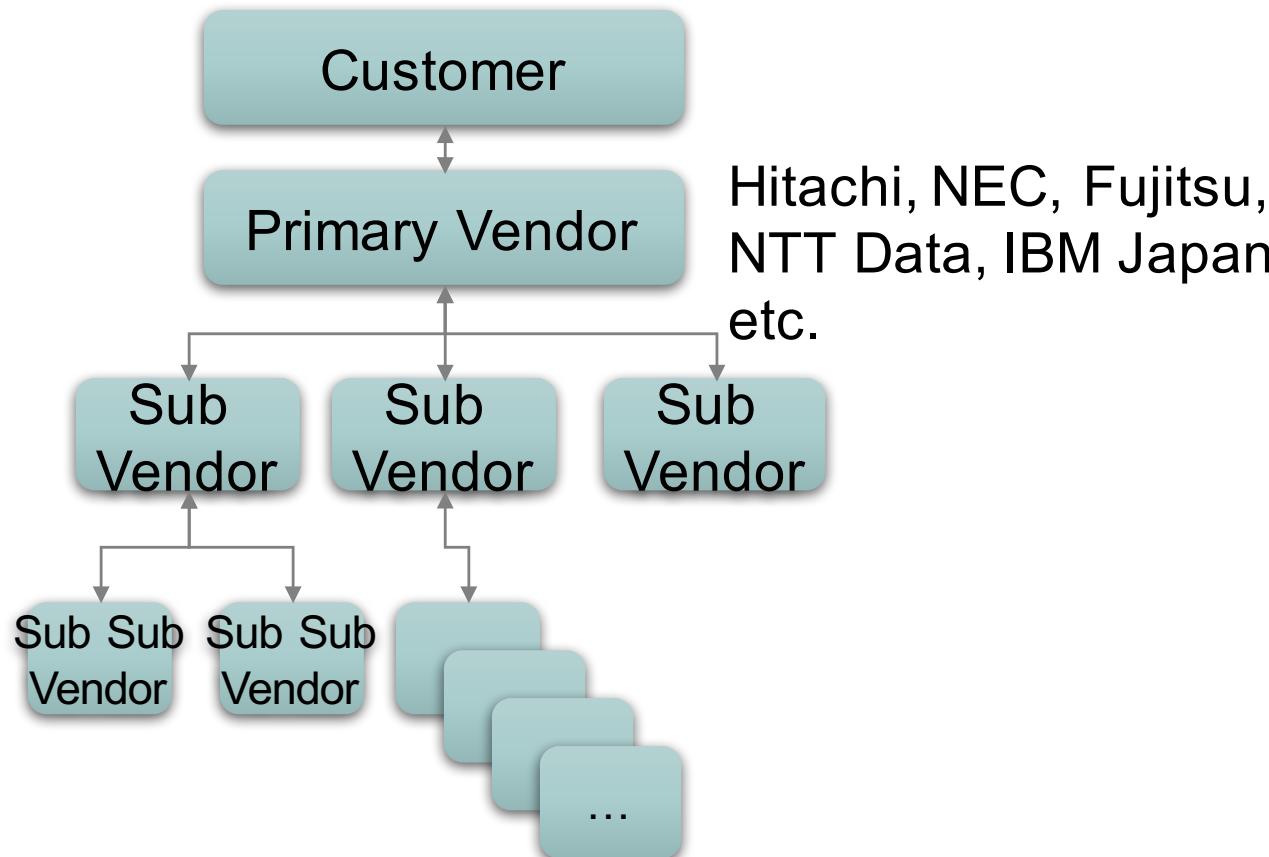
Car navigation system, etc.



2. Facts about Industry and Academia in Japan

2.1 Facts about Industry

- Structure of Information Services Vendor
 - Multiple Vendor Structure

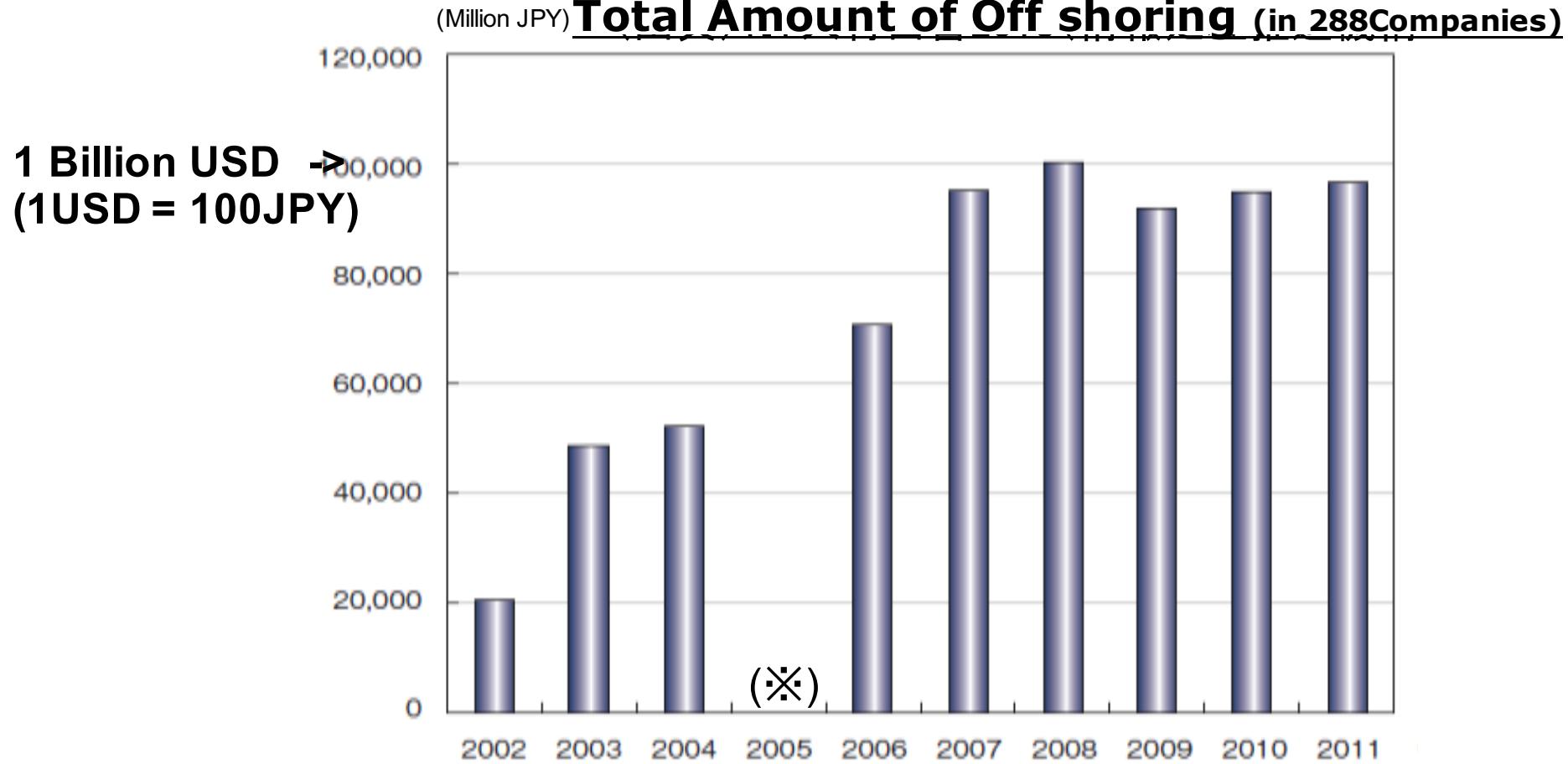


2. Facts about Industry and Academia in Japan

2.1 Facts about Industry



▪ Off shore Out Sourcing

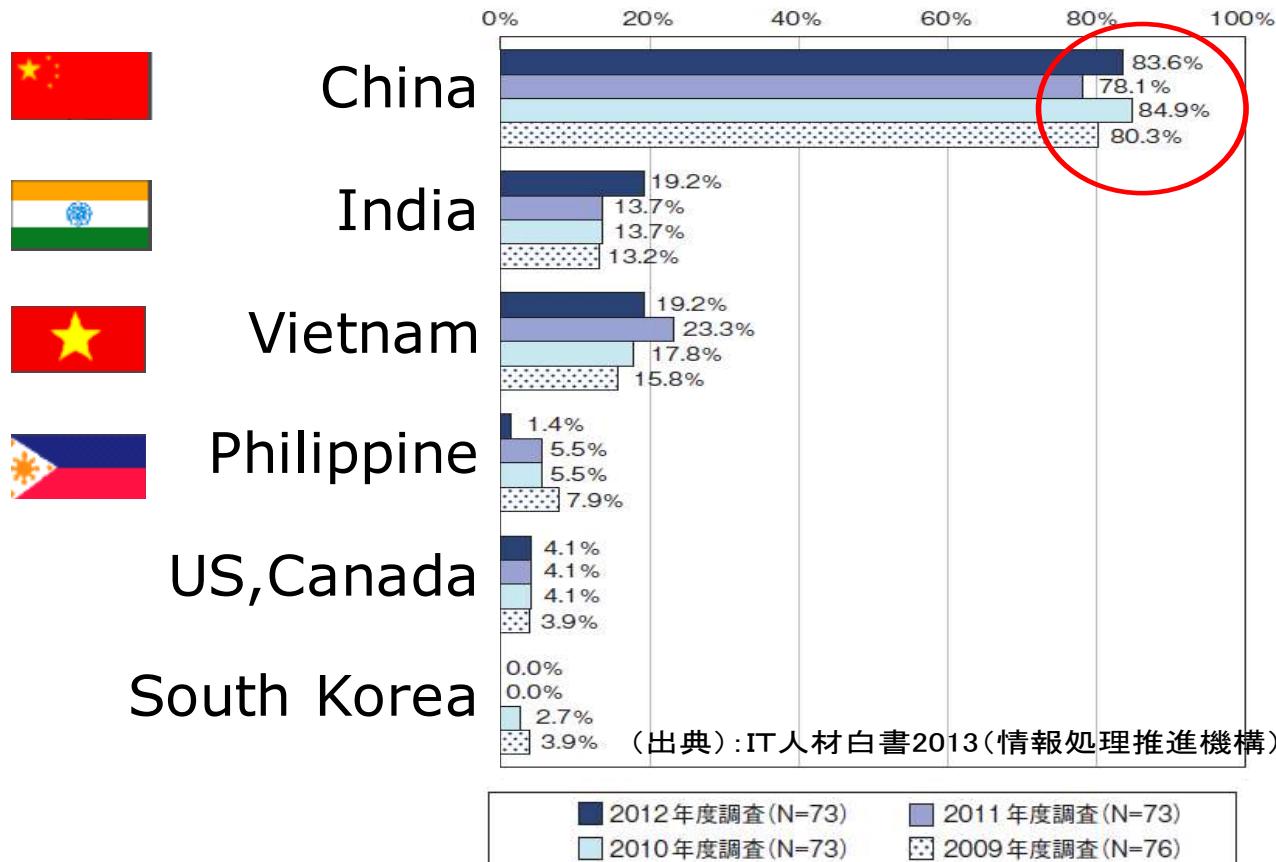


2. Facts about Industry and Academia in Japan

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
Development	market	market

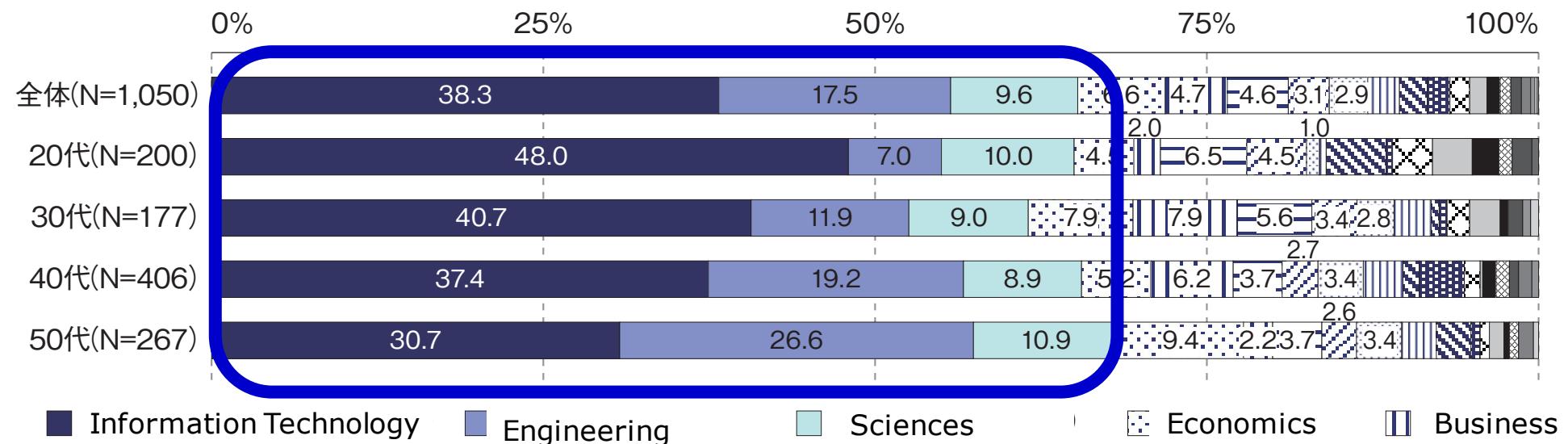
2. Facts about Industry and Academia in Japan

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.

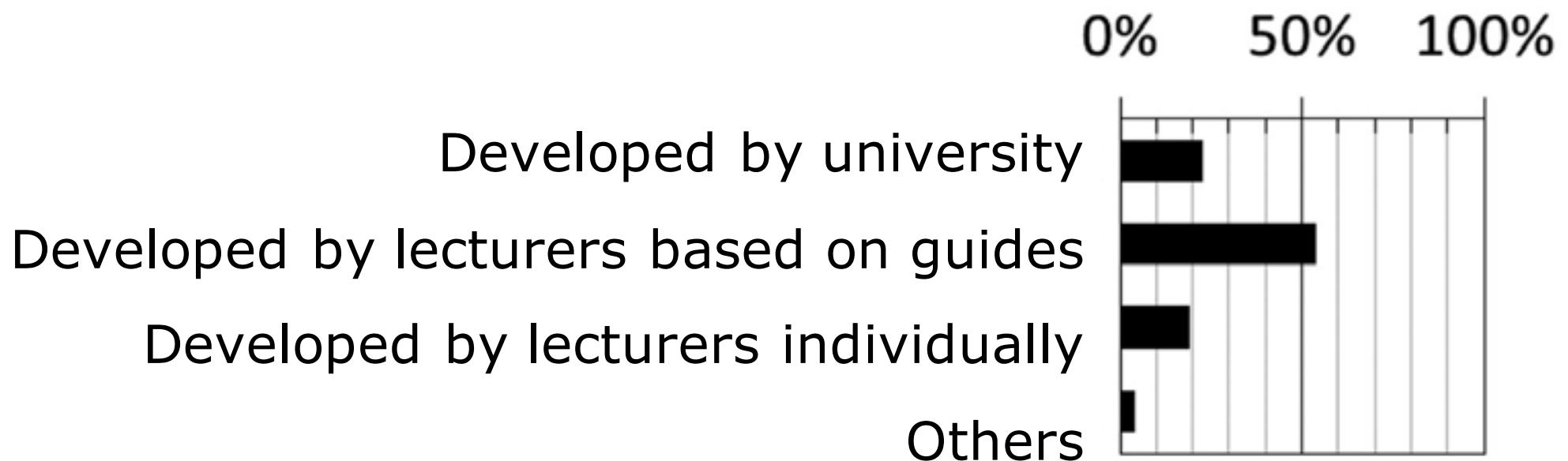


fig. Syllabus development types

2. Facts about Industry and Academia in Japan

2.2 Facts about Academic and Education

- 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.

GEBOK

エリア	ユニット
GUI科目ガイドance[1]	GUI 当該大学のネットワーク環境と情報検索規定[1] 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 HCI 機器 ICO6 グラフィカルユーザインターフェース ICO7 3次元ユーザインターフェース DIG1 著作権の原理[1]
ICO 情報とコミュニケーション[1]	Information and Communication ICO4 ハードウェア ICO5 情報理論 ICO6 コンピュータの構成[1] ICO7 データ構造と演算原理[1] ICO8 コンピュータの動作原理[1] CEO1 コンピューティングの要素と構成[4] CEO2 算法と論理回路 CEO3 オペレーティングシステム CEO7 プログラミング言語と実装原理方式 ALP1 アルゴリズムとプログラミング[1]
DIG 情報のデジタル化[1]	Information Digitalization DIG1 著作権の原理[1] DIG2 情報理論 DIG3 ハードウェア DIG4 ハードウェア DIG5 情報理論 DIG6 データ構造とアルゴリズム DIG7 探索問題 DIG8 探索問題 DMO1 モデル化の考え方[1]
CEO コンピューティングの要素と構成[4]	Computing Elements CEO1 コンピュータの構成[1] CEO2 算法と論理回路 CEO3 オペレーティングシステム CEO7 プログラミング言語と実装原理方式 ALP1 アルゴリズムとプログラミング[1]
ALP アルゴリズムとプログラミング[1]	Algorithm and Programming ALP1 アルゴリズムとプログラミング[1] ALP2 探索問題 ALP3 探索問題 ALP4 探索問題 ALP5 探索問題 ALP6 探索問題 ALP7 探索問題 ALP8 探索問題 DMO1 モデル化の考え方[1]
DMO データモデリングと操作[1]	Data Modeling and Manipulation DMO1 状態遷移モデル DMO2 グラフ DMO3 データ構造とアルゴリズム INW1 情報ネットワークでできること[1]
INW 情報ネットワーク[1]	Information Network INW1 情報ネットワークでできること[1] INW2 ネットワークの仕組み[1] INW3 インターネットサービス[2] INS1 情報行為と情報システム[1]
INS 情報システム[6]	Information Systems INS1 情報システムの構成要素[1] INS2 社会で利用できる情報技術[1] INS3 インターネット社会における問題[1] INS4 情報伝信のマナー[1] INS5 情報伝信のマナー[1] INS6 パソコンのセキュリティ管理[1]
ISS 情報処理とセキュリティ[7]	Information Security ISS1 情報処理とセキュリティ[1] ISS2 コンピュータの基本操作 ISS3 表計算によるデータ処理 ISS4 ハードウェア ISS5 ソフトウェア ISS6 WWWによる情報検索 ISS7 WWWによる情報検索
CLI コンピュータリテラシー[1]	Computer Literacy CLI1 コンピュータリテラシー[1]

表-3 GEBO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.

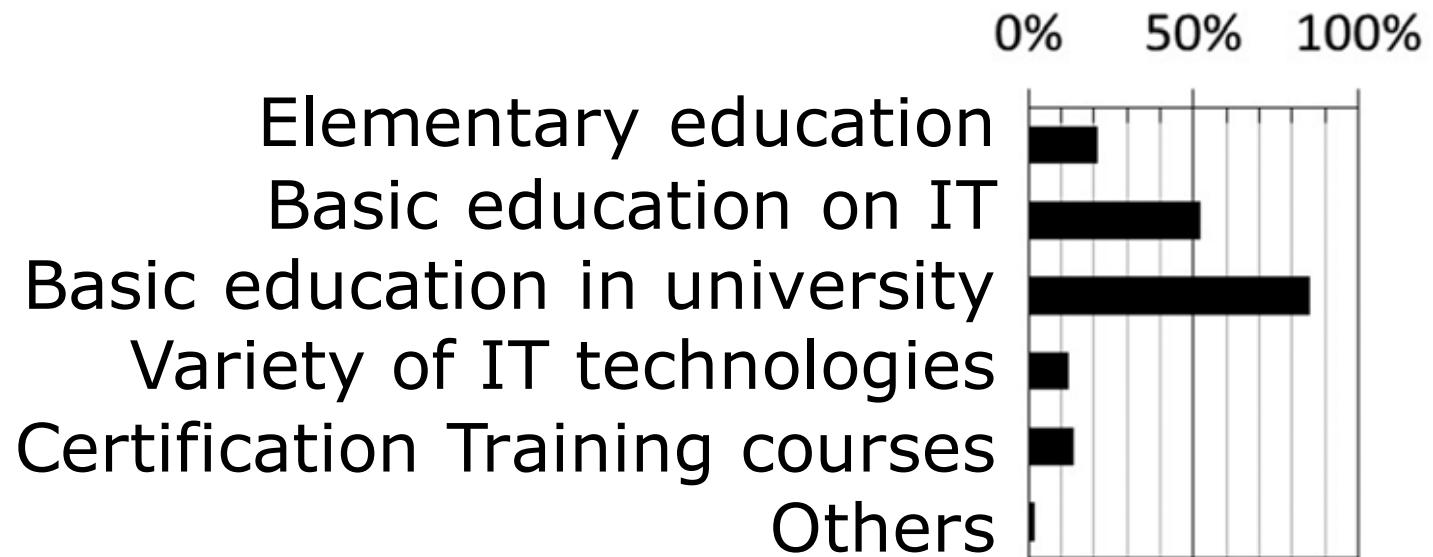
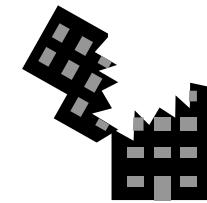


fig. Objectives of IT education courses

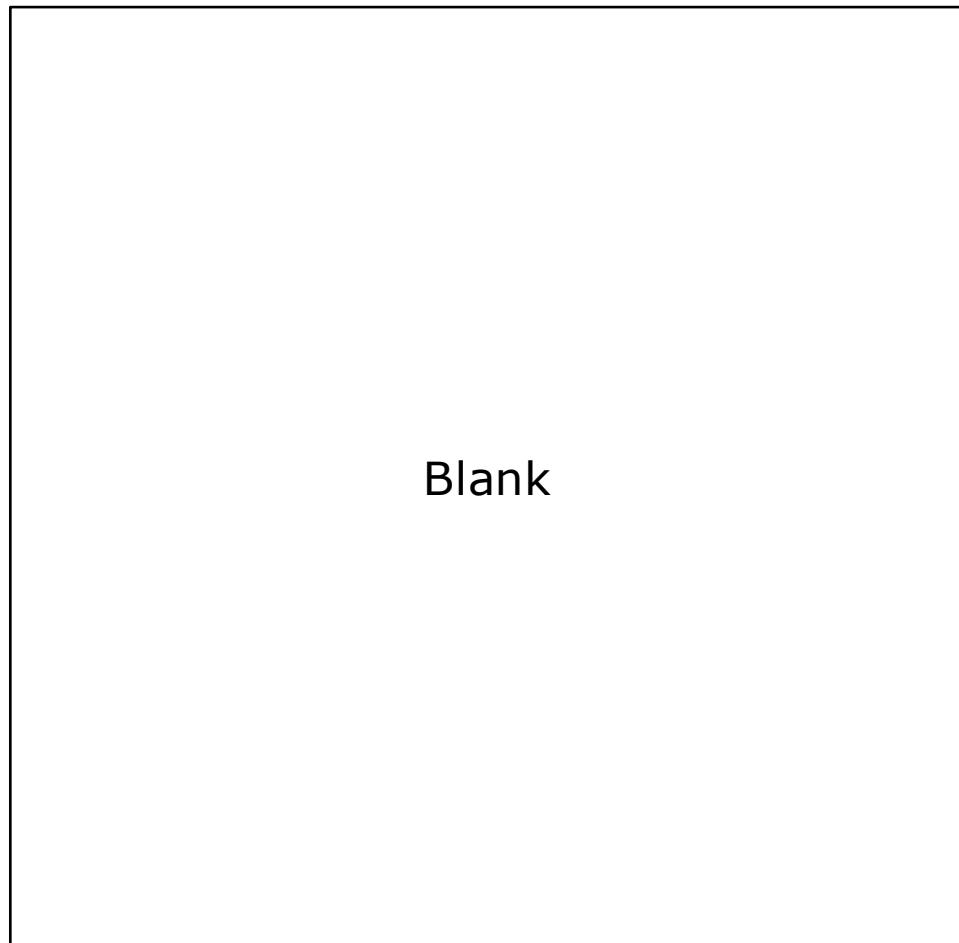
3. Challenges for Software Quality and Testing

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



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

The screenshot shows the homepage of the NPO ASTER website. At the top left is the logo 'ASTER Association of Software Test Engineering'. At the top right is a link to 'Japanese' with a flag icon. Below the header is a navigation bar with links: Home, Business, Organization, Contact, and Privacy Policy. The main content area features a large blue background image of a circuit board. To the right of the image, the text 'Association of Software Test EngineeRing' and 'NPO ASTER' is displayed. On the left side, there is a vertical sidebar with links: Home, Business, Organization, Contact, Privacy Policy, ICST2017, and InSTA2017. The 'Home' link in the sidebar is highlighted in white, indicating it is the current page. The main content area also contains a detailed description of the organization's mission and activities.

ASTER Association of Software Test Engineering

Home Business Organization Contact Privacy Policy

Association of Software Test EngineeRing
NPO ASTER

Home

Business

Organization

Contact

Privacy Policy

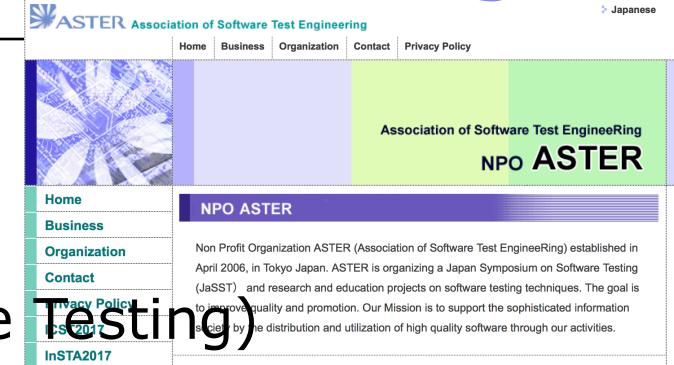
ICST2017

InSTA2017

NPO ASTER

Non Profit Organization ASTER (Association of Software Test EngineeRing) established in April 2006, in Tokyo Japan. ASTER is organizing a Japan Symposium on Software Testing (JaSST) and research and education projects on software testing techniques. The goal is to improve quality and promotion. Our Mission is to support the sophisticated information society by the distribution and utilization of high quality software through our activities.

4. Solutions and Activities in Software Testing

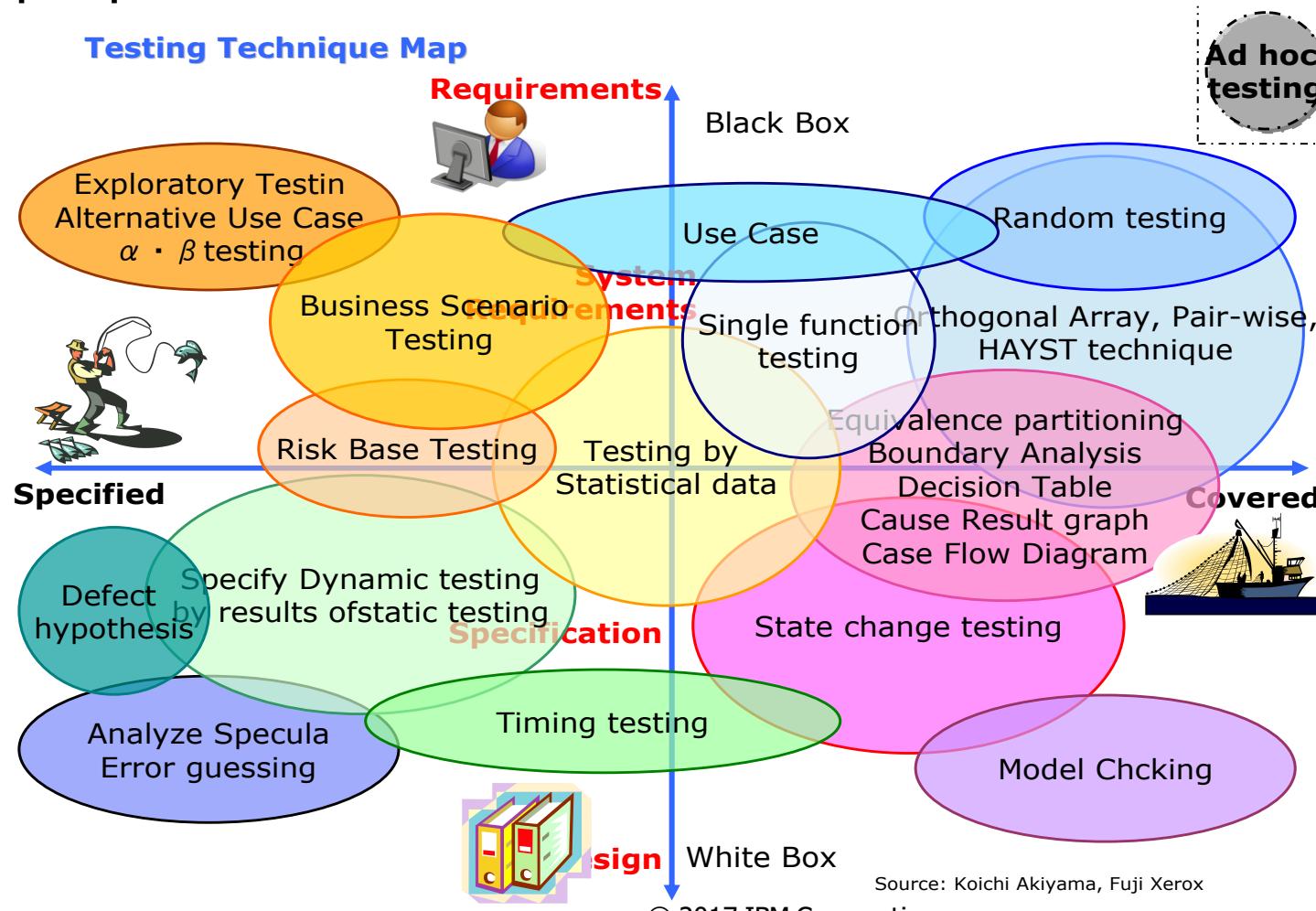


- NPO Aster activities:
 - Software testing event organization
 - JaSST (Japan Symposium on Software Testing)
 - Certification
 - JSTQB (Japan Software Testing Qualifications Board)
 - Research & Development
 - Testing Skills Standardization: Test.SSF
 - Citation of best paper: Zengo Award
 - International 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

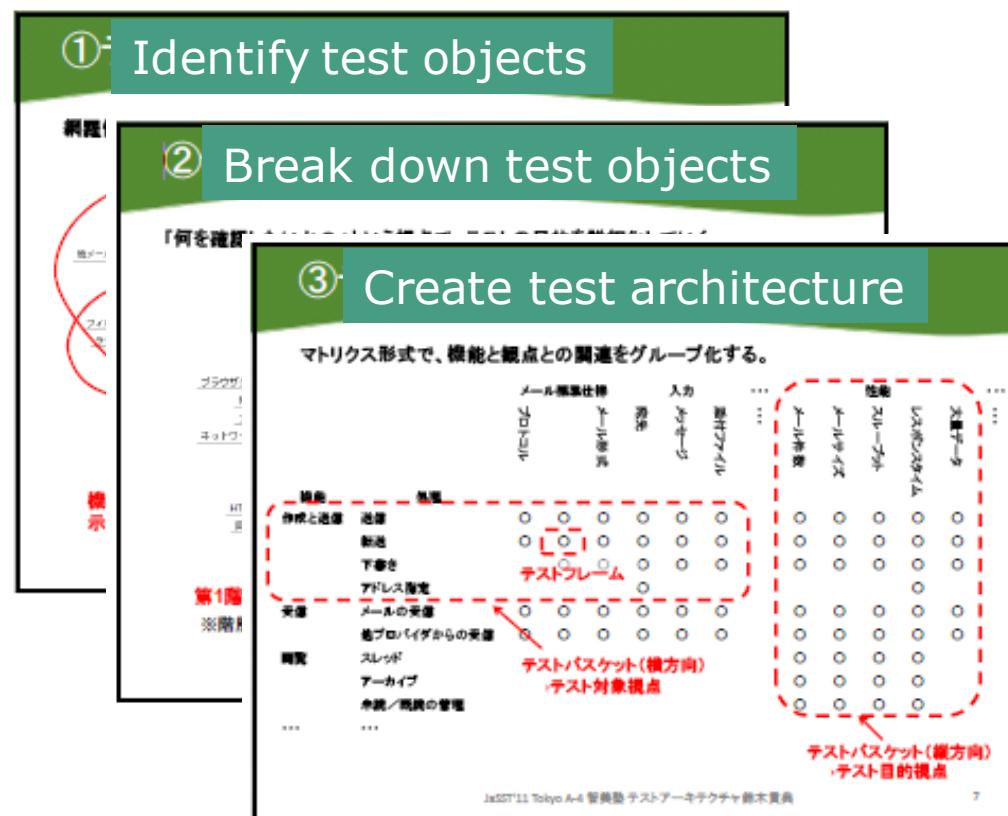


3. Solutions and Activities in Software Testing

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



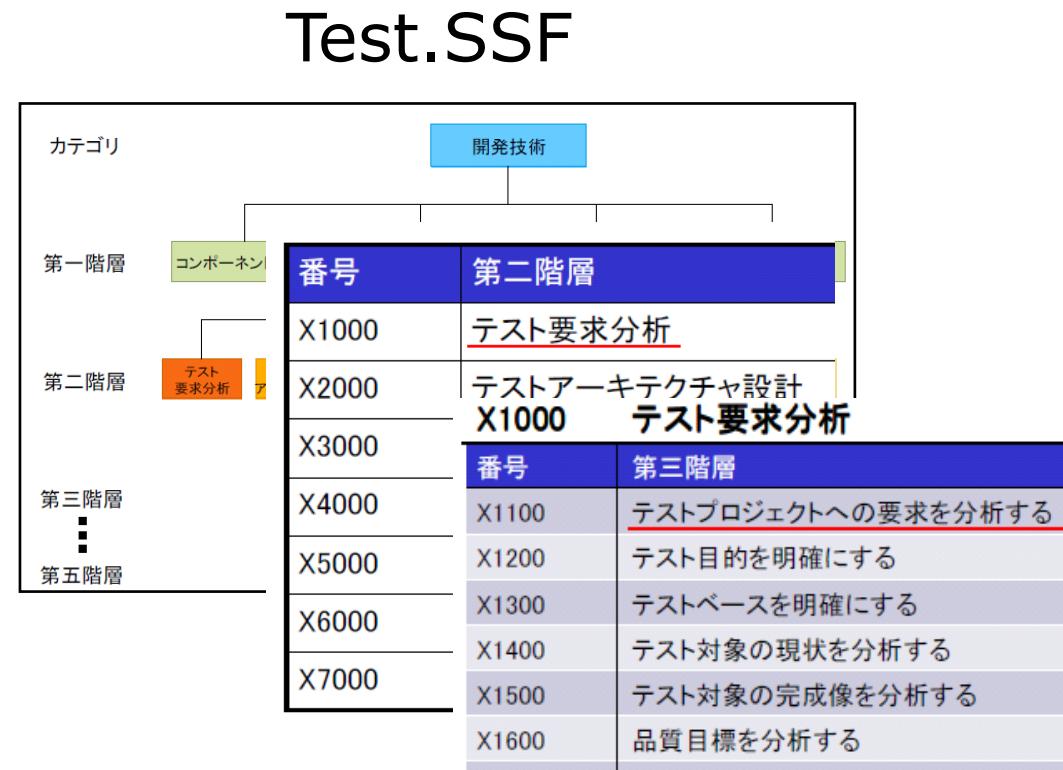
- A example of methodologies
- Identify test objectives
 - Break down into details
 - Create test architecture



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



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

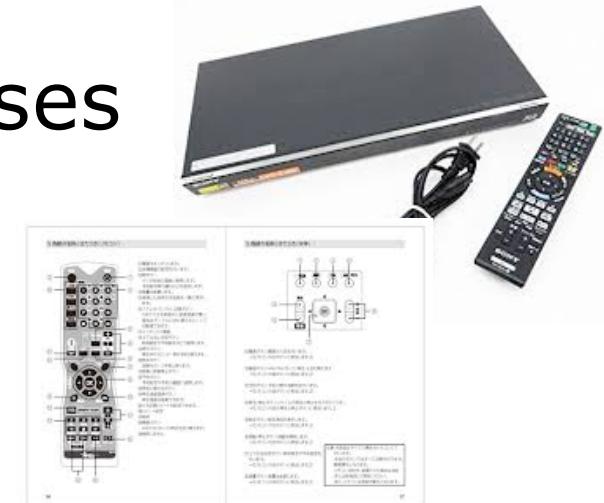
* My case collaboration Industry and Academia

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

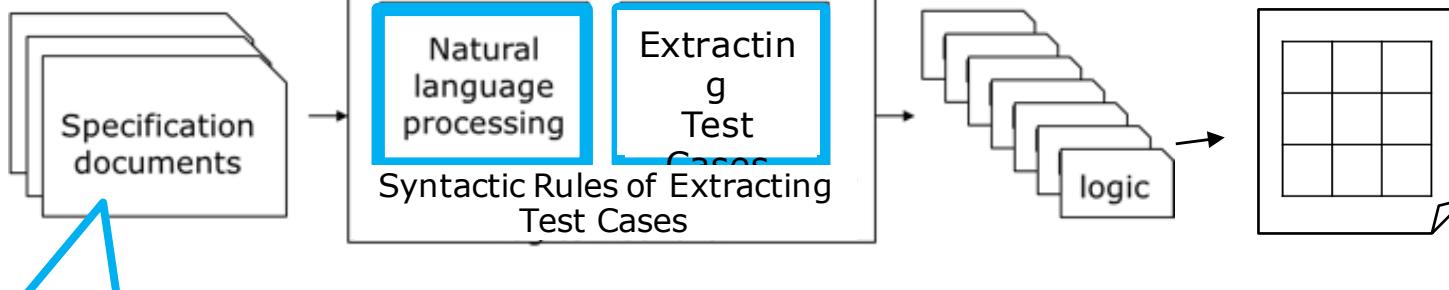
	Input	Output	Test Coverage Item
Test Case	age	fee	
1	20	five dollars	1
2	8	Not five dollars	2

* Applying Natural Language Processing Techniques to Decision Table Testing

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

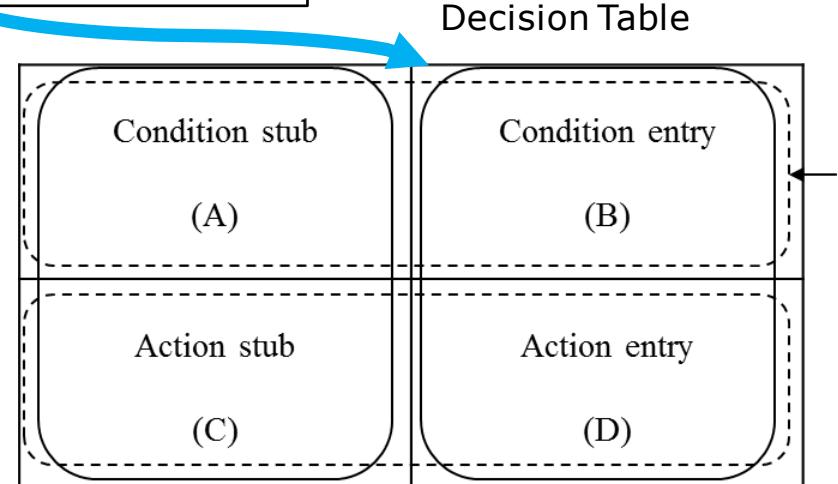
Table Testing

** 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**.

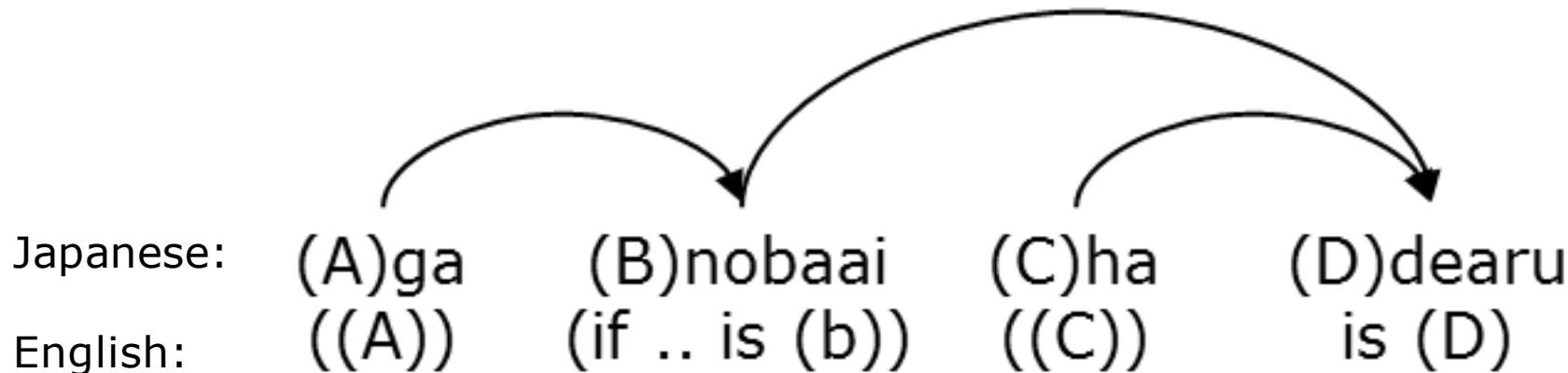
logic
if (A) is (B), (C) is (D).



* SEMANTIC ANALYSIS TECHNIQUE

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

▪ Logic retrieval



▪ Sample specification sentence

1. Japanese:

"Miraini betsuno detaga haitteitabaai, sono jitennno 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>	
	<i>Positive</i> <i>(a)</i>	<i>Negative</i> <i>(b)</i>	<i>Positive</i> <i>(c)</i>	<i>Negative</i> <i>(d)</i>
Evaluations				
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

	Document Groups					
	<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

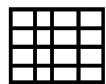
3. Solutions and Activities in Software Testing

- Collaboration Industry and Academia

		Academia's solutions	
		Current	New
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

شُكْرًا

Arabic

บุญคุณ

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