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Requirements Clinic: Third Party Inspection Methodology and Practice for Improving the Quality of Software Requirements Specifications

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NTT DATA

- 1. Background and Challenges**
- 2. Approach: Requirements Clinic**
- 3. Inspection Methodology**
- 4. Practice**
- 5. Assessment and Evaluation**
- 6. Conclusion and Future Work**

The quality of SRS (Software Requirements Specification) is the key to project success.

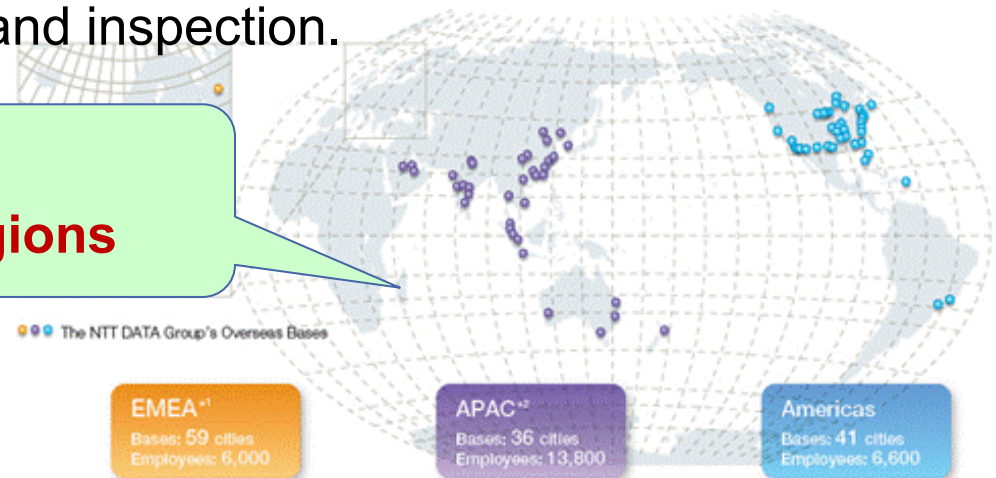
□ Our company (NTT DATA) is a global IT solution provider.

- ✓ More than 60,000 engineers specialized in the development of large-scale business information systems (BIS).

□ Requirements V&V (Verification and Validation) is a quality gate.

- ✓ Most of projects used review and inspection.

Global NTT DATA group bases
- 136 cities in 35 countries and regions



We observed two major challenges in making requirements V&V work in practice.

1. Practical and useful quality model are missing.

- ✓ Standard guidelines(e.g., IEEE Std. 830) are too generic.

2. Practical and organized inspection method for a SRS of large-scale BIS is missing.

- ✓ Inspection still relies on natural language reading and requires skill.

We focus on one quality model and one reading technique.

1. Practical and useful quality model are missing.

- ✓ Standard guidelines(e.g., IEEE Std. 830) are too generic.



One promising model is **Pragmatic Quality** [Krogstie,et.al 10]

2. Practical and organized inspection method for a SRS of large-scale BIS is missing.

- ✓ Inspection still relies on natural language reading and requires skill.

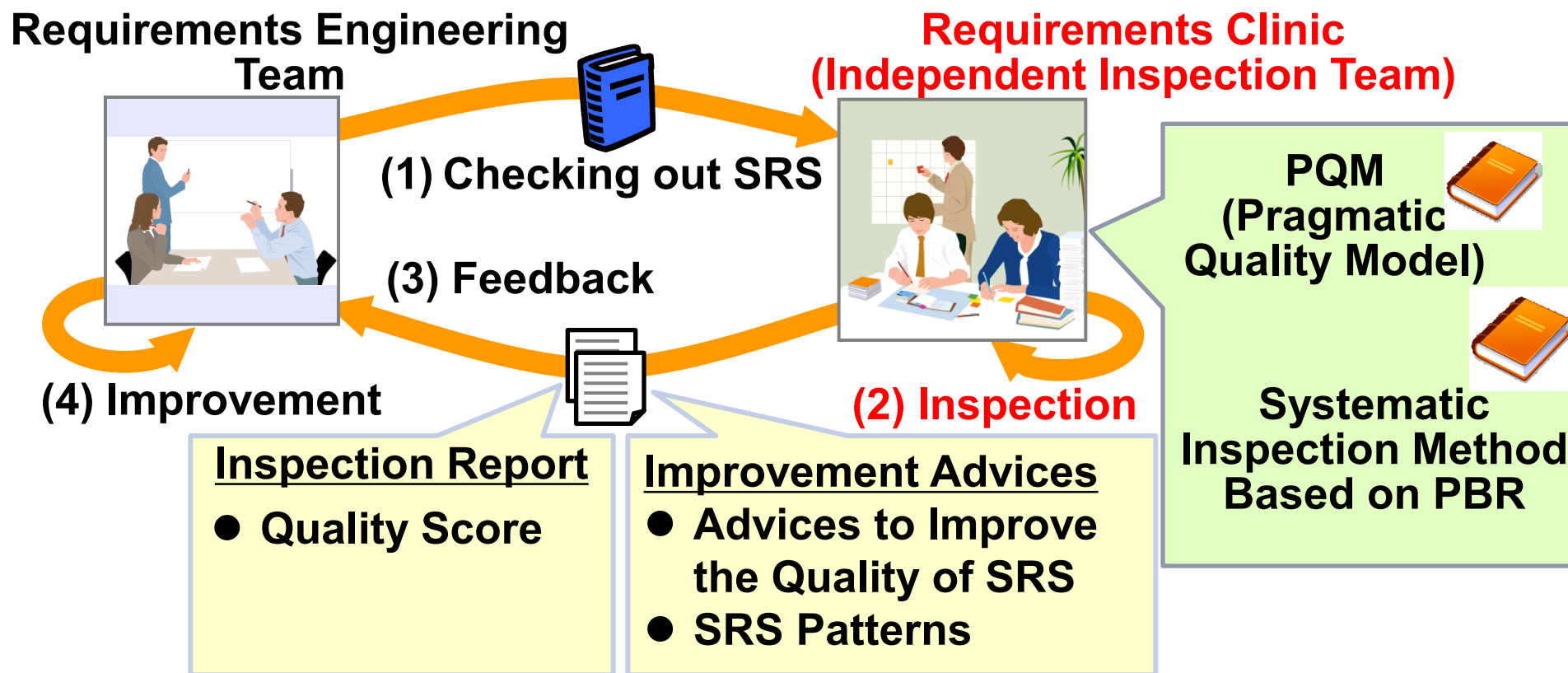


One promising way is **PBR (Perspective-Based Reading)** [Shull,et.al 00]

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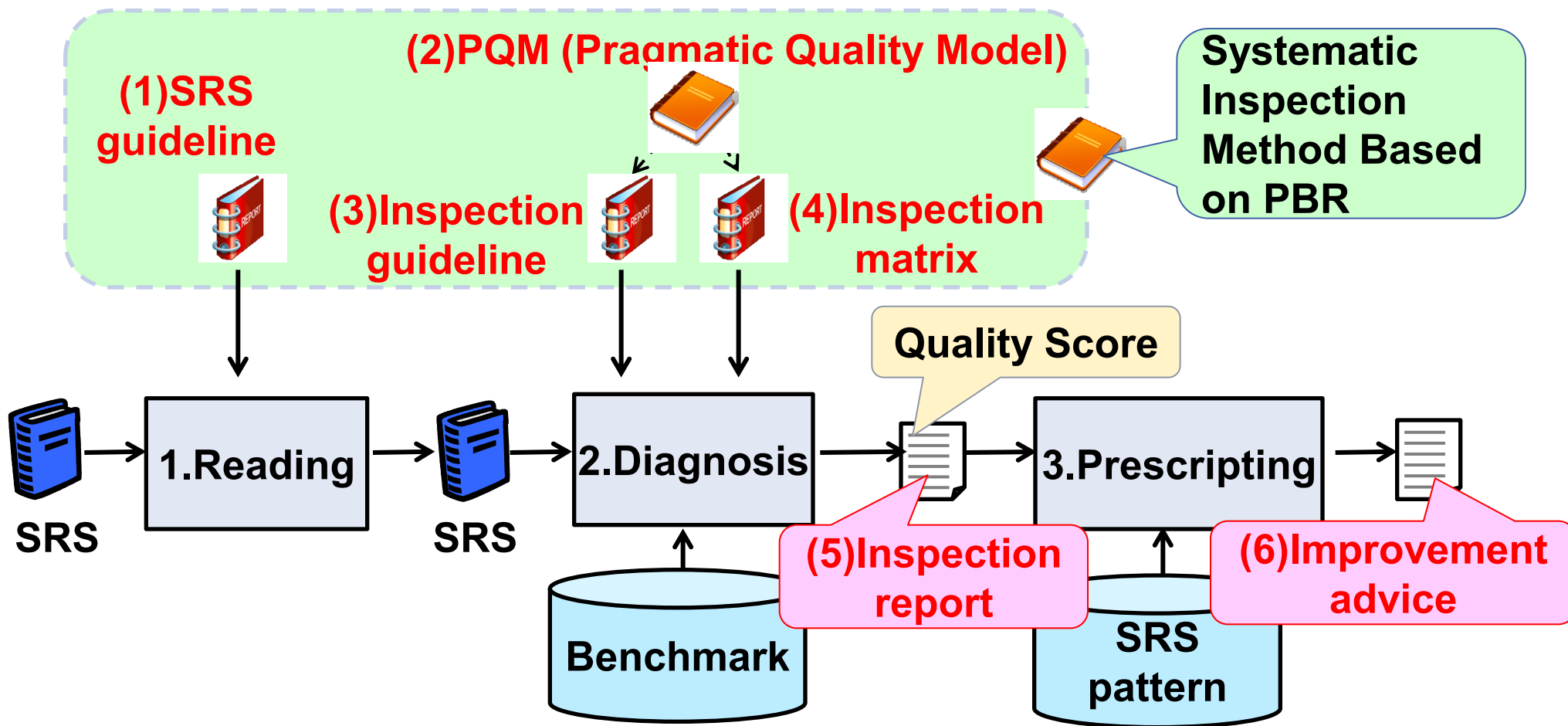
Clinic covers “the primary health care needs of populations”.

Requirements Clinic, an independent inspection team, conducts inspection method based on PQM and PBR.



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Inspection Process consists of three clinical activities.
There are **6 technical components**.



(1) SRS Guideline

SRS guideline helps inspectors to read SRS submitted from a project. TOC (Table of Contents) of SRS guideline is based on the IEEE Std. 830 and a bunch of SRS previously developed.

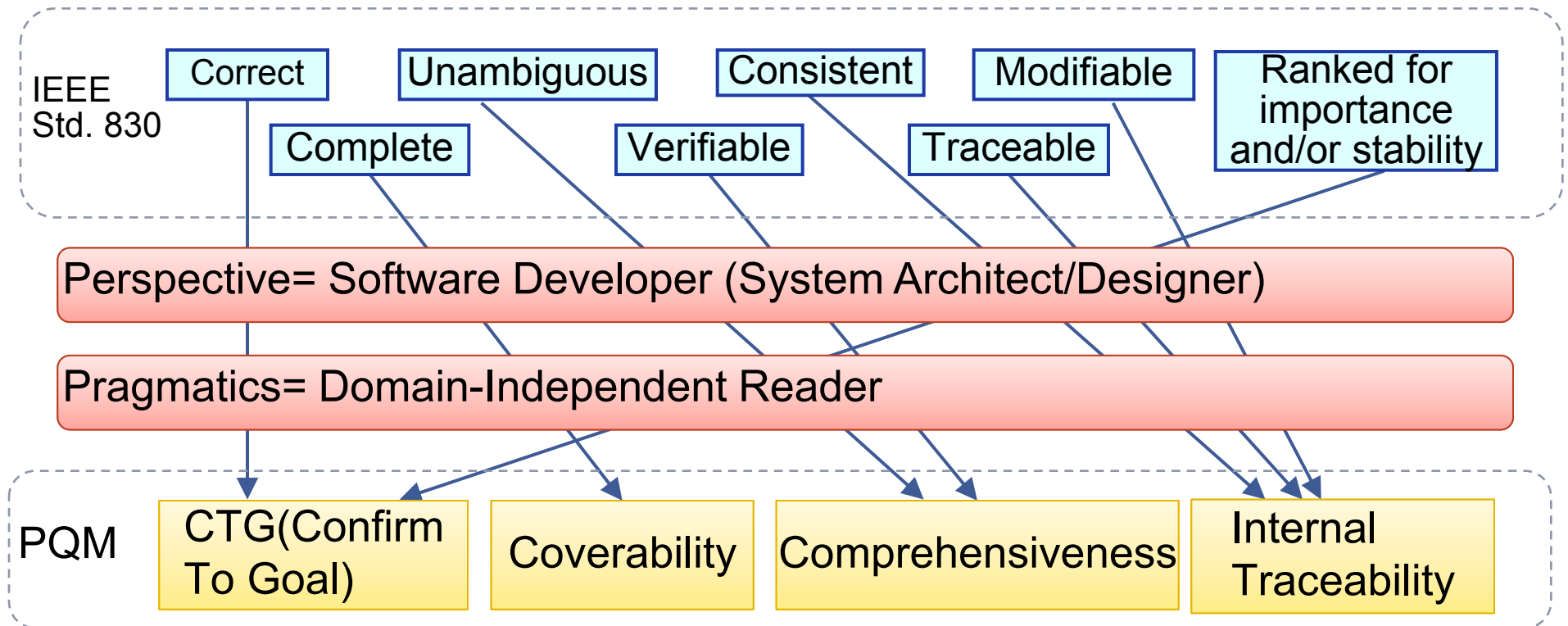
Chapter	Section
1. Introduction	1.1 Purpose of SRS
	1.2 Intended Reader
	1.3 Structure of SRS
	1.4 References
2. Overview of System	2.1 Goal of System
	2.2 Business and Scope of System
	2.3 Constraints
	2.4 Terms
3. Items Causing Change or Unspecified	3.1 Items Causing Changes
	3.2 Items Unspecified
4. Functional Requirements	4.1 Business Flow
	4.2 Functions
	4.3 Data Model Definition
5. Non Functional Requirements	5.1 NFR Grade
	5.2 Requirements to System Architecture
	5.3 Requirements to Migration
	5.4 Requirements to Service Provisioning

Inspectors identify inspection scope of target SRS by mapping TOC of SRS guideline and target SRS.

(2) PQM (Pragmatic Quality Model)

We developed PQM based on IEEE Std. 830 from the **perspective of software developer**.

Four quality characteristics of PQM are **primary “inspectable”** for **domain-independent reader**.



(2) PQM (Pragmatic Quality Model) Four Quality Characteristic

To enable third party inspection, we define concrete and evaluable quality characteristics.

□ CTG (Conform To Goal)

- CTG evaluates the degree of conformance of the descriptions of a SRS to the system goals.

□ Coverability

- Coverability is evaluated with whether a SRS is completely described in accordance with all the contents of our SRS guideline.

□ Comprehensiveness

- Use of standard description method, templates and terms lead to Comprehensiveness.

□ Internal Traceability

- Internal traceability requires that the items and relationship between them should be clearly identified in a SRS.

(3) Inspection guideline

Inspection guideline provides a question at each inspection point from the perspective of the **sub-characteristic of PQM**.
We identified **total 198 questions** (inspection points).

PQM				Example of Inspection Criteria for a Sub-Characteristic to Inspection Points	No. of Points
Characteristics		Sub-Characteristics			
ID	Name	ID	Name		
C1	COG	C1-1	Clarity of project goals	One project goal should be described in one sentence.	2
		C1-2	Correspondence to project goals	All reqs. should correspond to more than one project goal.	3
C2	Coverability	-	-	All contents of SRS should be described.	54
C3	Comprehen- siveness	C3-1	Templates usage	Template of SRS should be used.	36
		C3-2	Standard description usage	Standard description (notation) of SRS should be used.	6
		C3-3	Preparation of glossary	Glossary of SRS should be created.	3
C4	Internal Traceability	C4-1	Presence of listed artifacts	All artifacts that be stated in the artifact lists should be created.	16
		C4-2	Presence of Identifier	All artifacts and certain elements should have identifier.	32
		C4-3	Identifiability	All artifacts and certain elements are identifiable by identifier.	46
Total					198

(4) Inspection Matrix

Inspection matrix defines inspection points at the section.
It navigates inspectors to conduct inspection correctly at each point.

PQM				TOC of SRS guideline			
Characteristics		Sub-Characteristics		2.1 Goal of System	2.2 Business & Scope of System	2.3 Constraints	2.4 Terms
ID	Name	ID	Name				
C1	COG	C1-1	Clarity of project goals	X			
		C1-2	Correspondence to project goals	X			
C2	Coverability	-	-	X			
C3	Comprehensiveness	C3-1	Templates usage	X	X	X	
		C3-2	Standard description usage		X		
		C3-3	Preparation of glossary				X
C4	Internal Traceability	C4-1	Presence of listed artifacts	X	X	X	
		C4-2	Presence of Identifier	X	X	X	X
		C4-3	Identifiability	X	X	X	X

X indicates that there is at least one inspection point.

(4) Inspection matrix Quality Score

Quality score indicates inspection pass ratio.

PQM				No. of Points
Characteristics		Sub-Characteristics		
ID	Name	ID	Name	
C1	COG	C1-1	Clarity of project goals	2
		C1-2	Correspondence to project goals	3
C2	Coverability	-	-	54
C3	Comprehen- siveness	C3-1	Templates usage	36
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Total				198

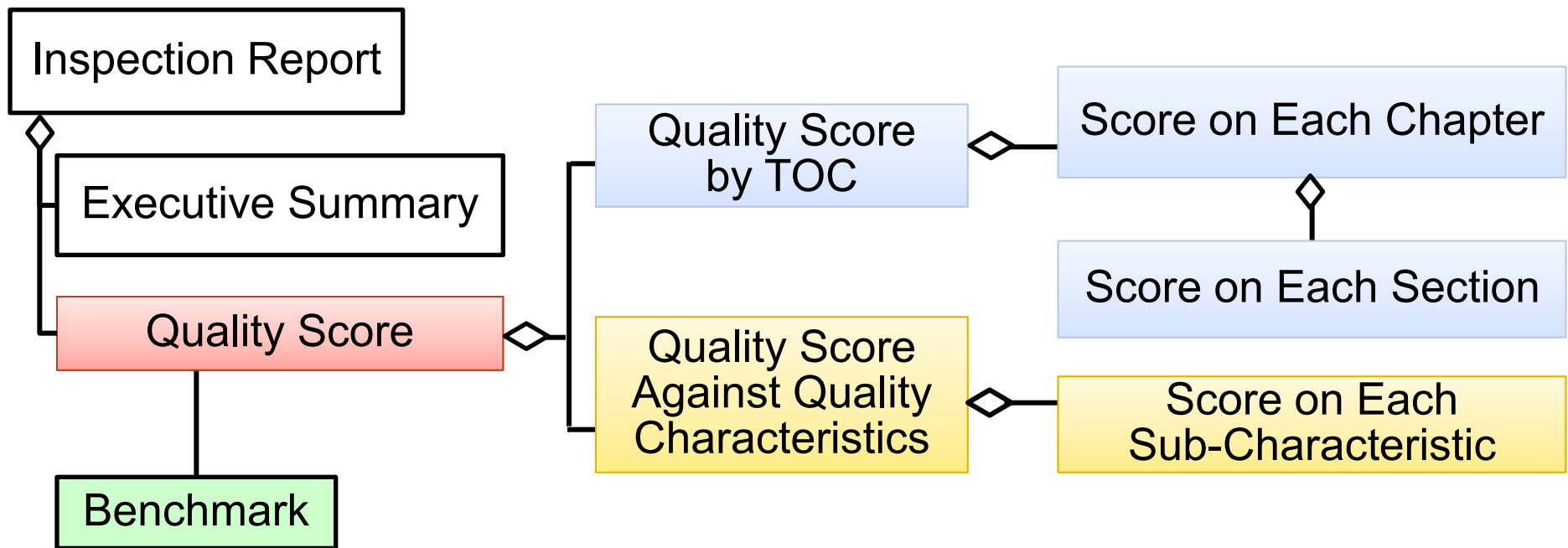
1. At each inspection point, the inspector is required to score the SRS: **assign +1 if no error, and assign 0 if any errors found.**
2. Summing up **the score of +1 or 0 over 198** inspection points.
3. Dividing the sum by the total number of the inspection points.



We can get a **Total Quality Score of a SRS between 0 and 100.**

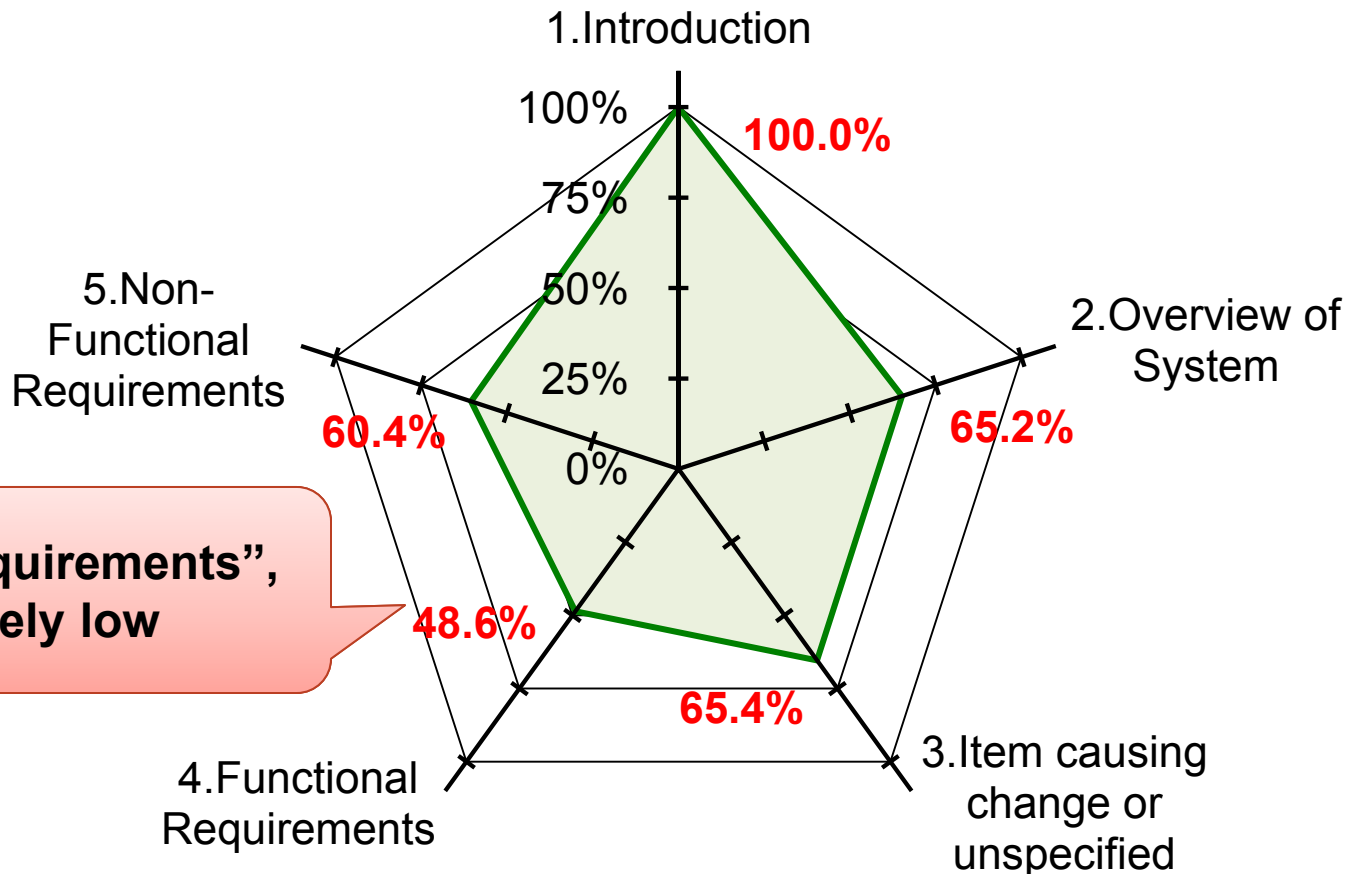
(5) Inspection report Meta Model

Inspection report presents the inspection results.
Quality score is presented from **two perspectives**: TOC and PQM.
Inspection report also includes **benchmark with other projects**.



(5) Inspection report Quality Score by TOC

The report visualizes the quality score of each chapter.
It helps inspectors to find weakness of the SRS.
It suggests developers to specific improvement points.

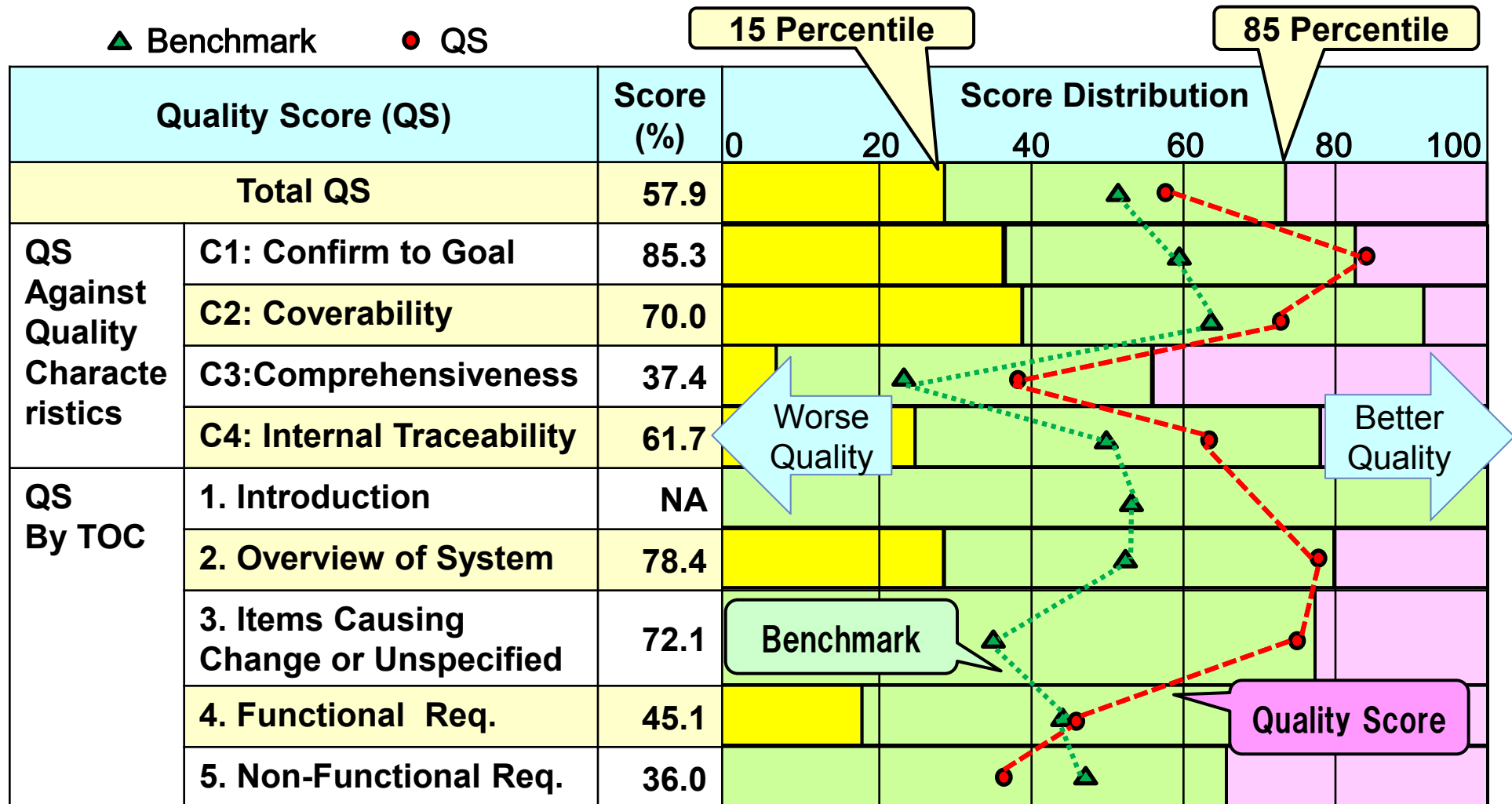


**“Functional Requirements”,
48.6%, is relatively low**

(5) Inspection report

Quality Score vs. Benchmark

Benchmark suggests project manager the relative quality of the SRS of his/her project among other projects.



(6) Improvement advice

Inspection team provides improvement advices and selected SRS patterns to RE team for taking actions to improve the SRS.

A Part of **Advices** for 2.1.3 (The purpose of the project)

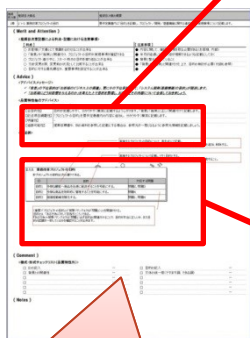
Quality Characteristic	Advice
Conform to project goal	Project goals are itemize by one sentence. The relationship between project goals and business requirements should be described.
Coverability	The background of the project should be described.
Comprehensiveness	—
Internal traceability	Each project goal should have identifier.

Suggesting improvement with respect to four quality characteristics of PQM

SRS pattern suggests a good example.

A Part of **SRS Pattern** for 2.1.3 (The purpose of the project)

ID	Project Goal	Corresponding Business Requirements ID.
P01	Deliver various service and product quickly to a customer.	BR02, BR03
P02	Manage various service and product efficiently.	BR04
P03	Provide service and product at lower price.	BR01, BR04

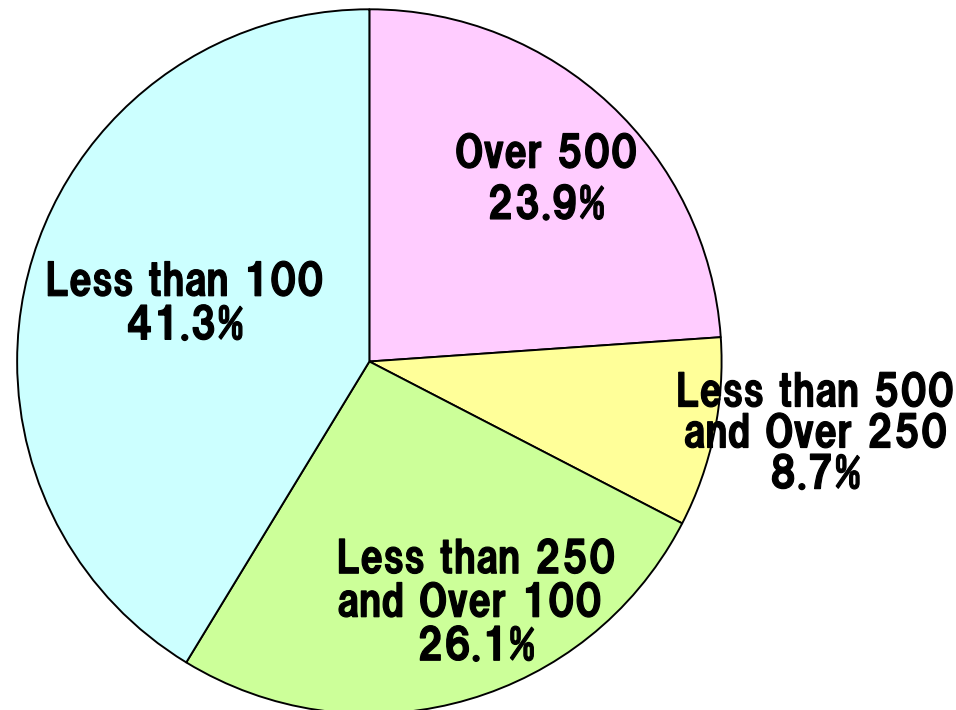


Improvement Advices

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We initiated the requirements clinic in 2010 and have been inspecting **30 to 40** sets of SRS **annually**.
About one fourth is project of more than **500 person-months**.

Project size distribution



Unit=Person Month

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We conducted feasibility assessment and evaluation to validate the proposed method.

1. Feasibility Assessment prior to Practice

- Before applying to real projects, we conducted a proof of concept of the proposed inspection method.

2. Evaluation from the Practices

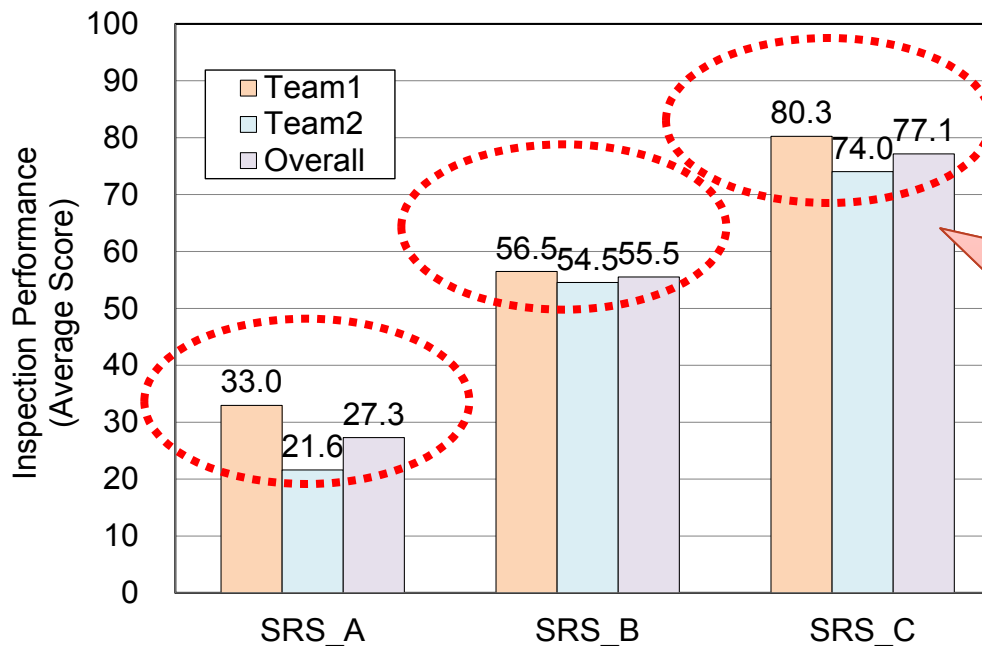
- We demonstrate the effect of the proposed inspection method with 12 samples from the practices.

1. Feasibility Assessment Method and Result

□ Method

1. We grouped 4 engineers into the following **two teams**.
 - Team 1: Two senior engineers with more than six years of experience
 - Team 2: Two junior engineers with less than two years of experience
2. Each team conducted inspections to **three SRSs** (A to C) **along with the proposed inspection method**.

□ Result



Difference of inspection performance is small enough

2. Evaluation – Method – Target projects

Statistics of inspection reports and opinions of project managers from the **12 projects (A to L)**.

Project ID	Domain	Type of Development	No. of Pages	
			SRS	Advices
A	Finance	New	648	19
B	Finance	Extension	374	47
C	Public	New	847	31
D	Finance	Extension	49	30
E	Public	Extension	13	40
F	Public	Extension	10	40
G	Public	Extension	72	40
H	Public	Extension	15	40
I	Public	Extension	7	40
J	Public	Extension	24	40
K	Public	Extension	140	40
L	Finance	Replacement	1,000	79
Total			3,199	446

2. Evaluation - Method-ROI

For evaluating the cost effectiveness of the inspection method, we defined the following metric.

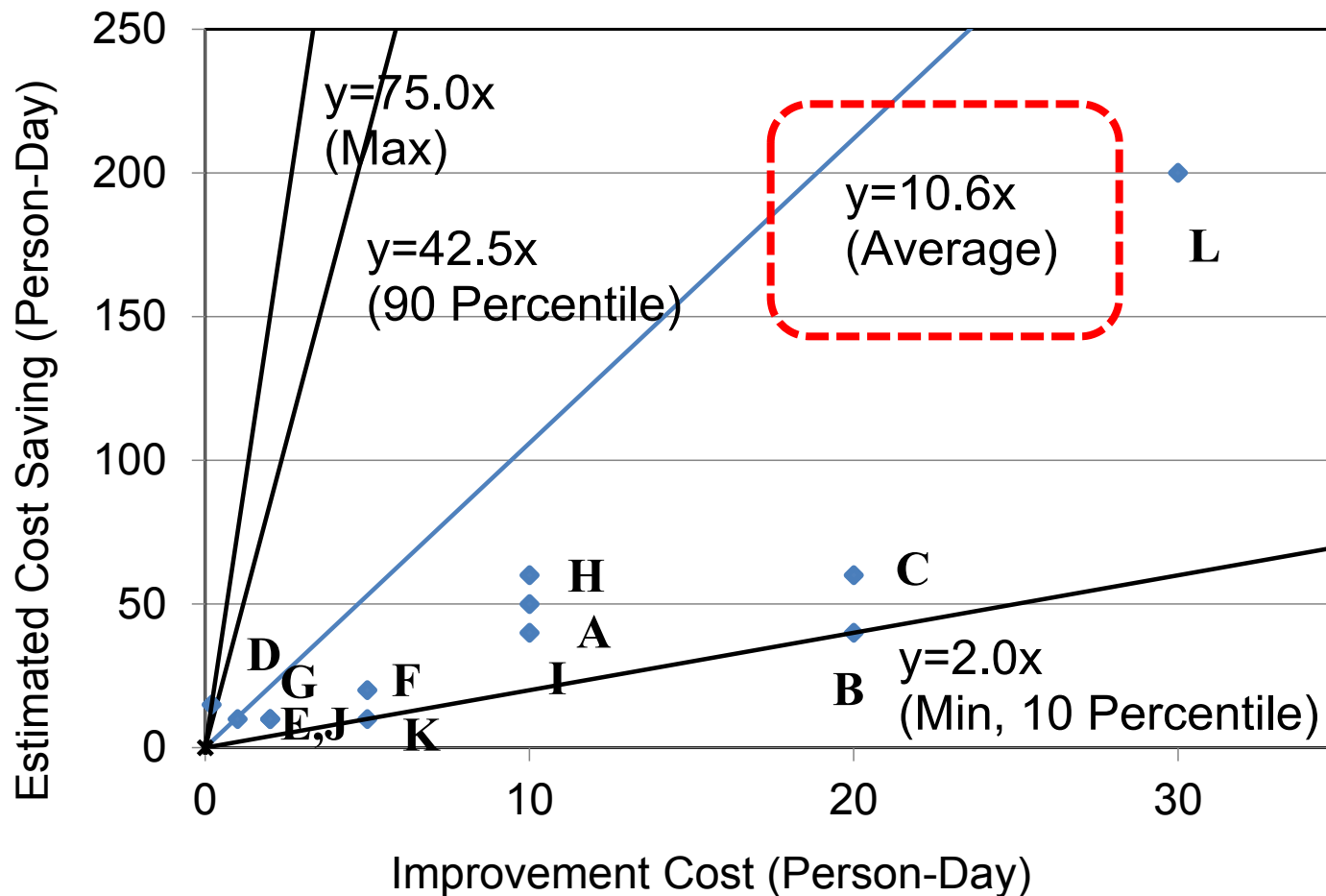
Estimated cost saved by the inspection in the subsequent design process.

$$\text{ROI} = \frac{\text{(1) Cost Saved by Inspection [Person-Days]}}{\text{(2) Effort to correct SRS [Person-Days]}}$$

Cost to correct a SRS based on its inspection report

2. Evaluation - Result - Distribution of ROI of 12 project

An average of all the **ROIs is 10.6**.
Maximum is 75.0 and minimum is 2.0



We collected **some 250 opinions** from the requirements engineering teams. The followings are some of major opinions.

1. Advices teach not only **what we should write**, but also **what we need not write**.
2. Graphical representation of QS including radar chart and benchmarking helps to **intuitively grasp overall health conditions of the SRS** and requirements engineering team.
3. Advices help to **share the knowledge on how to improve a SRS** and to convince the member of requirements engineering team to do.
4. SRS patterns are effective **to teach writing SRS to newcomers** to requirements engineering team.

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□ Conclusion.

- ✓ We proposed “Requirements Clinic”
 - Independent inspection team conducts Inspection methodology based on the PQM and PBR.
- ✓ We conducted the feasibility assessment and evaluation.
 - an average of 10.6 ROI in 12 projects.

□ Future Work.

- ✓ We can predict project risk based on the inspection.

Thank you !

✓ Questions?