A Guideline for Bidding & Contract Systems for Management & Maintenance Projects: the Concept of Comprehensive Contracts

The Sub-Committee on Maintenance, Management, Bidding & Contract
Construction Management Committee, Japan Society for Civil Engineers

The Efforts of the Japan Society for Civil Engineers

The Efforts of the Japan Society for Civil Engineers

Dec. 2012:

Establishment of The Social Infrastructure Maintenance Management & Replacement Task Force Committee

(Chairperson: Hashimoto Kotaro, the Former Chairman of the Japan Society for Civil Engineers)

July 2013:

The Establishment of the Special Committee on Priority Issues for Social Infrastructure Maintenance Management & Replacement

- Discussion by experts in industry, academia & the government
- An inquiry into the importance issues on maintenance and rehabilitation

➔ JSCE Initiatives & Strategies

A Guideline for Bidding & Contract Systems for Maintenance Works: the Concept of Comprehensive Contracts

1. Introduction➔ The Structure of the Draft Guideline➔ Table of Contents

Self-Diagnosis

1. Understanding the management cycle
2. Organizing target assets
3. Grasping the current situation
4. Evaluating if the management cycle is functioning
5. Identifying the need for improvements
6. Clarifying what action need to be done

Strategic Planning of Maintenance

7. Measures to achieve the entire purpose
8. Identifying and selecting available bidding & contract methods
9. An examination of the implementation procedures
10. The continuous improvement of maintenance management

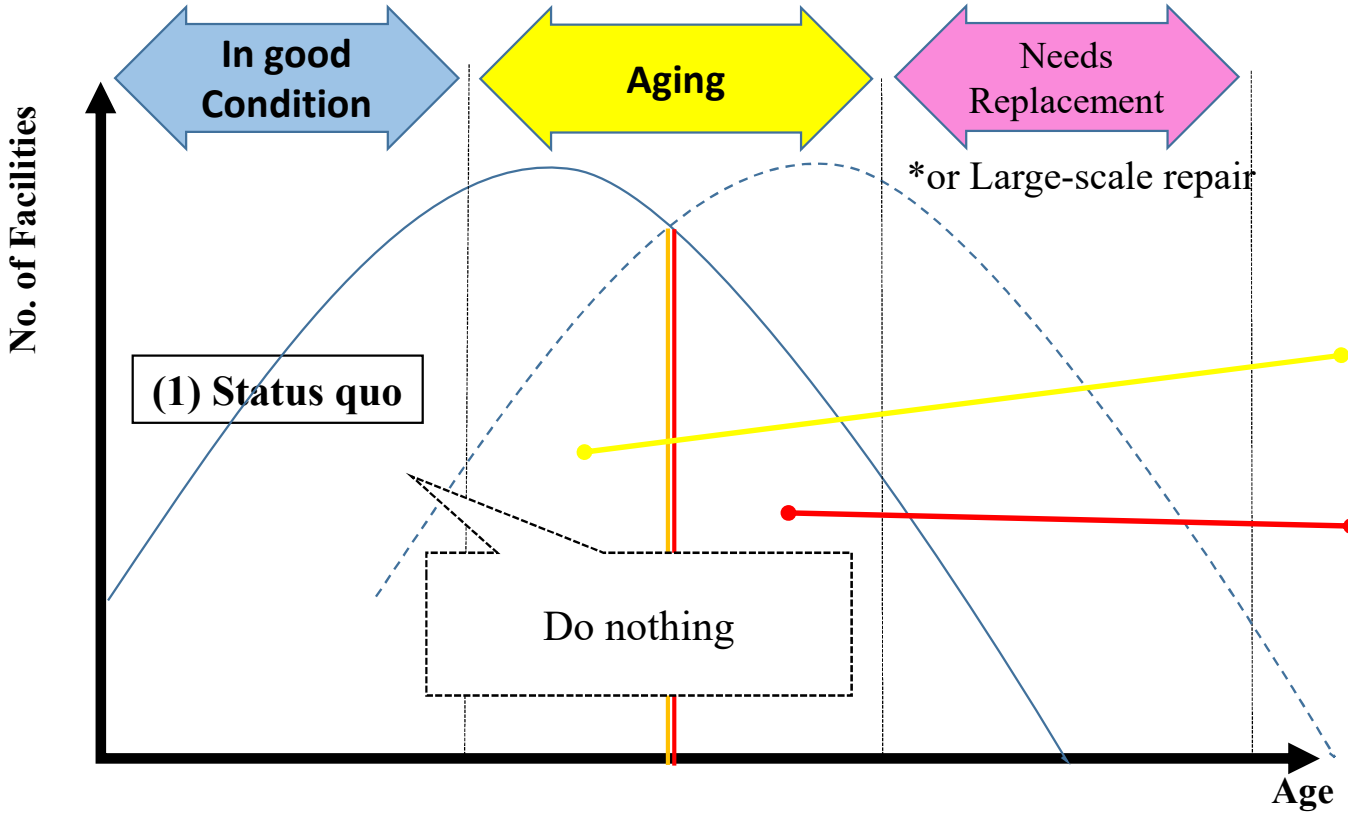
The Bidding Contract Schemes in the Draft Guideline

- Expanding the scale of the order & multi-year contracts
- Regional Maintenance Contracting
- Performance-Based Contracting
- Design Build / Partnering / Early Contractor's Involvement
- The Scheme to Support the Small-size Local Government

2. Self-Diagnosis ➔ To Understand the current Status

2. Organizing Target Assets
- ➢ The Type & quantity of Infrastructure
- ➢ The degree of physical deterioration

Organize in terms of the Type of Infrastructure & the extent of soundness



Types	Condition
i. Sound State	A state in which a problem has yet to occur in the structure
ii. Preventive Maintenance State	A state that does not hinder the operation but needs preventive maintenance
iii. Early Action State	Needs some immediate actions in lieu of some problems
iv. Emergency Measure State	A significant problems occurs in the structure of the facility, leading to an emergency & urgent actions

Future Challenges ➔ the importance of information sharing on the need for making corresponding repair plans in view of increases in the rate of salt related damages, floorboards reinforcement that results from big vehicles

Approaches to strategic maintenance and renewal

Longer service life through preventive maintenance

- **preventive maintenance type**

  Based on the inspection, carry out small-scale repair work in a short cycle when the damage is minor, and take measures before the damage impairs the required functions of the facility.

- **corrective maintenance type**

  Take actions just before the damage progresses to the point where the facility loses or is about to lose its required functions.

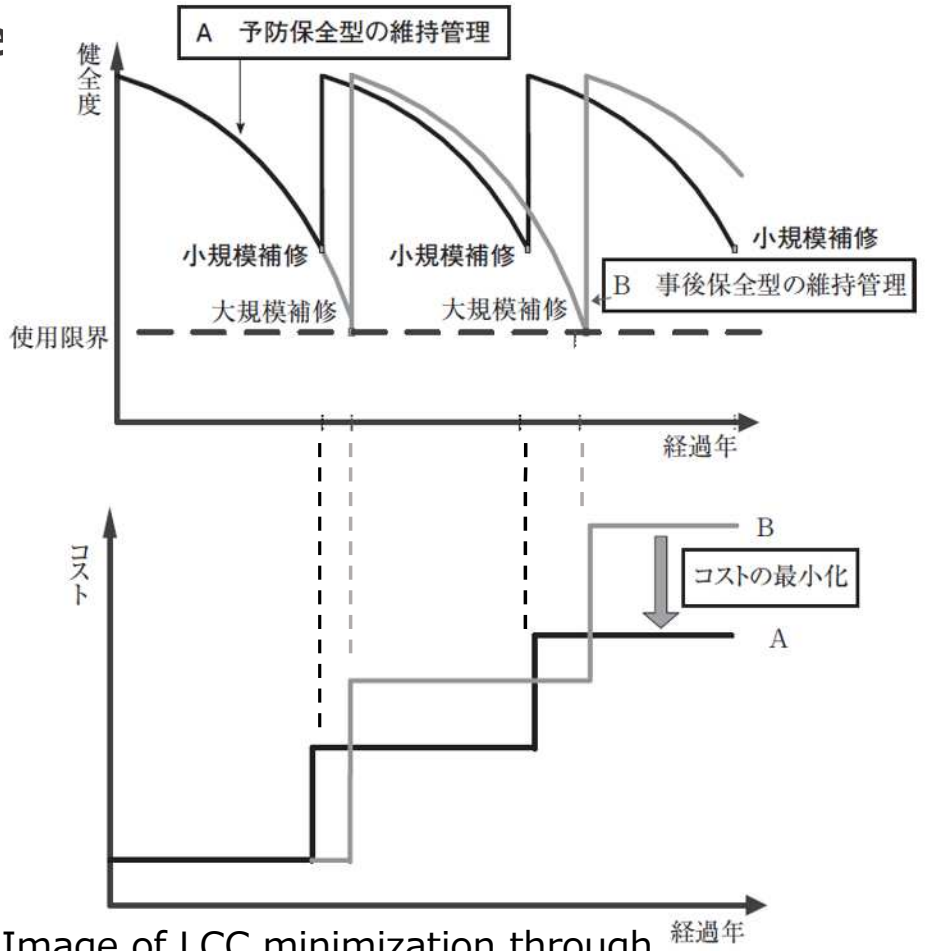
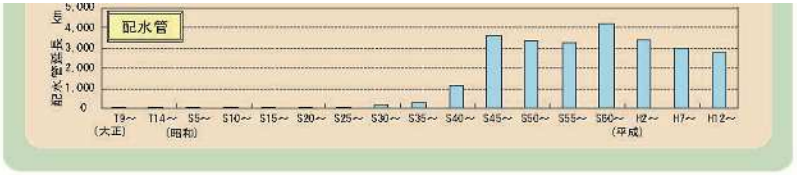


Image of LCC minimization through preventive maintenance

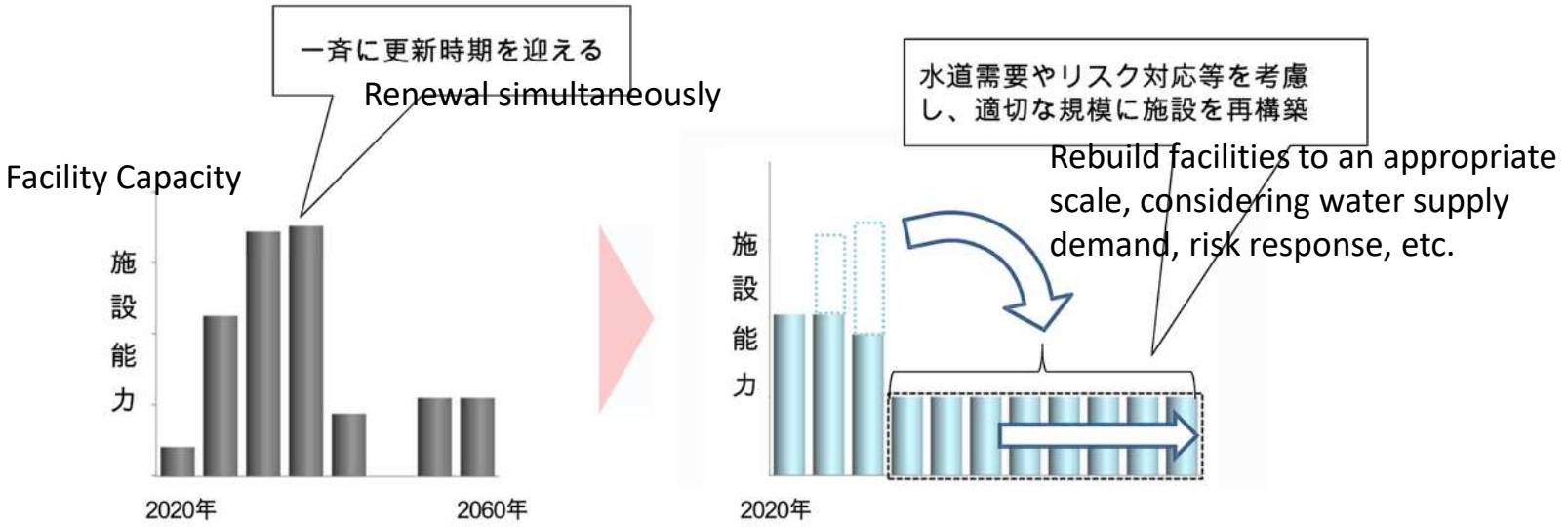
Amount of maintenance of water supply facilities by age

1. Water purification station
2. Water supply station 3. Water pipe



Renewal at the end of 60 years of construction
（築造60年間経過時点で更新）

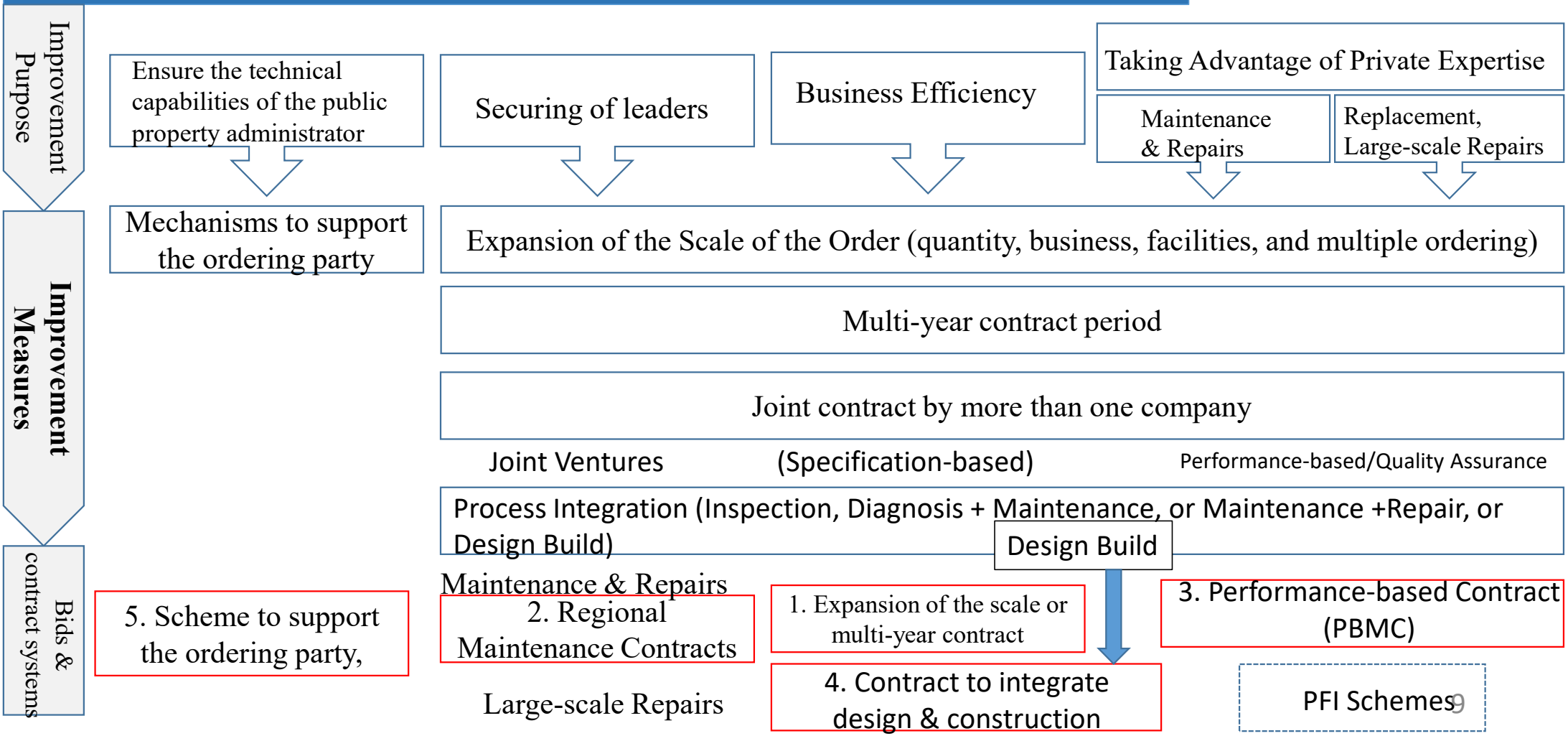
Planned renewal
（計画的な更新）



東京都水道局，www.waterworks.metro.tokyo.lg.jp/suidojigyo/torikumi/seisaku/step2/

3. Evaluation Strategy ➔ The Selection of Bidding & Contract System

The Individual Measure in the draft Guideline



4. Individual Measures ➔ (1) Expansion of Order Size . Multi-year Contracts

The Case of Aomori Prefecture

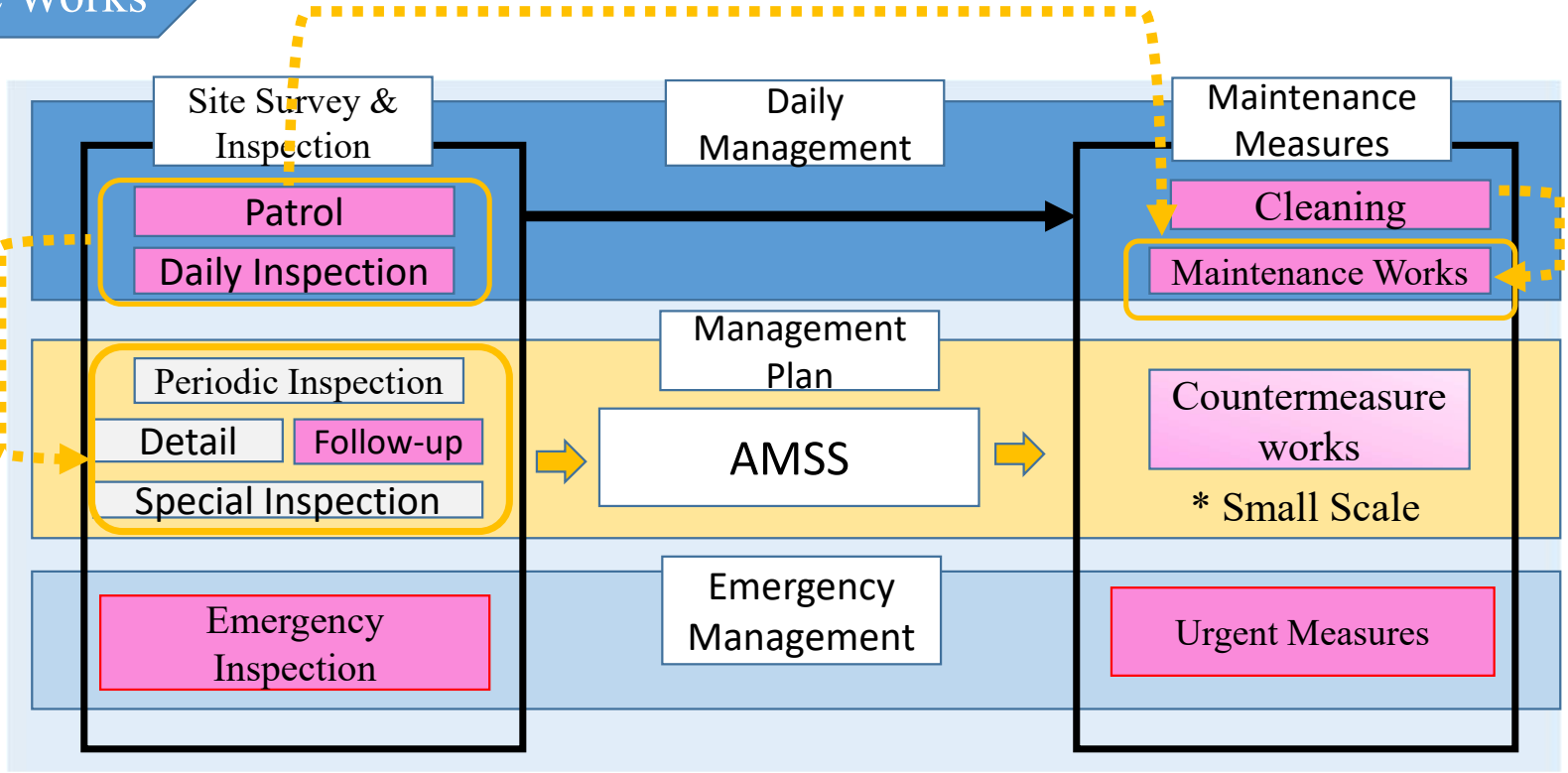
Using daily inspection & Cleaning business to discover defects

Framework of Maintenance Works

Using the results of daily inspection to support project management and the construction of countermeasures

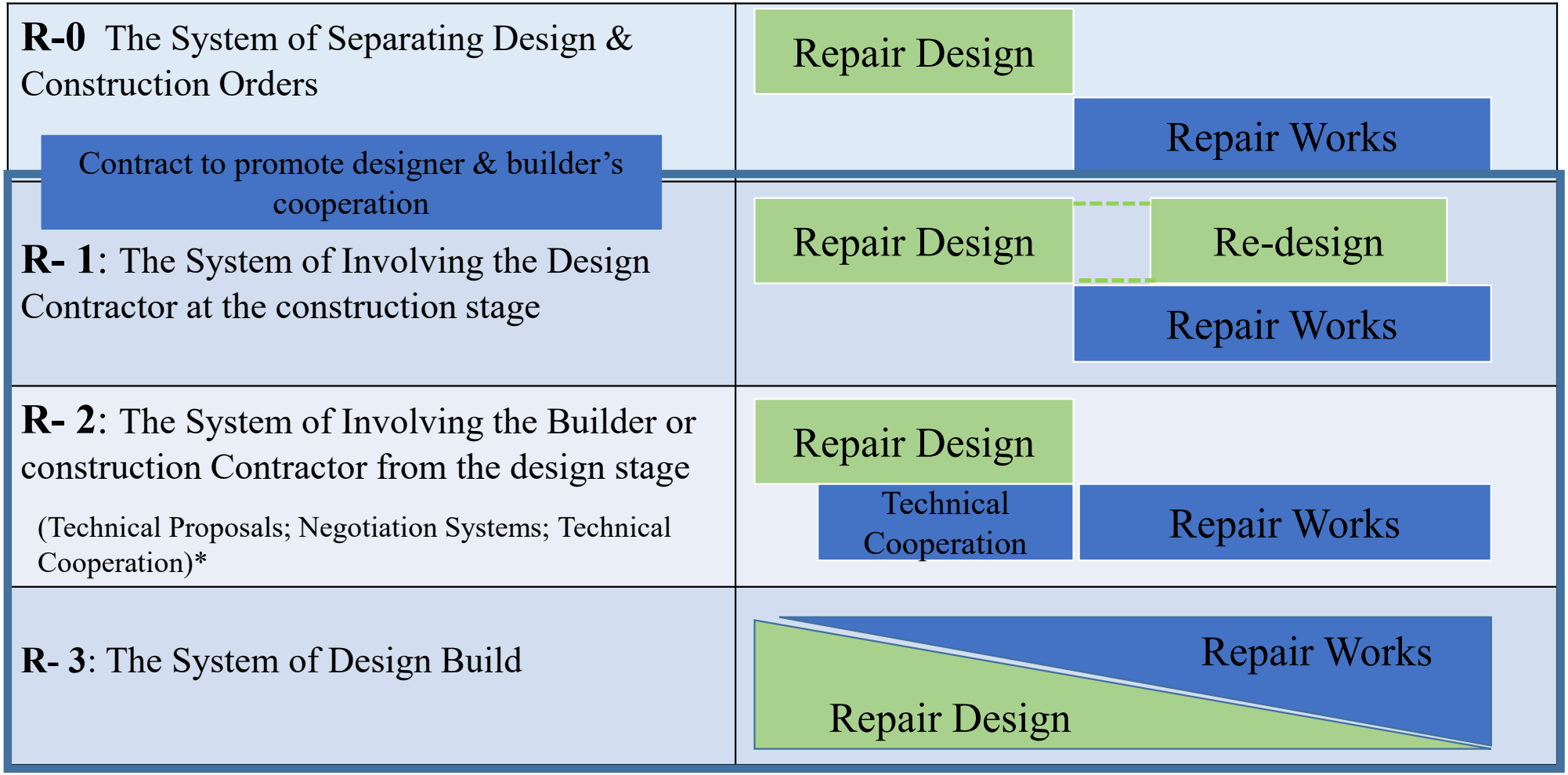
Reflecting the Information on the structure obtained through the AMSS inspection in long-term plans (maintenance control measures)

Bundled Activities

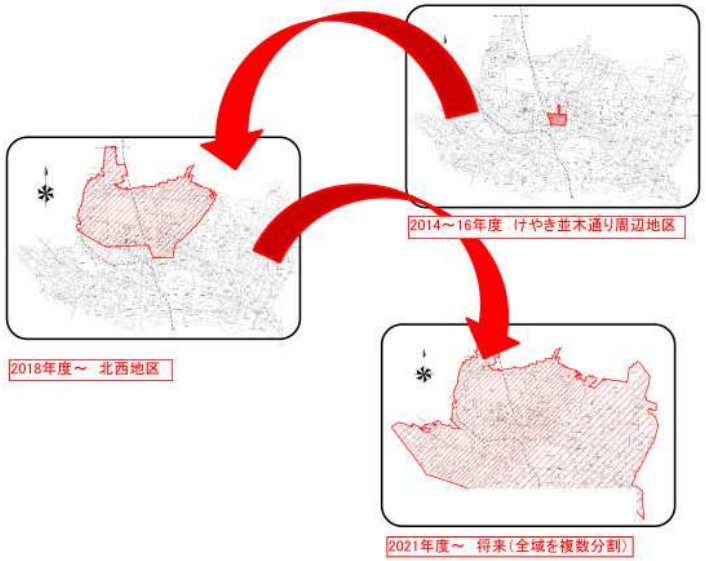


AMSS: Aomori Prefecture Bridge Asset Management Support System

4. Individual Measures ➔ (4) Expansion of Order Size & Multi-year Contracts

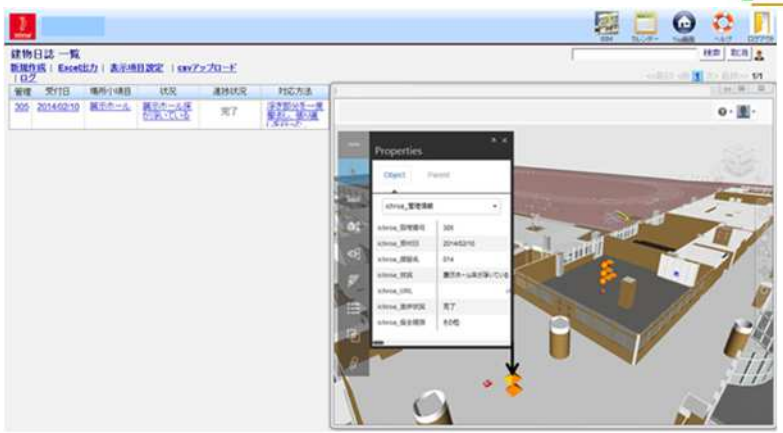


Bundled Contract for Road Maintenance in Fuchu, Tokyo



project.nikkeibp.co.jp/atclppp/PPP/434167/011400092/?ST=ppp-print

Source: 府中市HP



www.maeda.co.jp/select/2015/09/08/1534.html

3. Strategic Planning➔ Continuous improvement

10 The Continuous Improvement of Maintenance Management

Improvement of the Bidding & Contract System

It is important to start the improvement little by little, rather than proceeding to incorporate the entire elements of improvement at once

As an Example:

Single-year contract, Separation of Design/Build

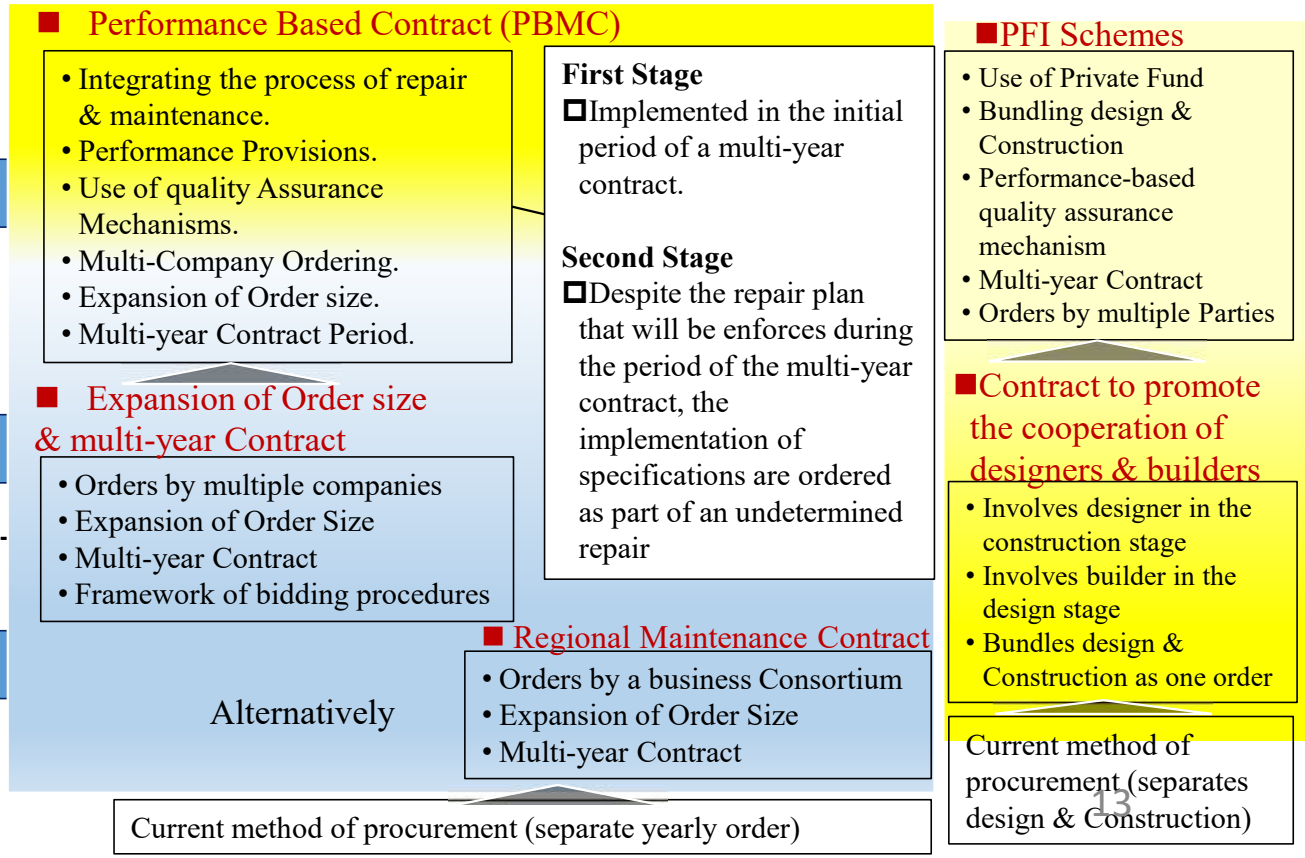
➔multiple year, expanding the scope of work

Survey, Matching & Organizing of Business Assets

➔The accumulation of data required for performance-based orders

The Introduction of Performance Based Contracts

➔Monitoring & determining adequate management targets



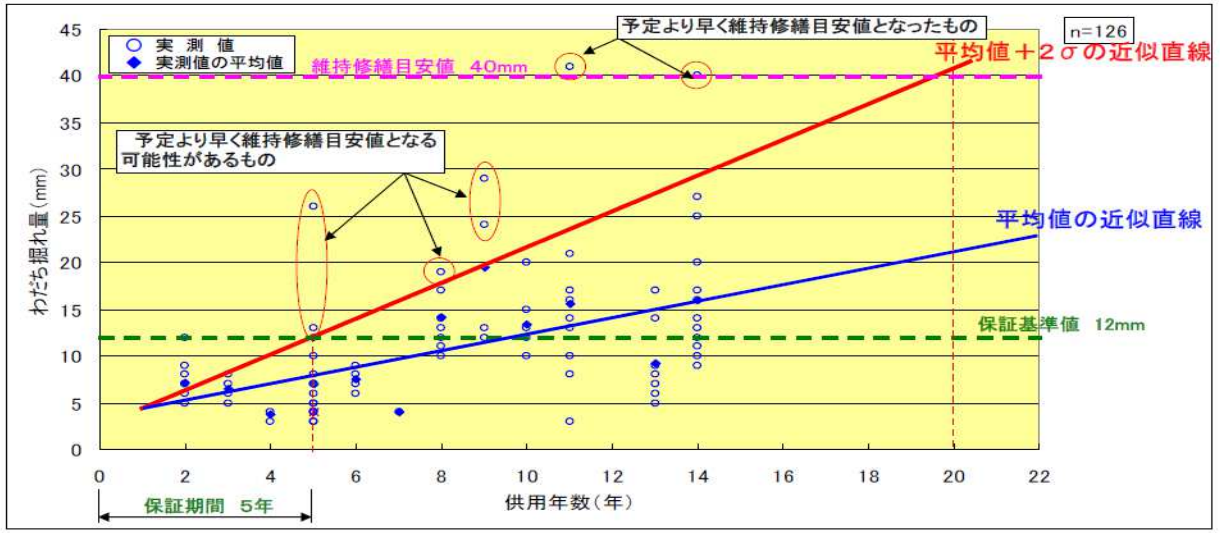
A Theoretical Perspective

Case Analysis : Asphalt Pavement Construction

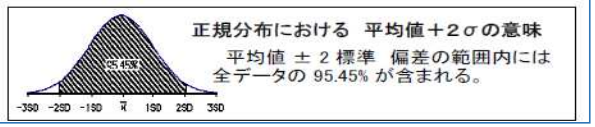
Focus : 2011 & 2012 estimate of asphalt pavement construction by Chugoku Development Bureau (with long-term guarantee 10 + 11 = 21)

Relationship between rut, digging amount & the life of a pavement

保証基準値を規定することにより、予定より早く修繕が必要となる（または、なる可能性がある）性能の劣る舗装を排除することができ、舗装の長寿命化を図ることができます。



※ 維持修繕目安値とは、切削オーバーレイ等の修繕を行う目安値であり、わだち掘れ量は40mm、ひび割れ率では40%としています。



（中国地方整備局、記者発表資料）

The Model of Long-term Guarantee Contracts

Public Procurement as a Symmetric Auction

- Assumption of n symmetric firms

<Behaviour of Companies>

- Individual Cost calculation
  based on the probabilistic distribution of the marginal cost parameter θ.
- Deciding on optimum bid price
  also based on a bidder's estimation of other bidders' costs & the probability of a successful bid

<Expected Profit Maximization Behaviour>

$$\max_{p}(p-\theta q)P(p)$$

Bid Price | Cost | Prob. of a successful bid

<Equilibrium Solution: optimum bid price>

$$p^*(\theta)=\theta q+\frac{q\int_{\theta}^{\overline{\theta}}M(s)ds}{M(\theta)}$$

Introducing the parameter of the Long-term Guarantee Contracts

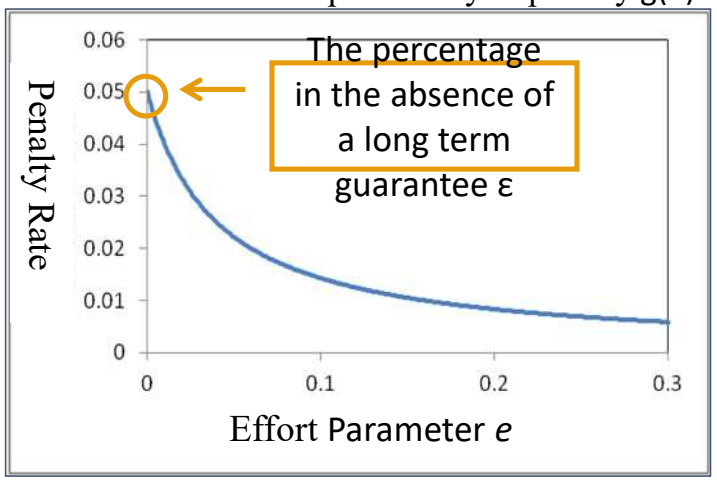
Denoting the long-term guarantee Contract *Introducing:*

Penalty X

Additional Effort Parameter e

The probability of penalty g(e)

Effort Parameter e & probability of penalty g(e)

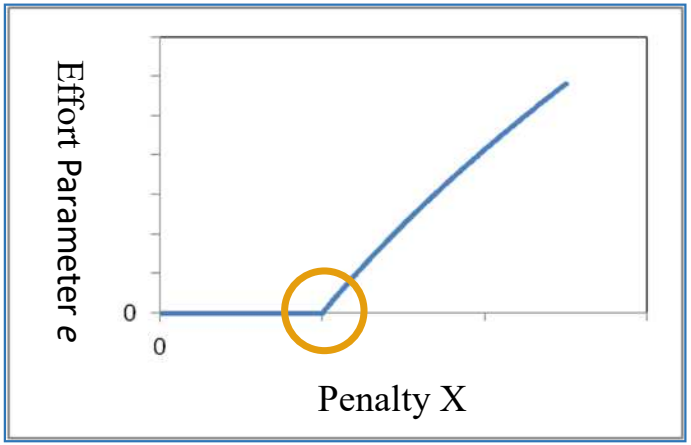


Long-term Guarantee Contracts：a model of bidding behaviour

■ The bidding behavior of the ordering party

The solution of $g'(e) = -\frac{\theta q}{X}$: α

→ $e = \begin{cases} \alpha & (\alpha > 0) \\ 0 & (\alpha < 0) \end{cases}$



■ Equilibrium solution

Optimum bidding price: $p^*(\theta) = \theta(q + eq) + Xg(e) + \frac{q\int_{\theta}^{\bar{\theta}} M(s)ds}{M(\theta)}$

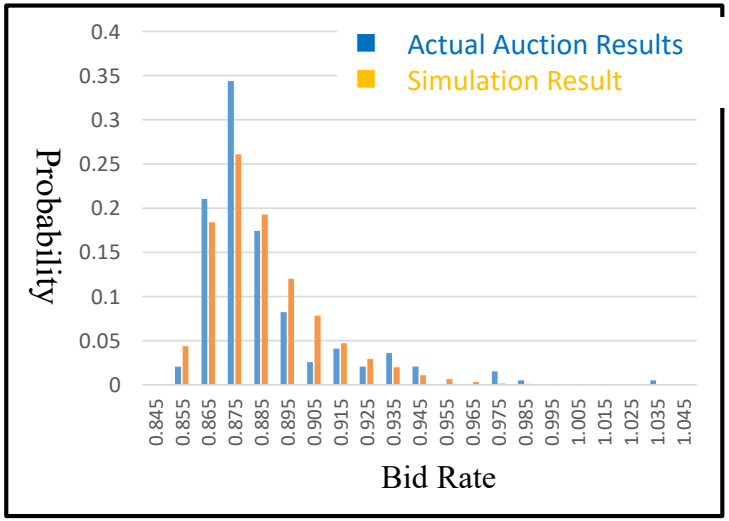
cost　penalty　profit

The details of the contract (given the size of the penalty) affect:
-the contractor's bidding behaviour / whether to make additional efforts
-a low penalty distorts the contractor's incentive for additional efforts

An analysis of the case of to understand the bidding behaviour of the ordering party

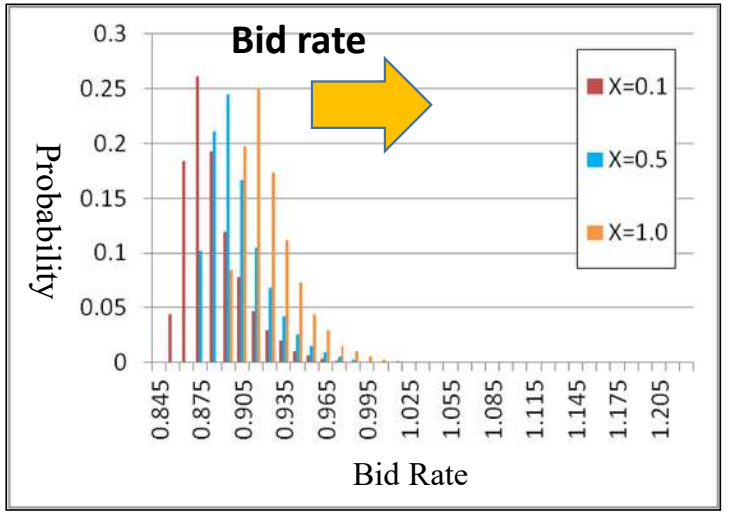
Focus : H23 & H24 estimate based on asphalt pavement construction by Chugoku Development Bureau (with long-term guarantee 10 + 11 = 21)

Estimation of Actual Bidding



A possible representation of the real distribution of penalty costs

change resulting from penalty X



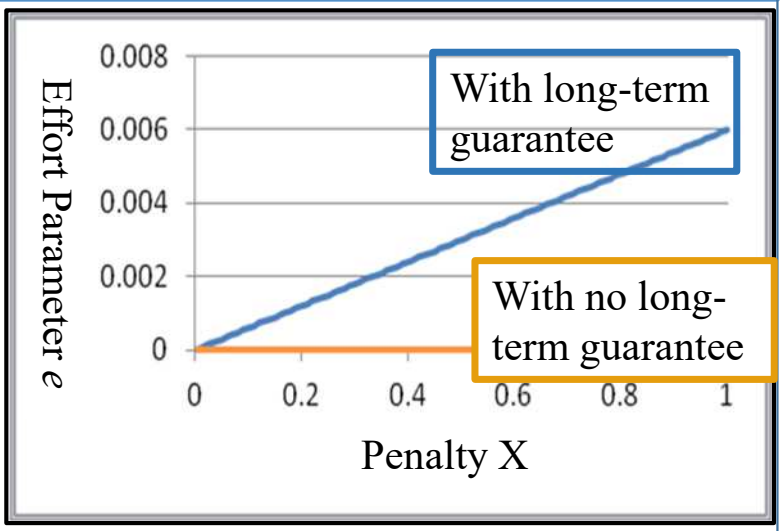
If the penalty is increased, bid price increases

The penalty costs facilitates an understanding of bidding behaviour

A case analysis : the determination of penalty X

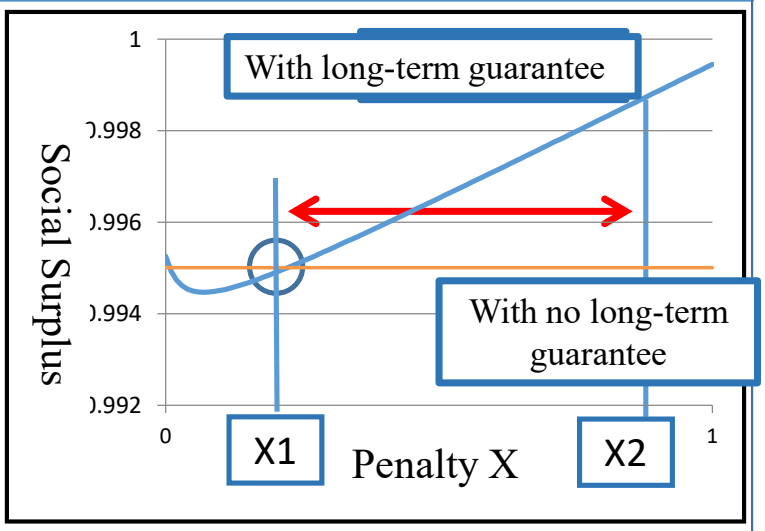
The changes that results from penalty X

Effort Parameter e



If you set Penalty X higher, the effort parameter e of the ordering party will increase

Social Welfare SW



(profit of each ordering party)>0 → X<X2

In comparison, long-term guarantees leads to higher social surplus :
→ X1<X<X2

In Reality: the Case of Tohoku

- Long-term (3-year) Quality Guarantee Contracts by the Government
- Pilot Project in Tsuruoka, Tohoku Bureau
  - 1.4km pavements
  - 24.8km maintenance
  - Guaranteed: Mar 2012 – Mar 2015
  - ¥428 million
- Performance Indicators
  - Rutting (<8mm after 3yr)
  - Crack (< 20% after 3yr)
  - Hydraulic permeability (> 1000ml/15sec in 2012) and
    (> 700ml/15sec in 2015)

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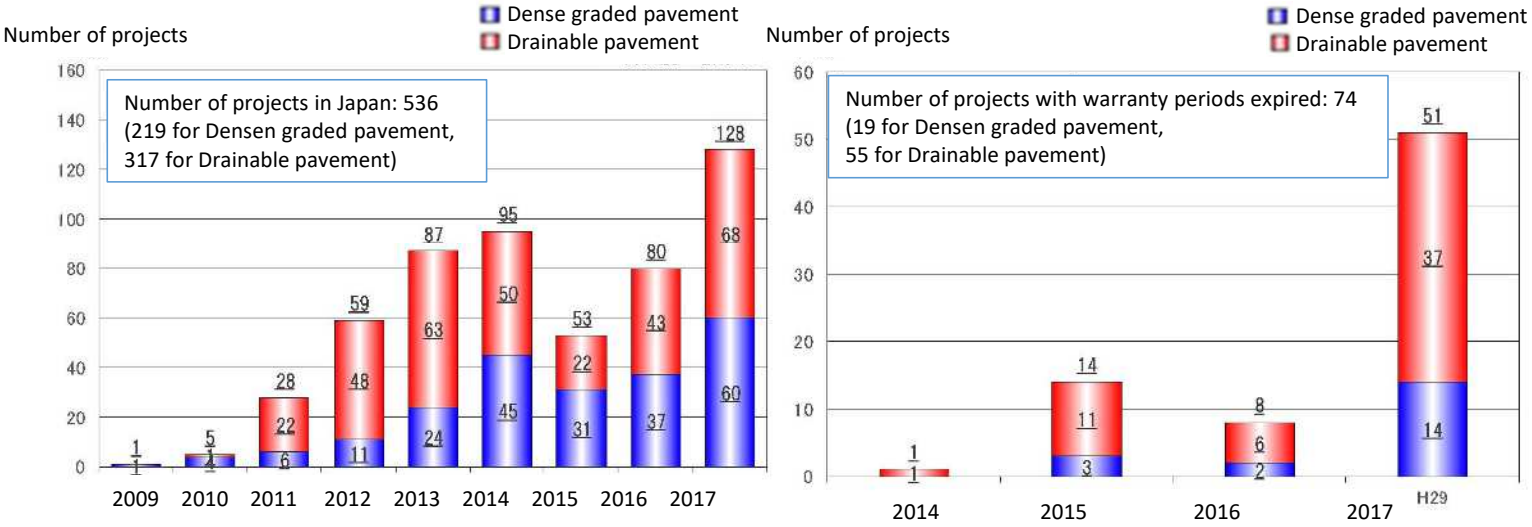
The number of newly constructed asphalt pavements with long-term guarantees

- In 2017, 128 newly constructed asphalt pavement projects adopted long-term guarantee. The total number of such projects from 2009 to 2017 was 536, including 219 dense graded pavement projects and 317 drainable pavement projects.
- By 2017, 74 projects had reached the expiration of their warranty periods (5 years or 3 years for drainable pavement in northeastern area only). An evident increase in the number for 2017 can be observed compared with former years.



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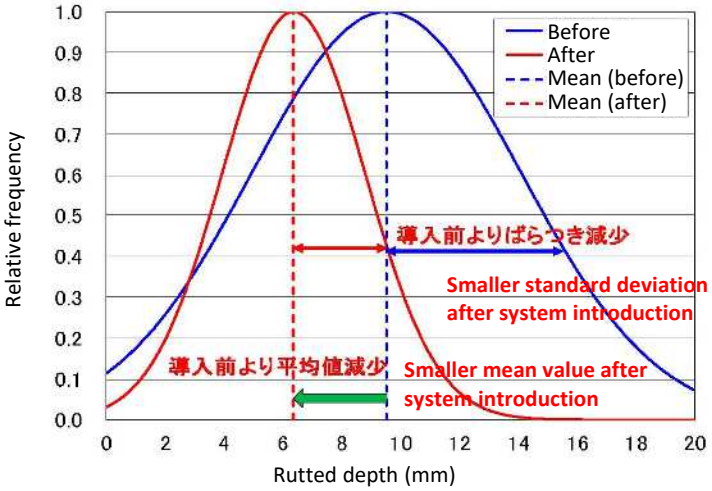
R1第1回資料

Performance indicators of the newly constructed asphalt pavements

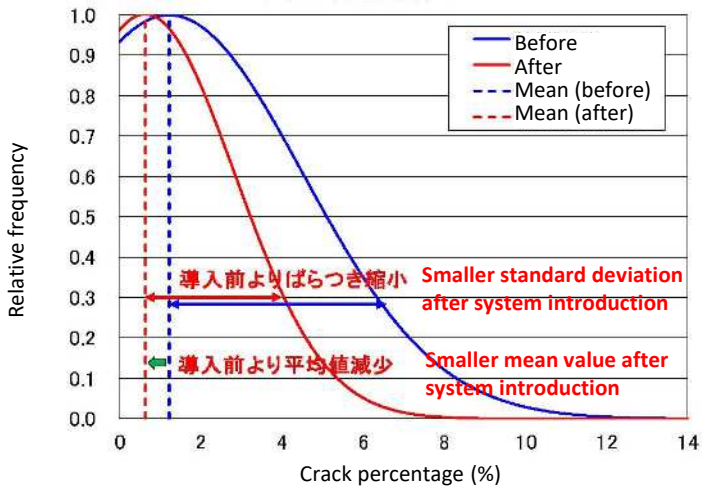
国土交通省

- Comparing the performance of the pavements between pre- and post-introduction of long-term guarantee system, the rutting and cracking of the pavements with long-term guarantees were significantly alleviated according to the mean values and standard deviations after 5-year services.
- The previous results suggested that there is a clear effect in improving pavement performance and uniformity of quality from long-term guarantee system introduction.



	Before system introduction	After system introduction	comparison
Number of samples	2,598	3,674	1,076
Mean (mm)	9.54	6.38	-3.16
Standard deviation (mm)	4.57	2.42	-2.15

The comparison of rutted depth after 5-year services between pre- and post- introduction of long-term guarantee system



	Before system introduction	After system introduction	comparison
Number of samples	2,598	3,588	990
Mean (%)	1.23	0.63	-0.60
Standard deviation (%)	3.30	2.21	-1.09

The comparison of crack percentage after 5-year services between pre- and post- introduction of long-term guarantee system

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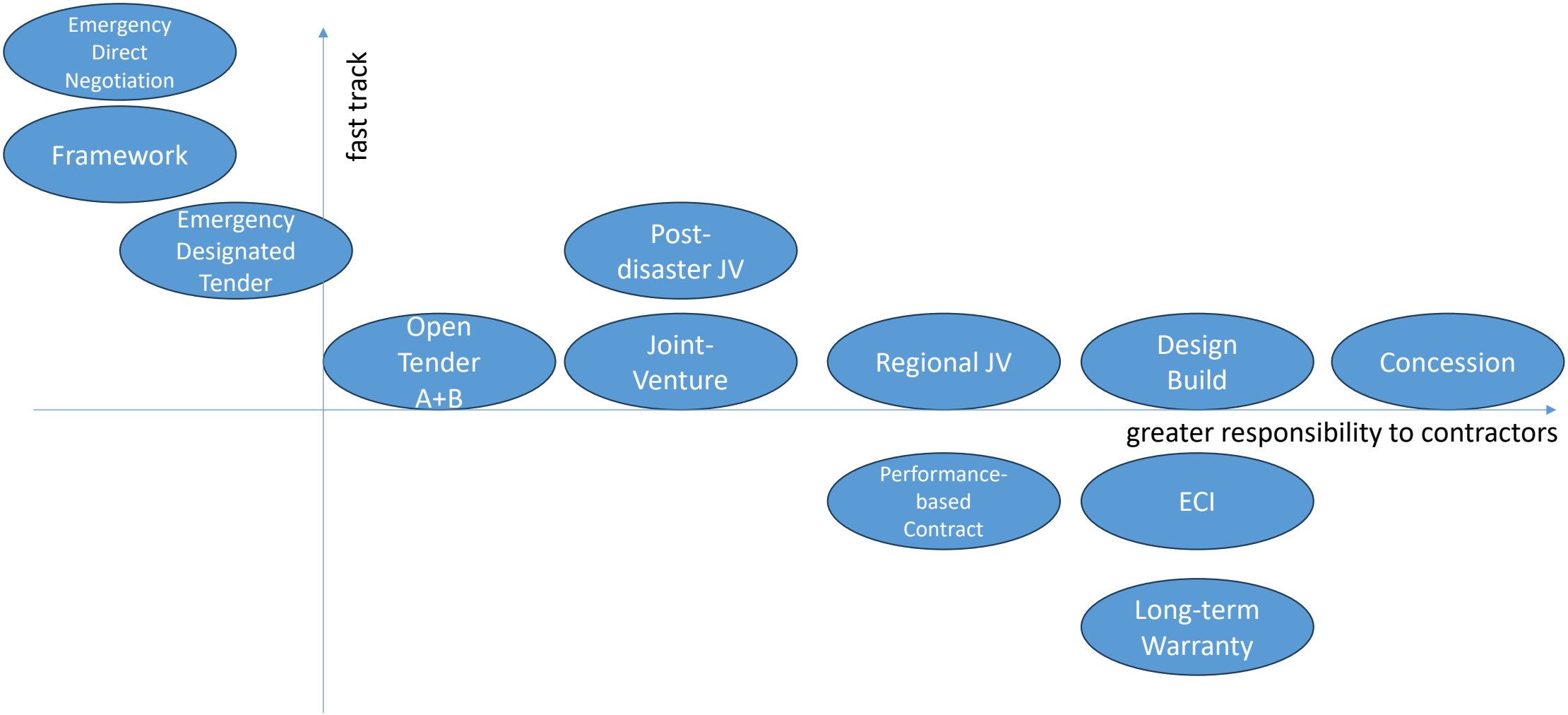
R1第1回資料



Mapping Different Project Delivery Methods for Maintenance

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