

6th EWA / JSWA / WEF Joint Conference  
„The Resilience of the Water Sector“  
15-18 May 2018, Munich, Germany



# Research Towards a Long-Term Restoration Plan for Sewage Pipes

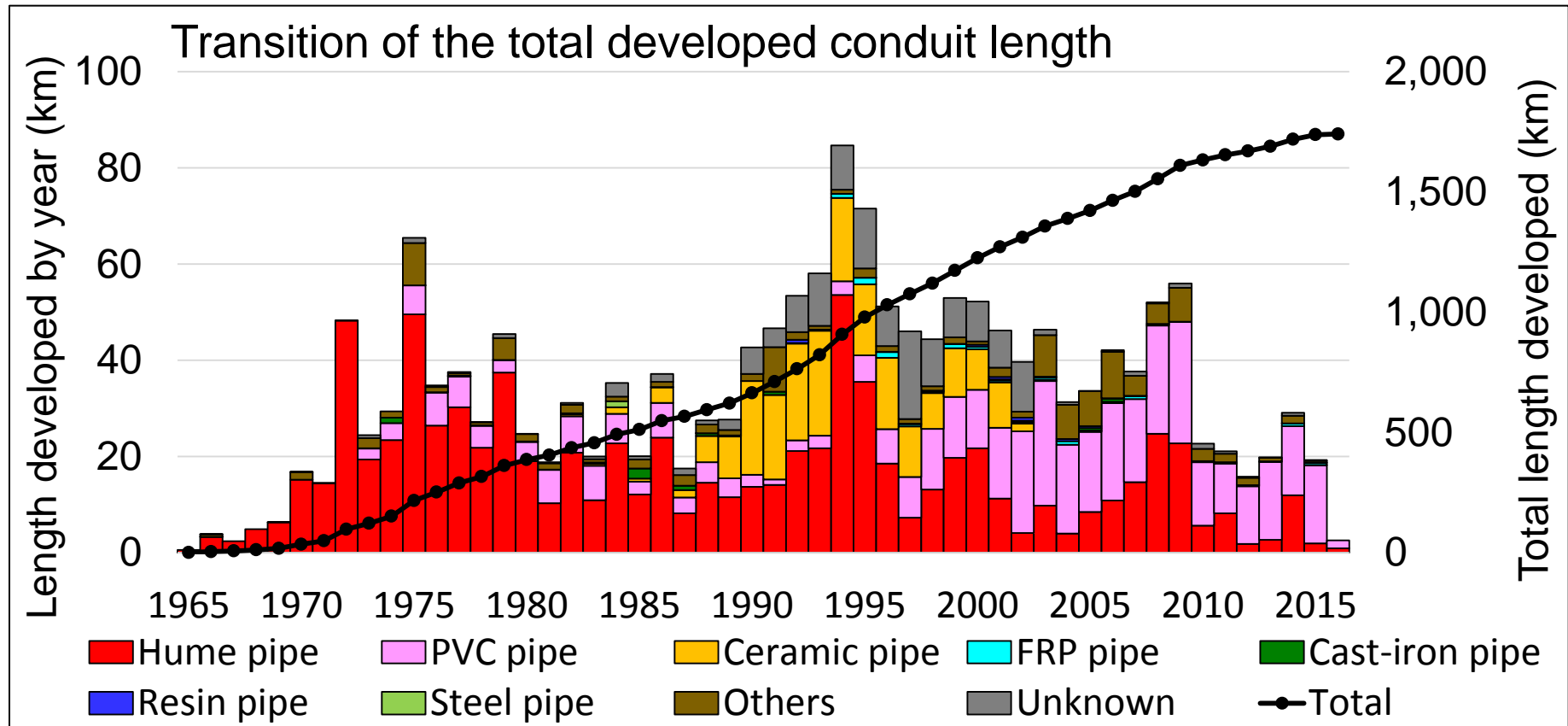
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16 May

# 1. Purpose of Research

## ● Old Pipes Increasing



# 1. Purpose of Research

- Sustainable Sewerage Project

- Preventive maintenance
- Quantitative survey
- Non-destructive and non-excavation survey



The Impact Elastic-wave Inspection Method Survey

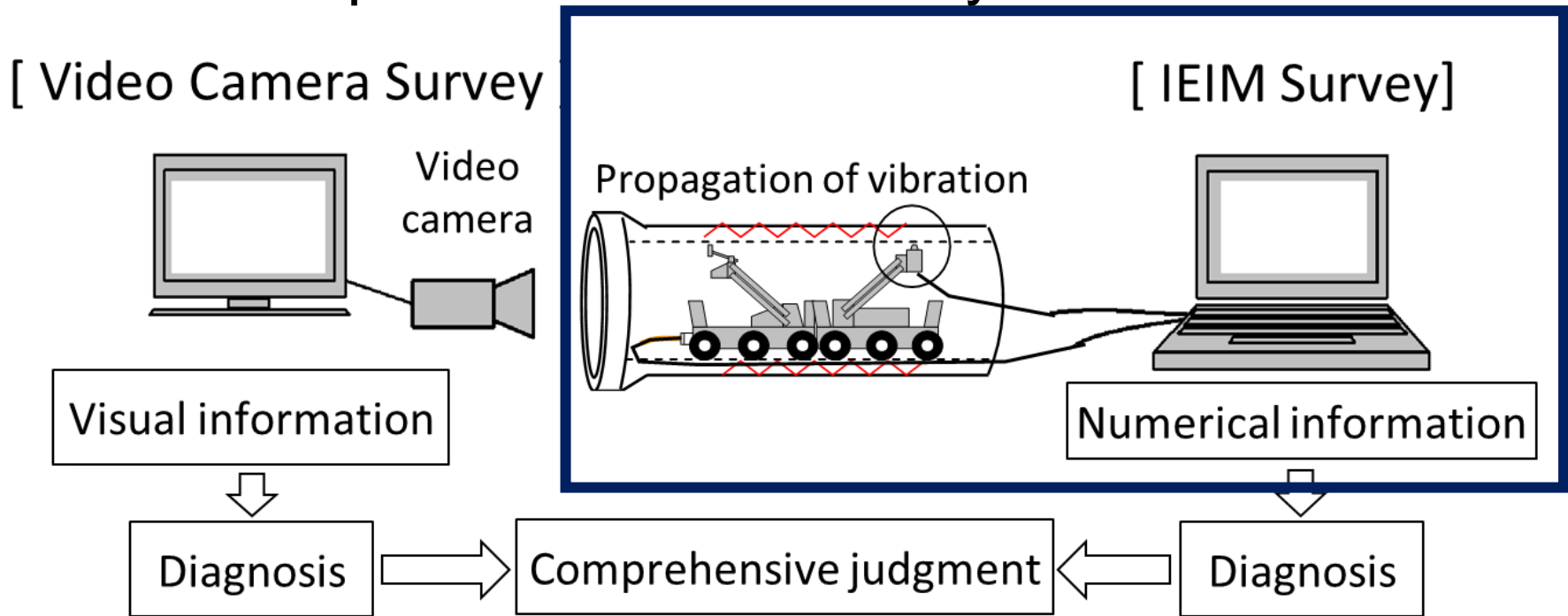
# 1. Purpose of Research

- What is the Impact Elastic-wave Inspection Method Survey (IEIM Survey) ?
  - New evaluation method
  - Quantitatively grasp the remaining strength
  - By applying a light impact to the pipe
  - For Hume pipe



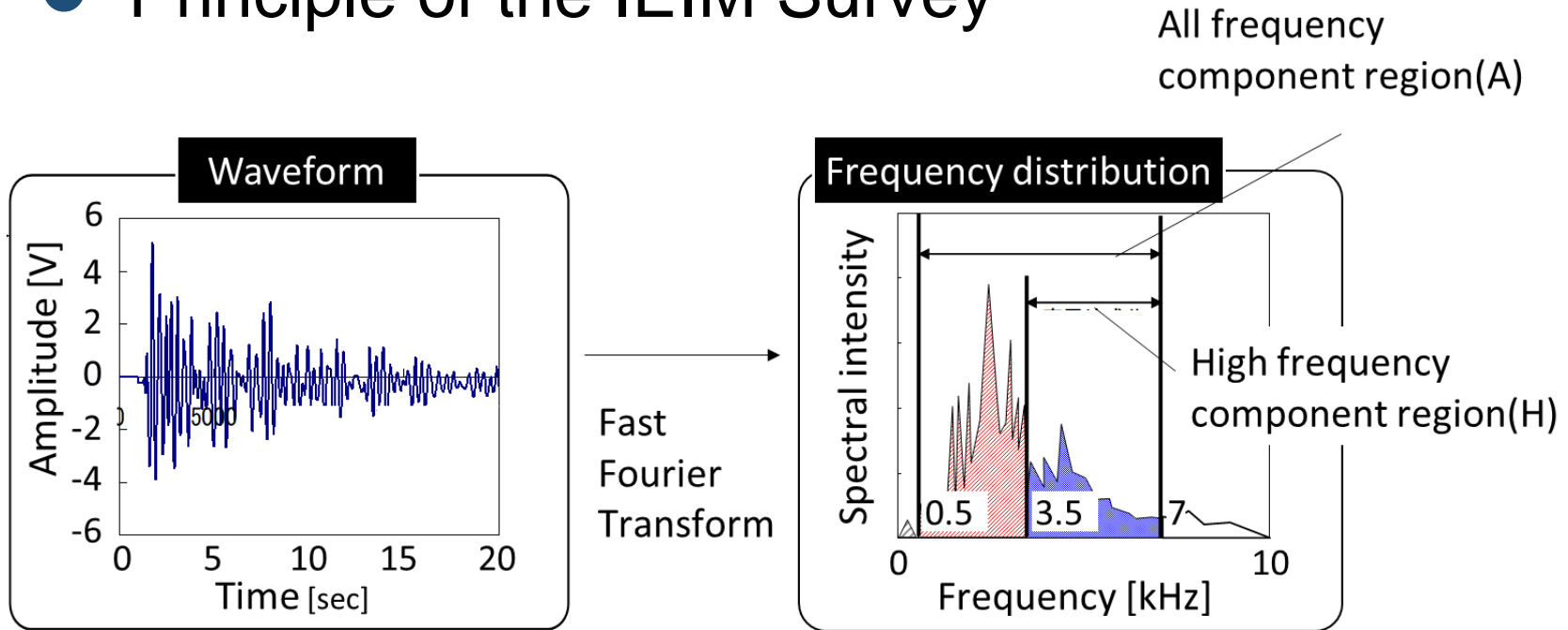
# 1. Purpose of Research

- Principle of the IEIM Survey



# 1. Purpose of Research

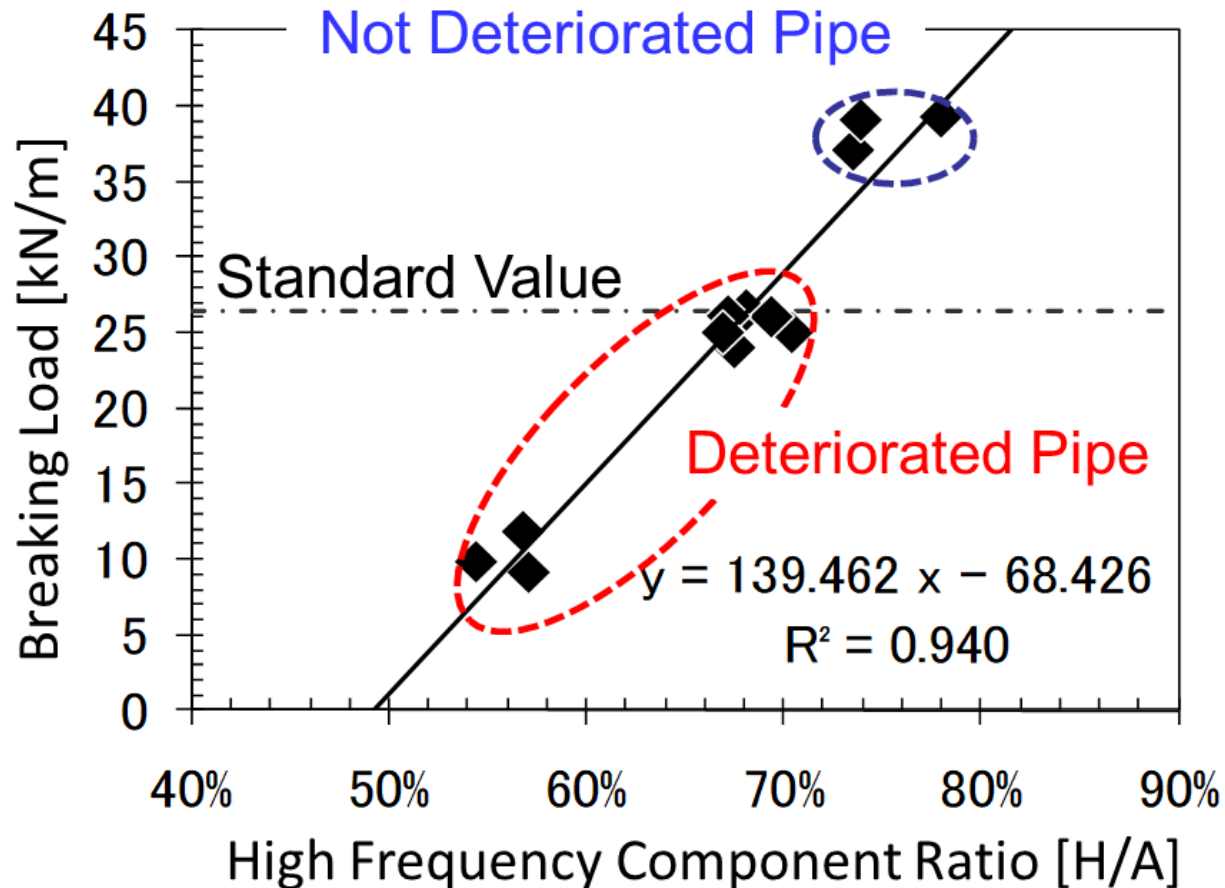
- Principle of the IEIM Survey



$$\text{High Frequency Component Ratio (\%)} = \frac{H}{A}$$

# 1. Purpose of Research

- Principle of the IEIM Survey



# 1. Purpose of Research

- Survey Demonstration on the Ground



Not Deteriorated Pipe



Deteriorated Pipe



# 1. Purpose of Research

- Formulate a Long-Term Restoration Plan
  - Using the IEIM survey
  - Life estimation of aged pipes

## 2. Research Content

- Implementation of Survey
- Arrangement and Consideration of Survey Results
- Estimation of Target Durable Life of Existing Pipes
- Formulation of a Long-Term Restoration Plan

### 3. Results of Research

- Implementation of Survey

- No biasing of the laying conditions

Item		Corrosive Environment	General Environment	
Years	Around 10 years		○	—
	Around 20 years		○	—
	Around 30 years		○	○
	Around 40 years		○	○
	Around 50 years		—	○
Usage Classification	Sea-side	Residential areas	—	○
		Commercial areas	—	○
		Industrial areas	—	○
	Mountain-side	Residential areas	—	○
		Commercial areas	—	○
		Industrial areas	—	○

## 3. Results of Research

- Implementation of Survey

- Combination of video camera and IEIM survey

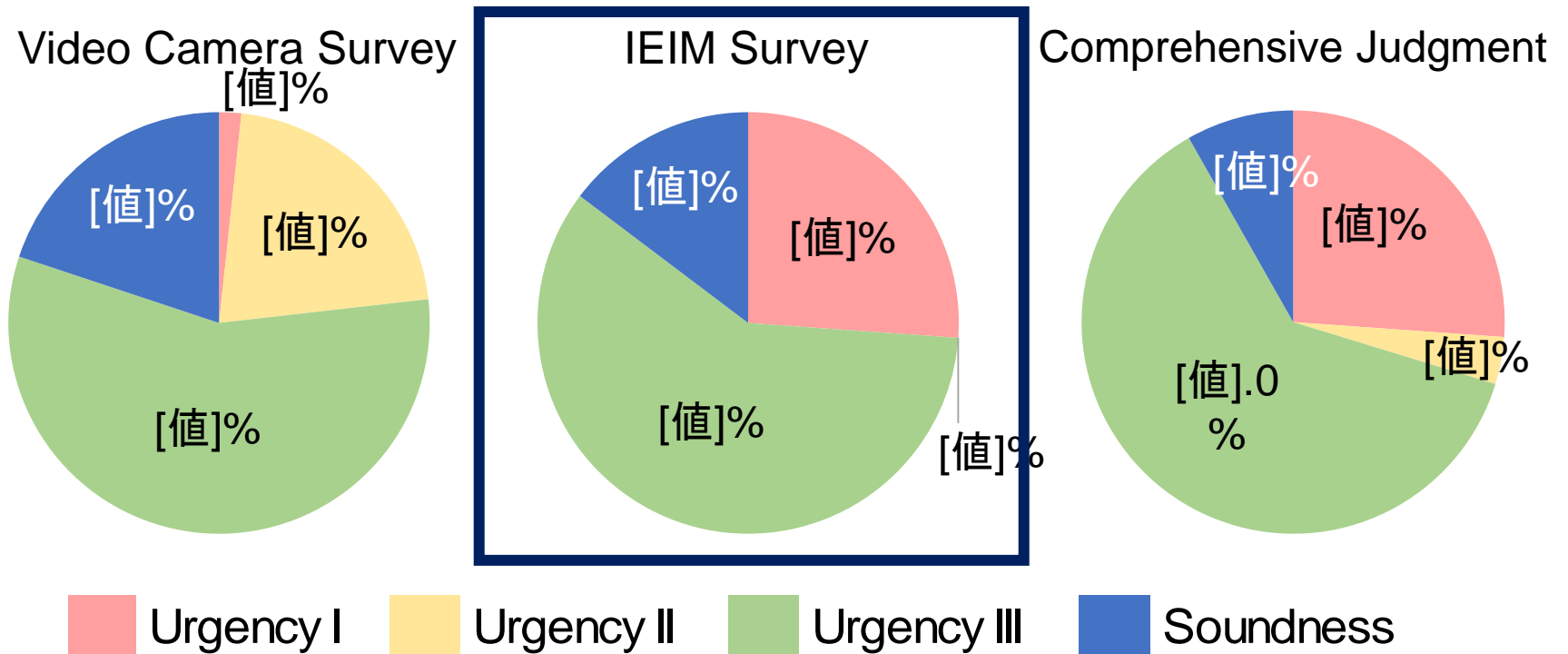
		IEIM Survey			
		Urgency I	Urgency II	Urgency III	Soundness
Video Camera Survey	Urgency I	Urgency I	Urgency I	Urgency I	Urgency I
	Urgency II	Urgency I	Urgency II	Urgency II	Urgency II
	Urgency III	Urgency I	Urgency II	Urgency III	Urgency III
	Soundness	Urgency I	Urgency II	Urgency III	Soundness



Comprehensive judgment  
 (Prioritize bad results)

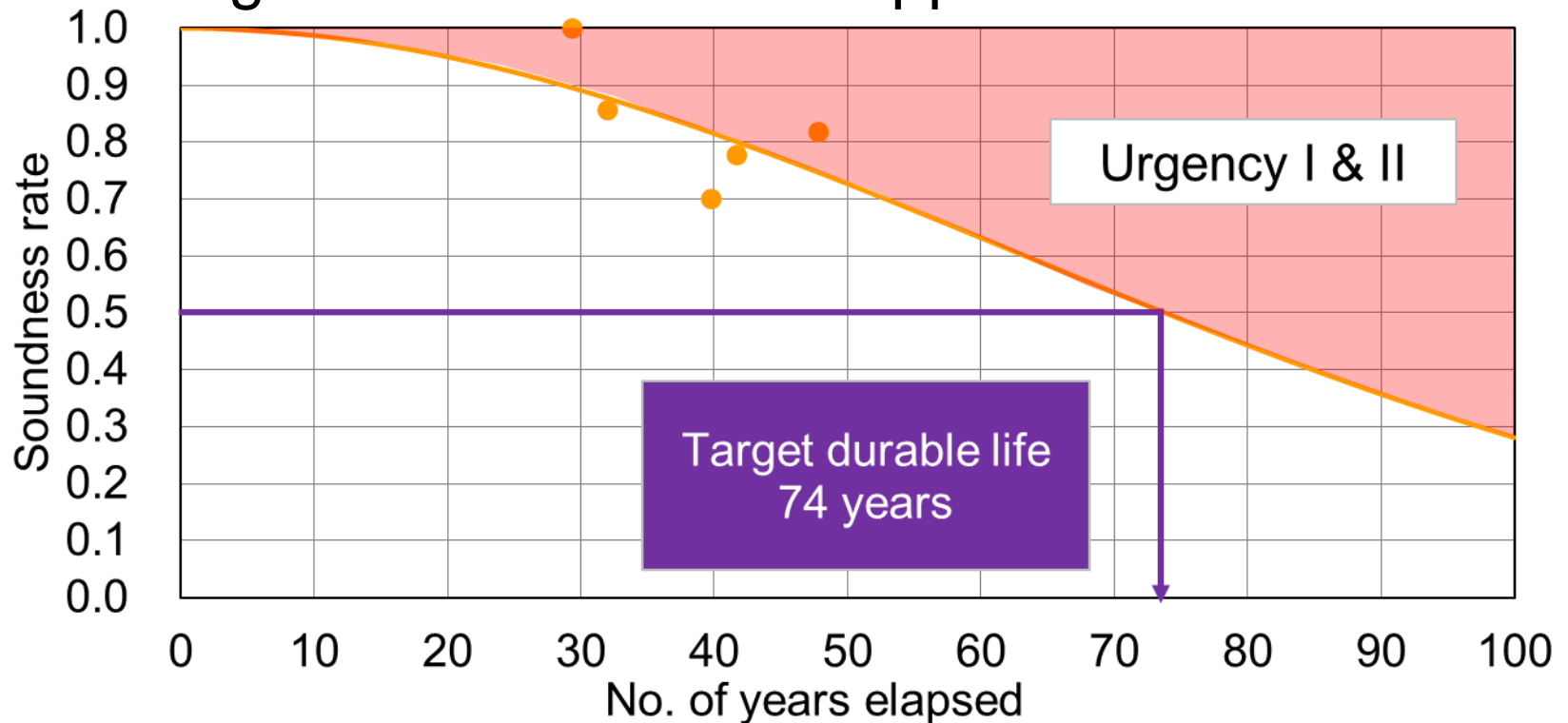
### 3. Results of Research

- Arrangement and Consideration of Survey Results
  - IEIM survey can find flaw that video camera can't



### 3. Results of Research

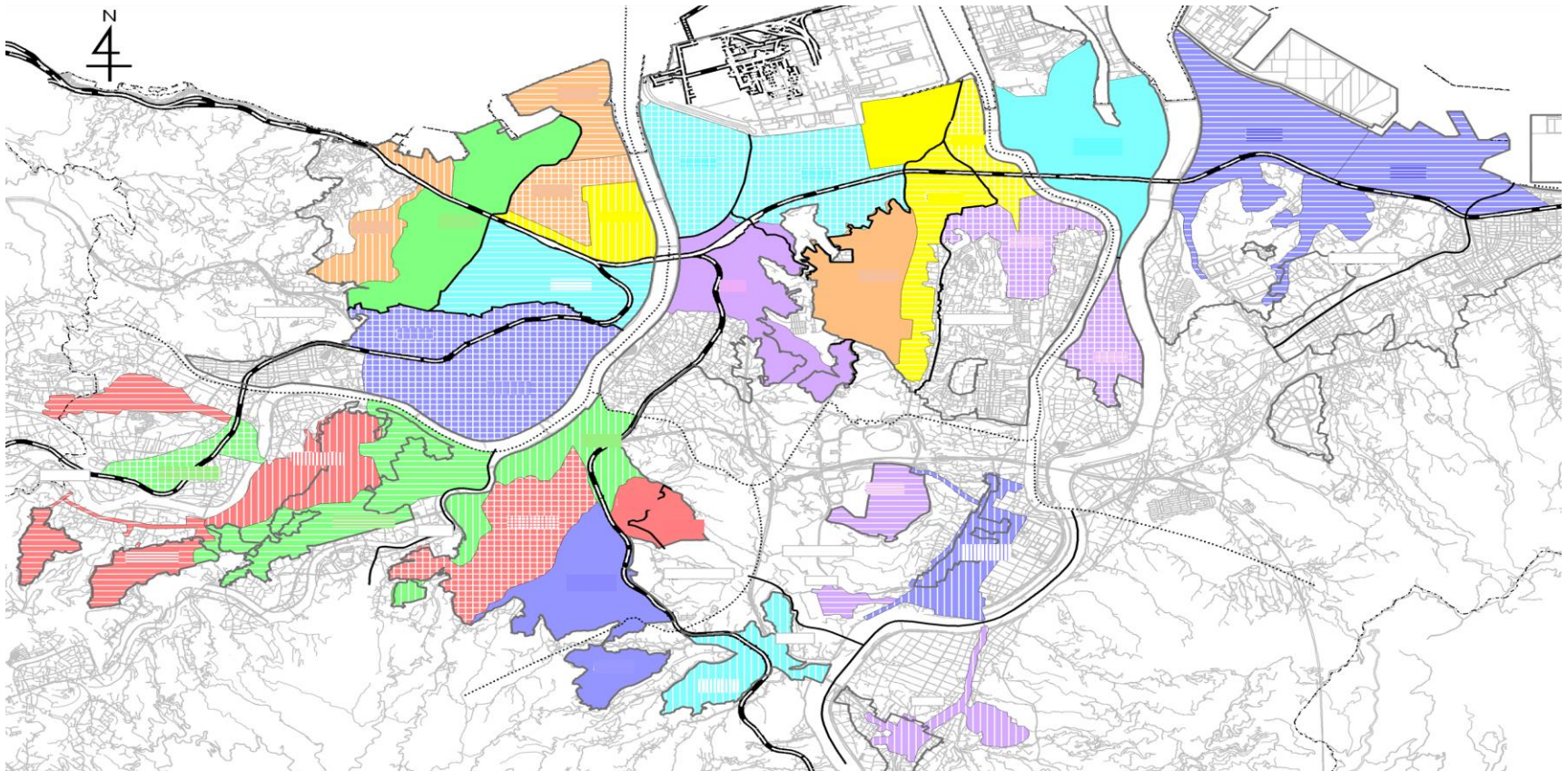
- Estimation of target durable life of existing pipes
  - Using Weibull distribution approximation



— Urgency III or Soundness [Predicted] ● Urgency III or Soundness [Actual]

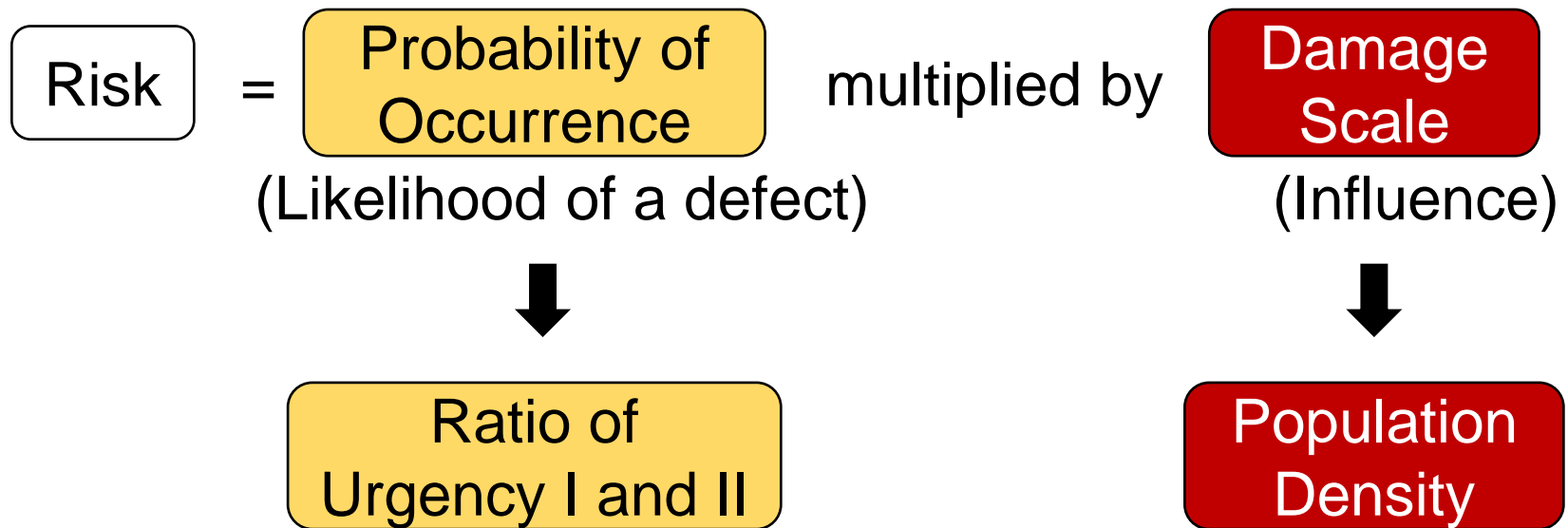
## 3. Results of Research

- Formulation of a long-term restoration plan
  - Classification of blocks



## 3. Results of Research

- Formulation of a long-term restoration plan
  - Setting the priority of blocks





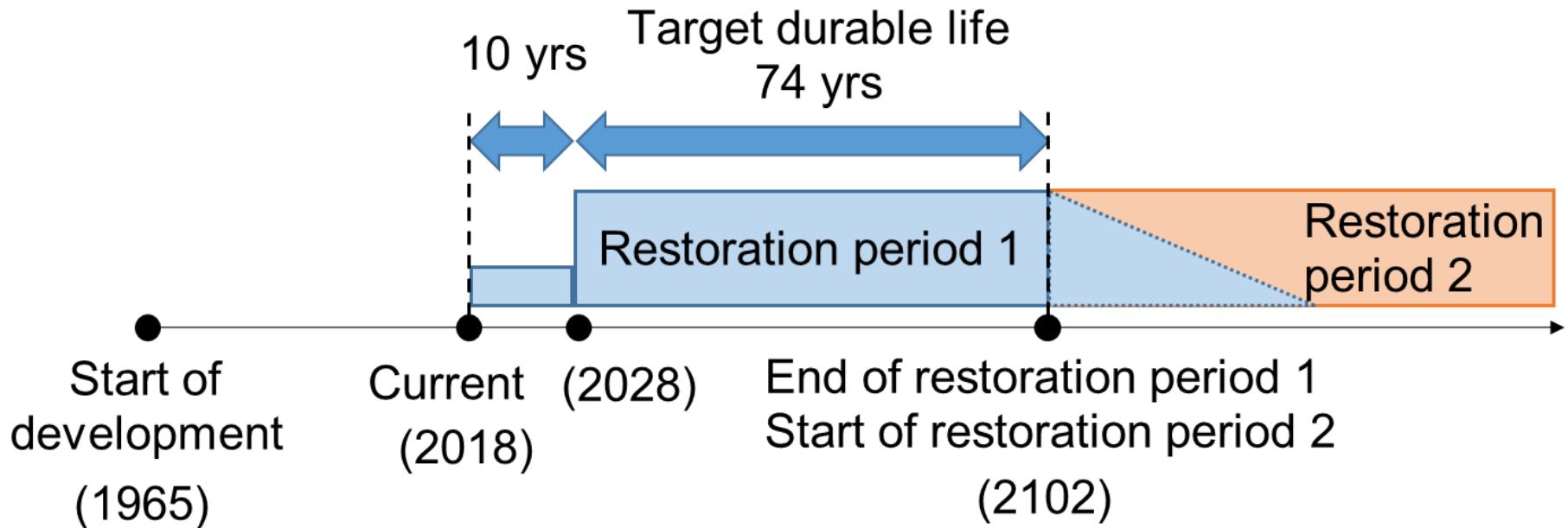
### 3. Results of Research

- Formulation of a long-term restoration plan
  - Setting the priority of blocks

Block	(1)Probability of Occurrence		(2)Damage Scale		Risk	
	Ratio of Urgency I and II	rank	Population Density (persons/ha)	rank	(1)×(2)	rank
Block 8	12.8%	8	159.5	1	20.37	1
Block 1	20.6%	1	69.8	5	14.40	2
Block 5	18.4%	3	70.6	3	13.01	3
⋮	⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮	⋮
Block 28	0.8%	26	39.3	15	0.30	26
Block 22	5.1%	22	4.4	28	0.23	27
Block 27	0.6%	28	29.9	18	0.18	28

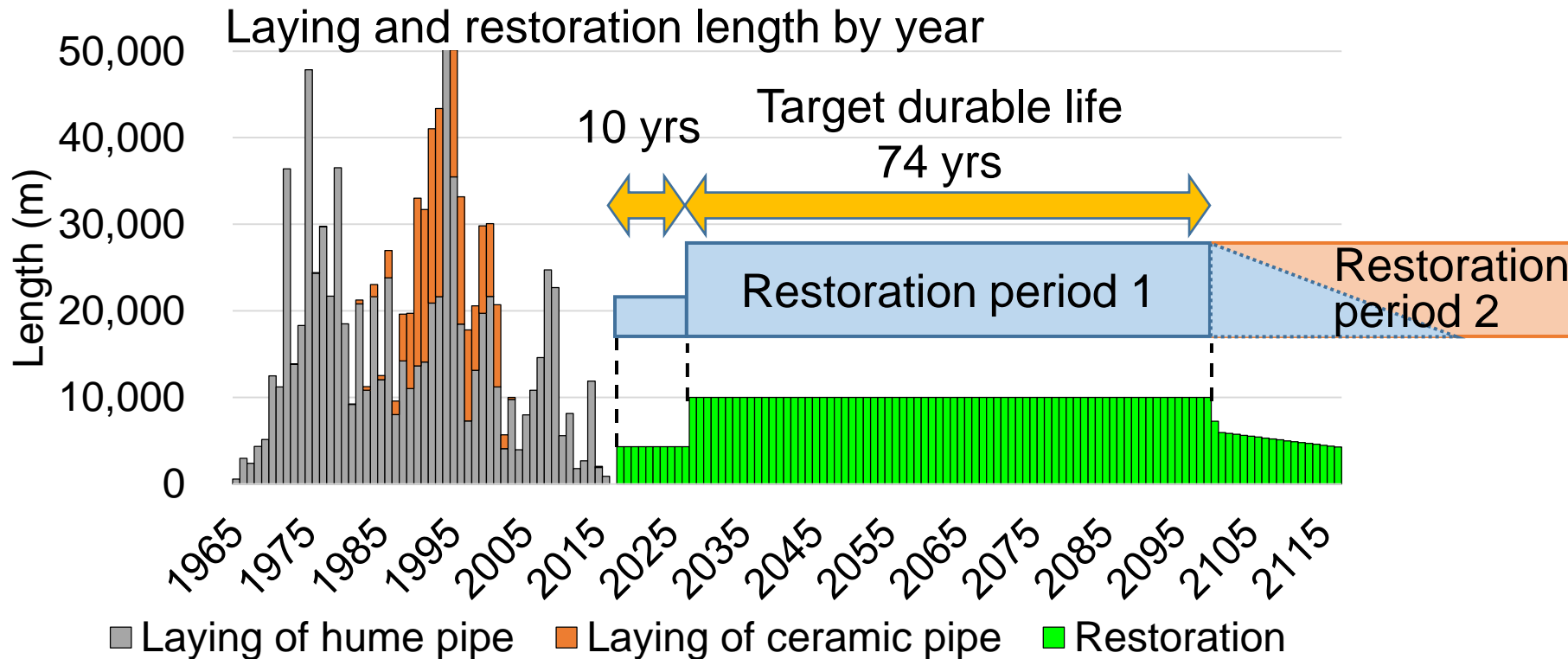
## 3. Results of Research

- Formulation of a long-term restoration plan
  - Setting the scenario



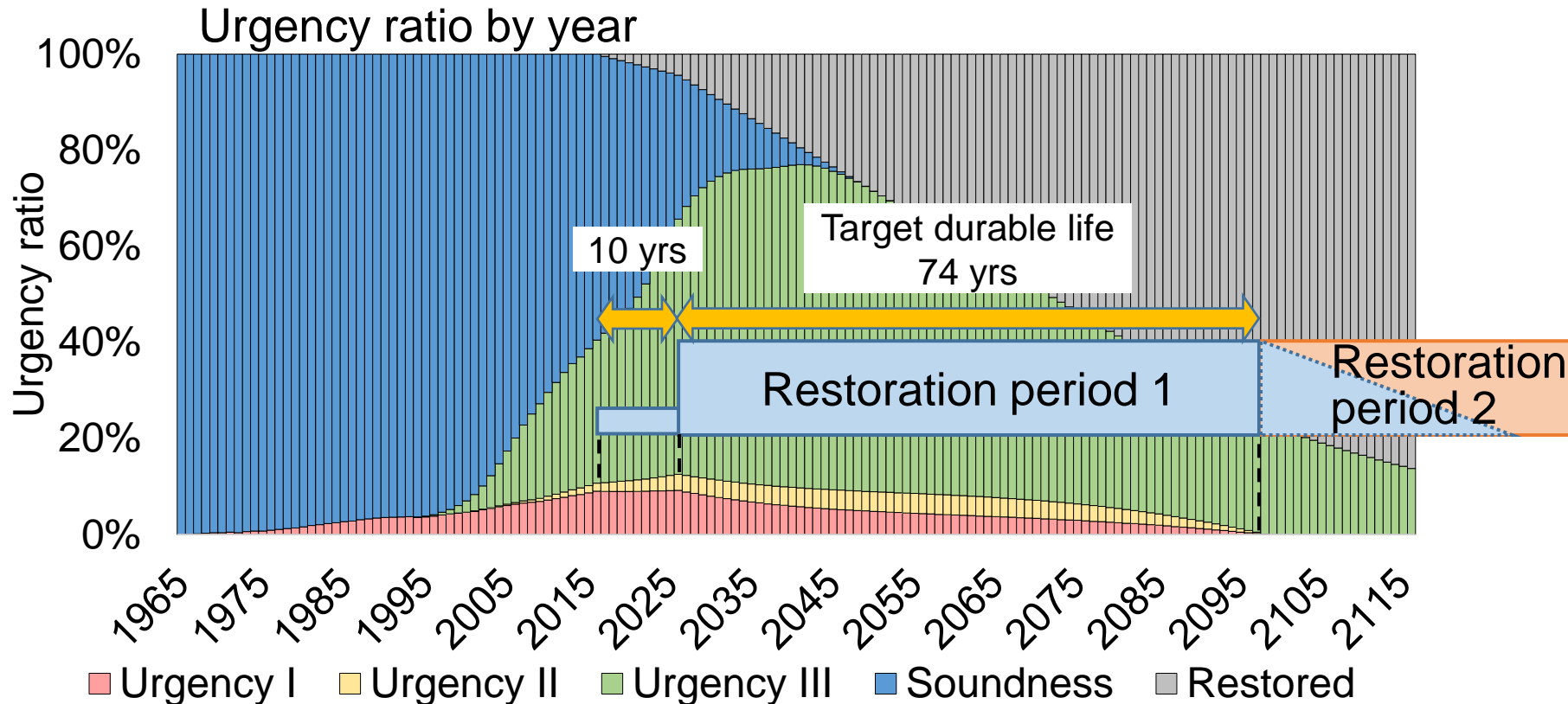
### 3. Results of Research

- Formulation of a long-term restoration plan
  - Recommended scenario



## 3. Results of Research

- Formulation of a long-term restoration plan
  - Recommended scenario



## 3. Results of Research

- Formulation of a long-term restoration plan
  - Premise of planning

1<sup>st</sup> year

Survey

Surpassed  
30 years or  
more



2<sup>nd</sup> year

Design



3<sup>rd</sup> year

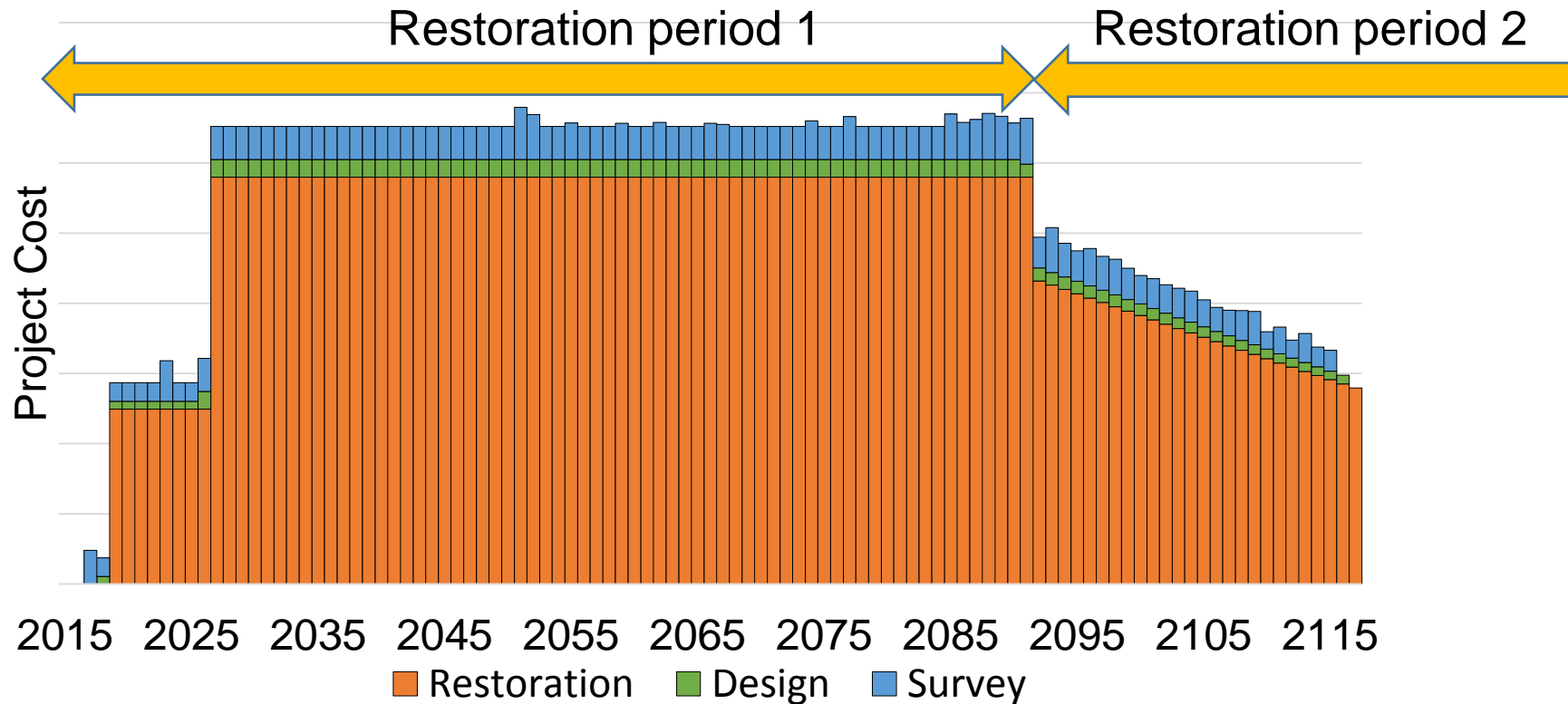
Restoration

The object of design and  
restoration is the urgency I and II.

## 3. Results of Research

- Formulation of a long-term restoration plan

Image showing the project cost by year



## 4. Conclusion

- I used the Impact Elastic-wave Inspection Method Survey. (IEIM Survey)
- IEIM survey can find flaw that video camera can't.
- From the survey results, I set the target durable life using Weibull distribution approximation.
- From the survey results, I set the long-term recommended restoration plan.

Vielen Dank für Ihre Aufmerksamkeit.

御清聴ありがとうございました

Thank you so much for kind attention.



Japan Institute of Wastewater  
Engineering and Technology