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A Method to Visualize the Relationship between Regulations and Architectural Constraints

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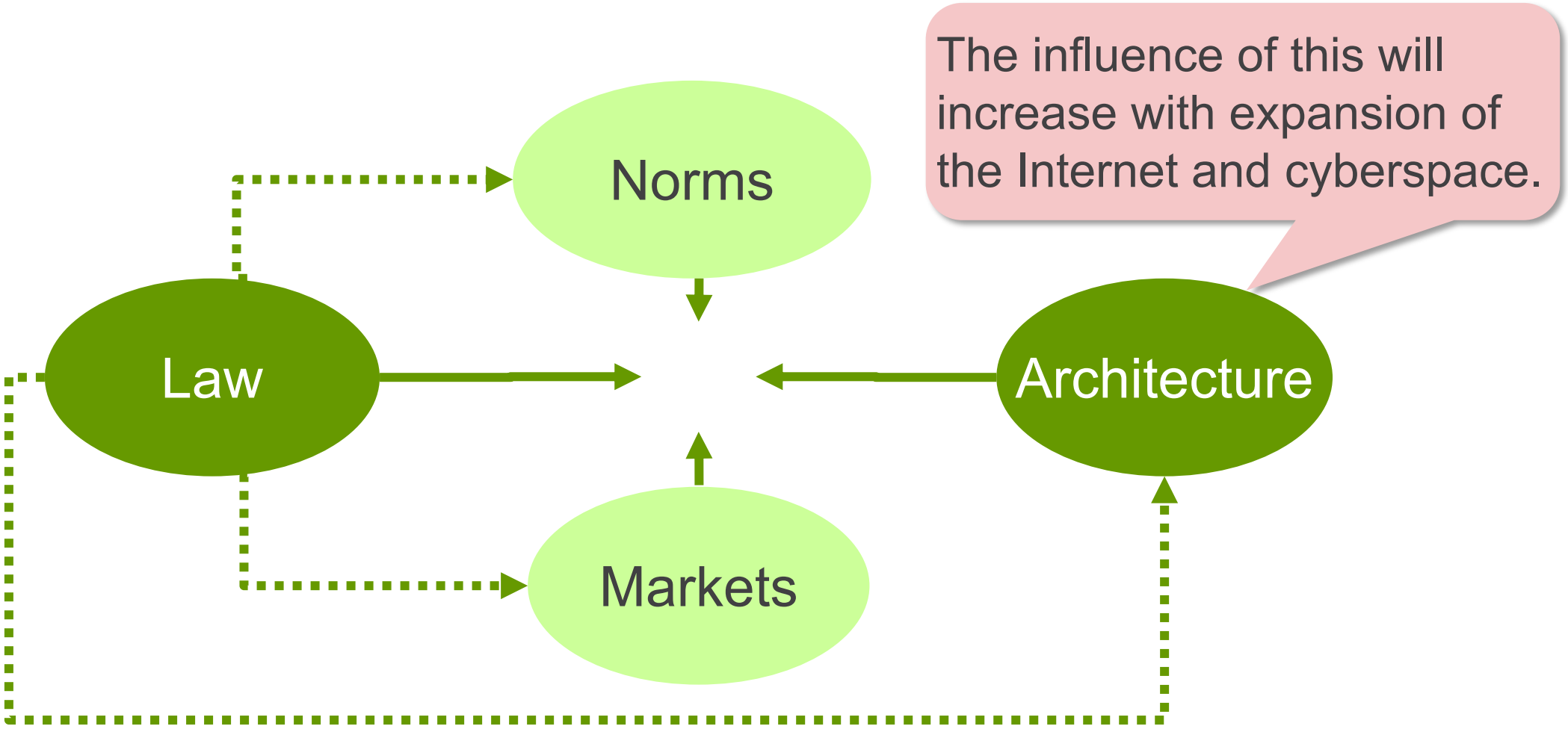
Introduction

Background (1) Regulator Types

Four factors to regulate human behaviors.

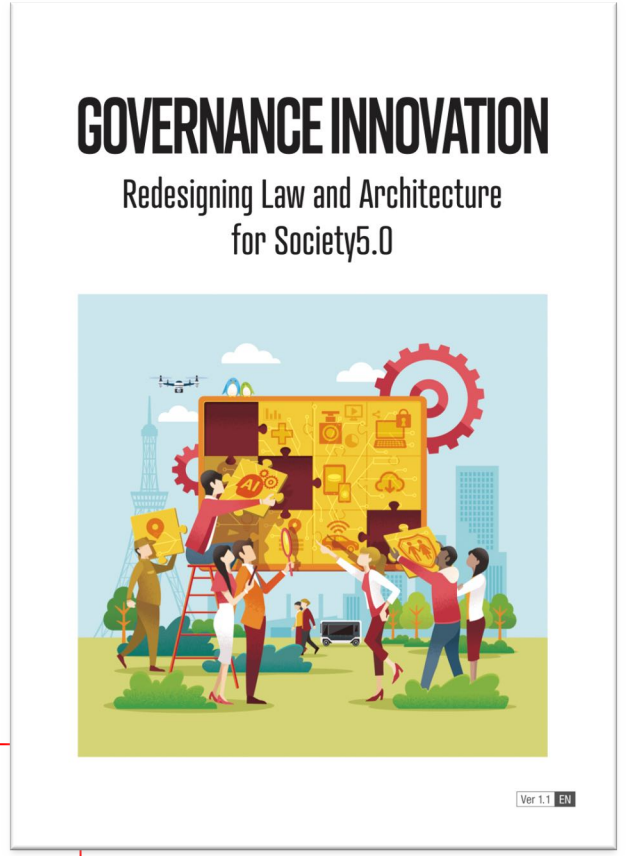


(Prepared by the author based on Lessig 1998).

Background（2）Situation in Japan

- METI published a report, **“GOVERNANCE INNOVATION: Redesigning Law and Architecture for Society 5.0”** to address the rapid changes in the society, owing to the impact of digital technologies like big data, IoT, and AI in July 2020.

- The report proposes **to replace or complement the regulation that is currently implemented by law by combining architecture** and other regulatory elements.



The report states that regulation by architecture will be efficient in the coming years; however, there are concerns and it is important to make the rules transparent and review them from time to time.

Definition of the Architecture

[Definition by ISO/IEC/IEEE42010:2011]

- <system> Fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution.

[Definitions by Legal Studies]

- Operable physicality [Matsuo 2008].
- Environmental constraints on action [Narihara 2011].

In this study, the scope of the architecture definition by ISO/IEC/IEEE42010 is stated the Entire Architecture. The one defined by legal studies, including physical elements in the realization, is stated Hardware & Software Architecture.

Characteristics of Regulation by Architecture①

Regulation by architecture has different characteristics from regulation by law.

	Law	Architecture
How to regulate	Impose sanctions after the fact	Pre-emptive suppression
Awareness of regulations	The subject needs to be aware of the rules	No need for the subject to be aware of the rules
Enforcement	Need an enforcement body and process	Automatically done

(Prepared by the author based on Narihara 2011)

Characteristics of Regulation by Architecture②

Examples with drunk driving regulation

by Law

A driver needs to be aware that drunk driving is illegal.
If one drinks and drive, he/she will be arrested them.

by Architecture

Mandate cars that will not start if there is alcohol on the driver's breath.
It prevents drunk driving even if the driver is not aware of the law.

Architecture can automatically constrain the behavior without user's recognition.

Concerns and Issues Raised by Previous Studies

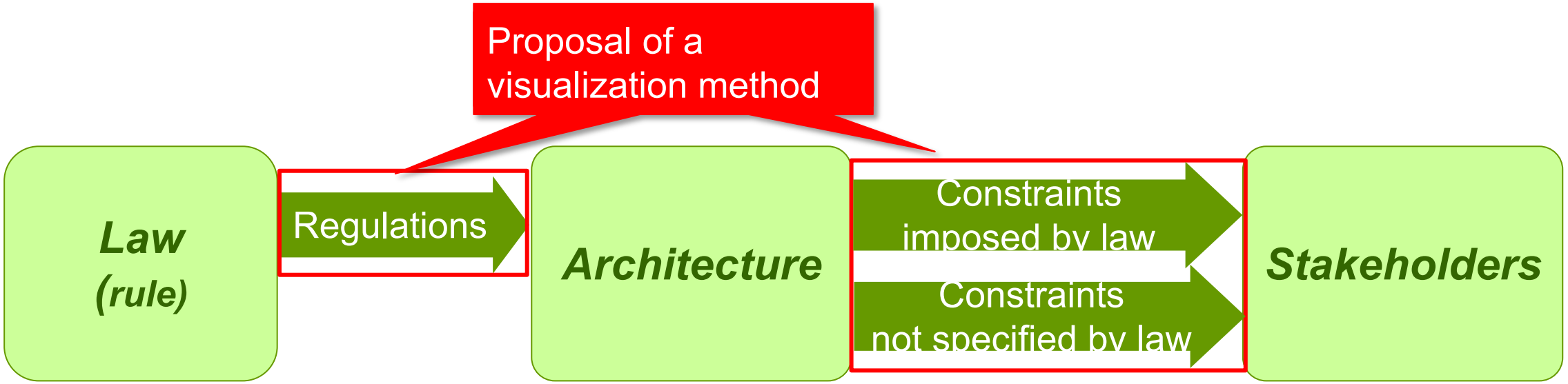
- The characteristic of “Unnecessity of Awareness” could cause situations that people overlook the appropriateness of the regulation.

- A discipline to visualize architecture regulation is worth considered. [Matsuo 2017]

However, a concrete visualization method has not been proposed.

Purpose of This Study

We propose a method to visualize the relationship between regulations and architectural constraints.



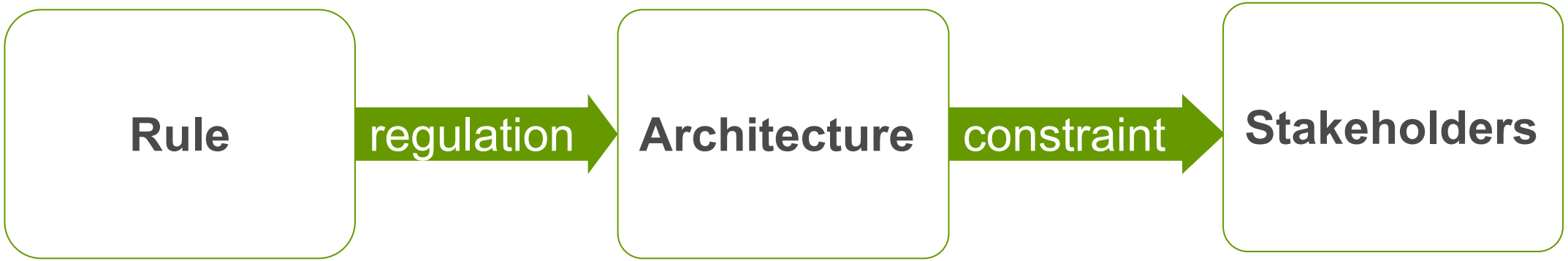
System engineers use this method to reveal the constraints faced by users owing to the architecture and verify that there is no deviation from the regulations.

Visualization Method Design

Overview of Visualization Method

1. Classify the objects that the rule regulates

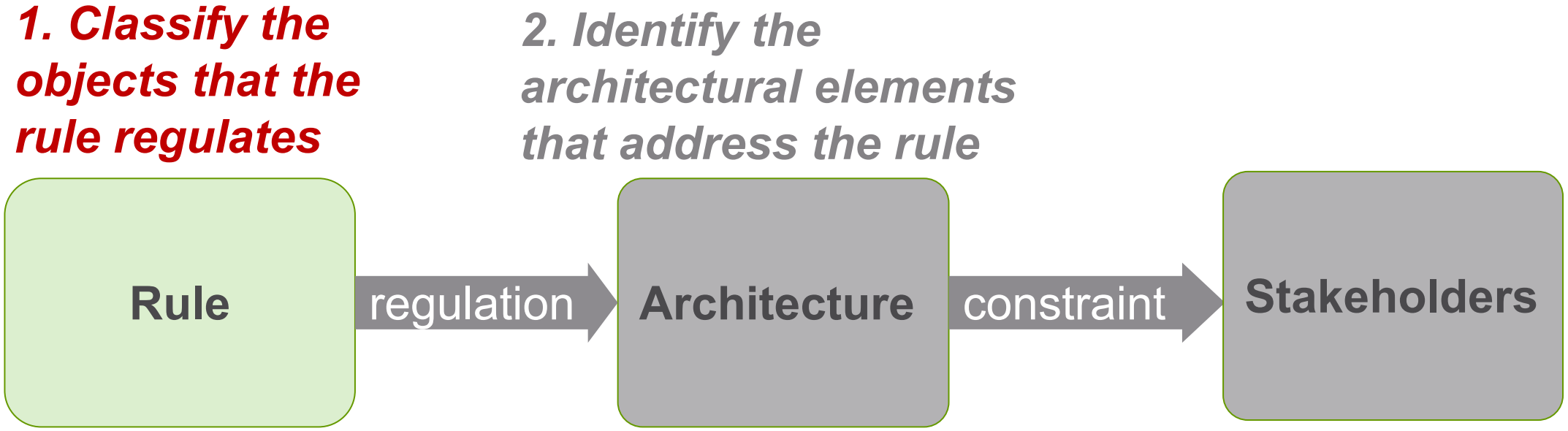
2. Identify the architectural elements that address the rule



3. Identify the type of regulations

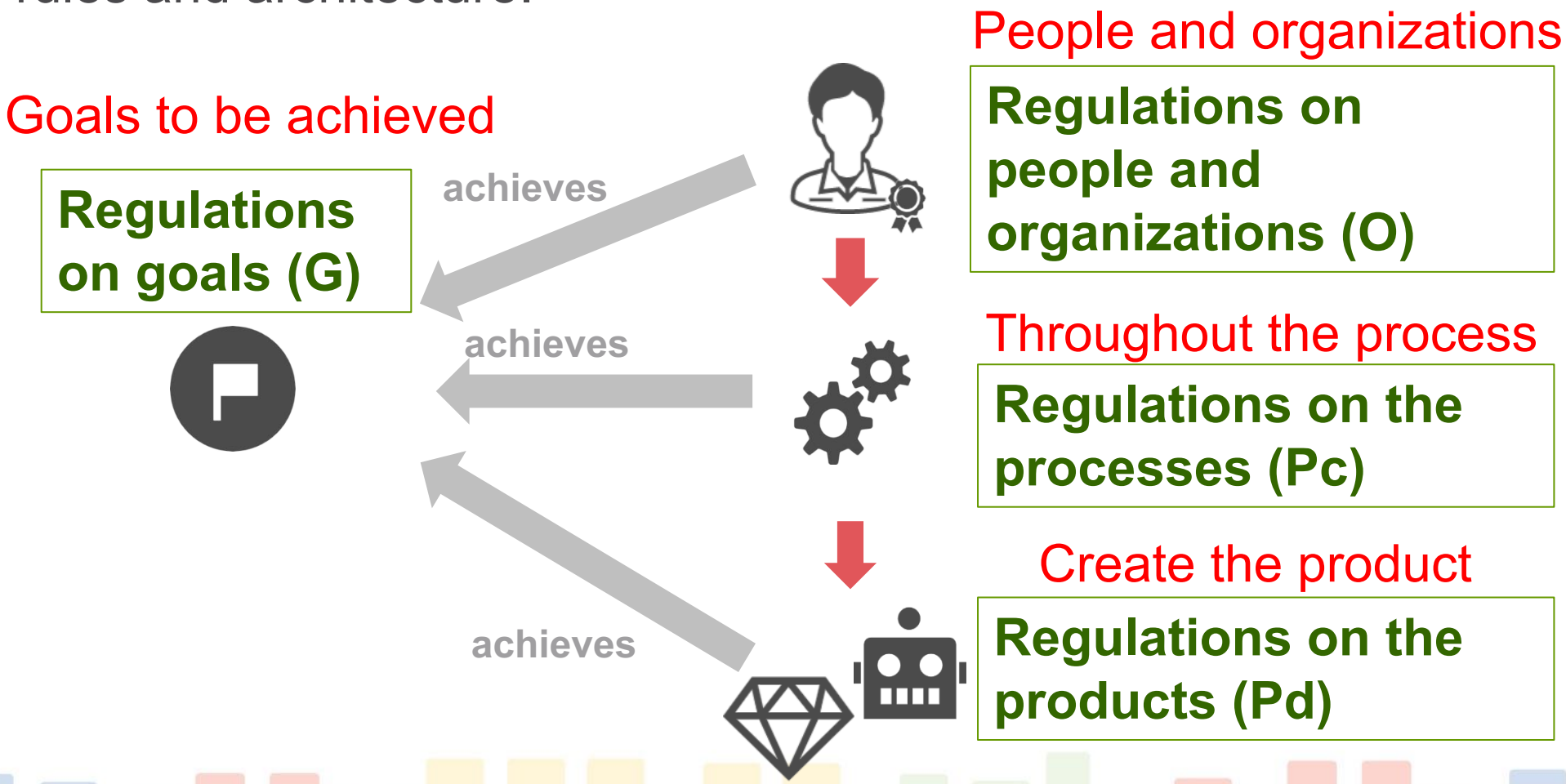
4. Identify the constraint types imposed by the architecture

Overview of Visualization Method



1. Classification of the Objects Regulated by the Rules

Decomposition of the regulatory scope of rules with the aim of clarifying the interface between rules and architecture.



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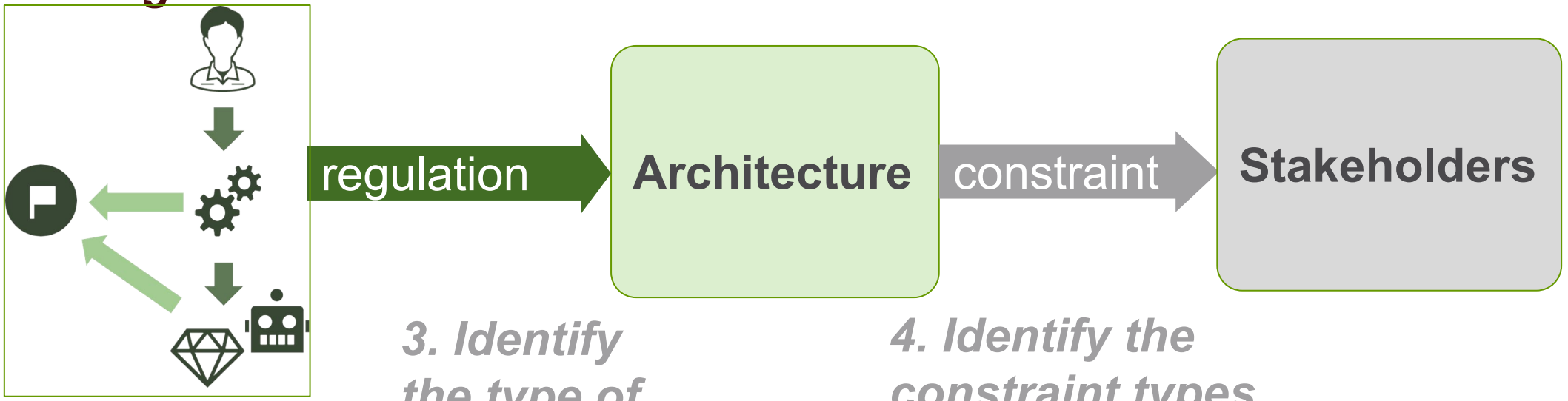
1. Classify the objects that the rule regulates

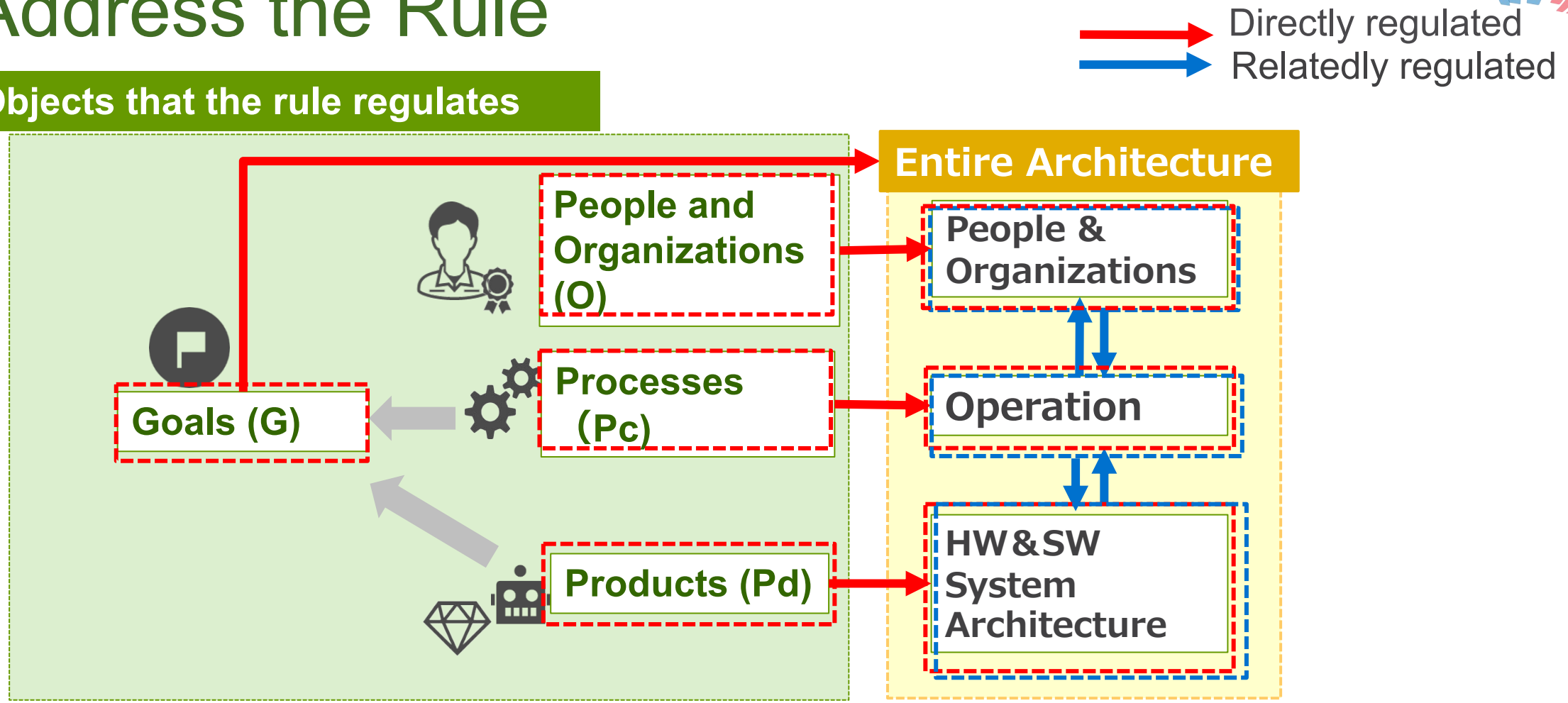
2. Identify the architectural elements that address the rule



3. Identify the type of regulation

4. Identify the constraint types imposed by the architecture

2. Identification of the Architectural Elements that Address the Rule



Identifies not only the elements that directly address the regulation, but also the elements that are needed in connection with achieving regulatory compliance.

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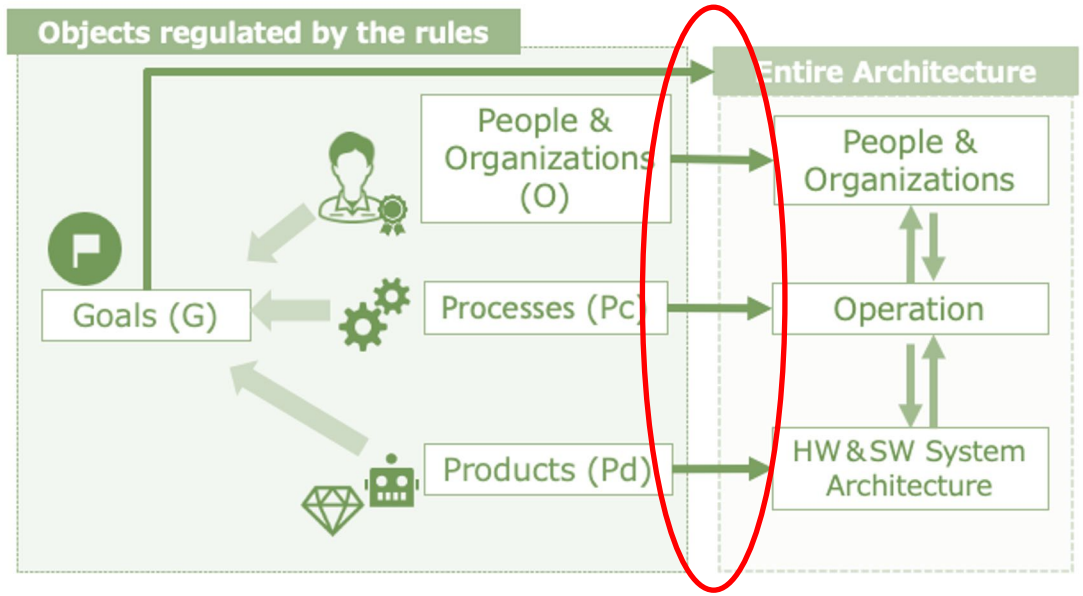


3. Identify the type of regulation

constraint

Stakeholders

4. Identify the constraint types imposed by the architecture

3. Identification of the Types of Regulation

Regulation on architecture by rules can be obligatory or prohibited.

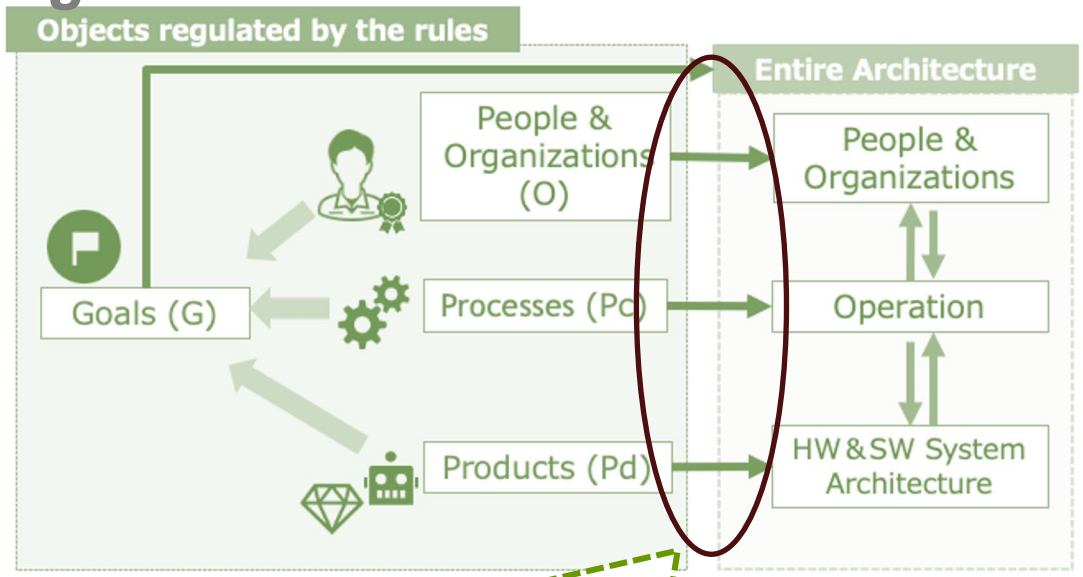
Type of Regulation	Explanation
Obligation	Something that the system must do, and there are corresponding elements in the architecture.
Prohibition	Something that the system must not do, and no corresponding element is allowed in the architecture.

Conditional obligations and prohibitions may also not contain elements that correspond to the architecture. In such cases, the visualization method should be the same as the treatment for prohibitions.

Overview of Visualization Method

1. Classify the objects that the rule regulates

2. Identify the architectural elements that address the rule



constraint

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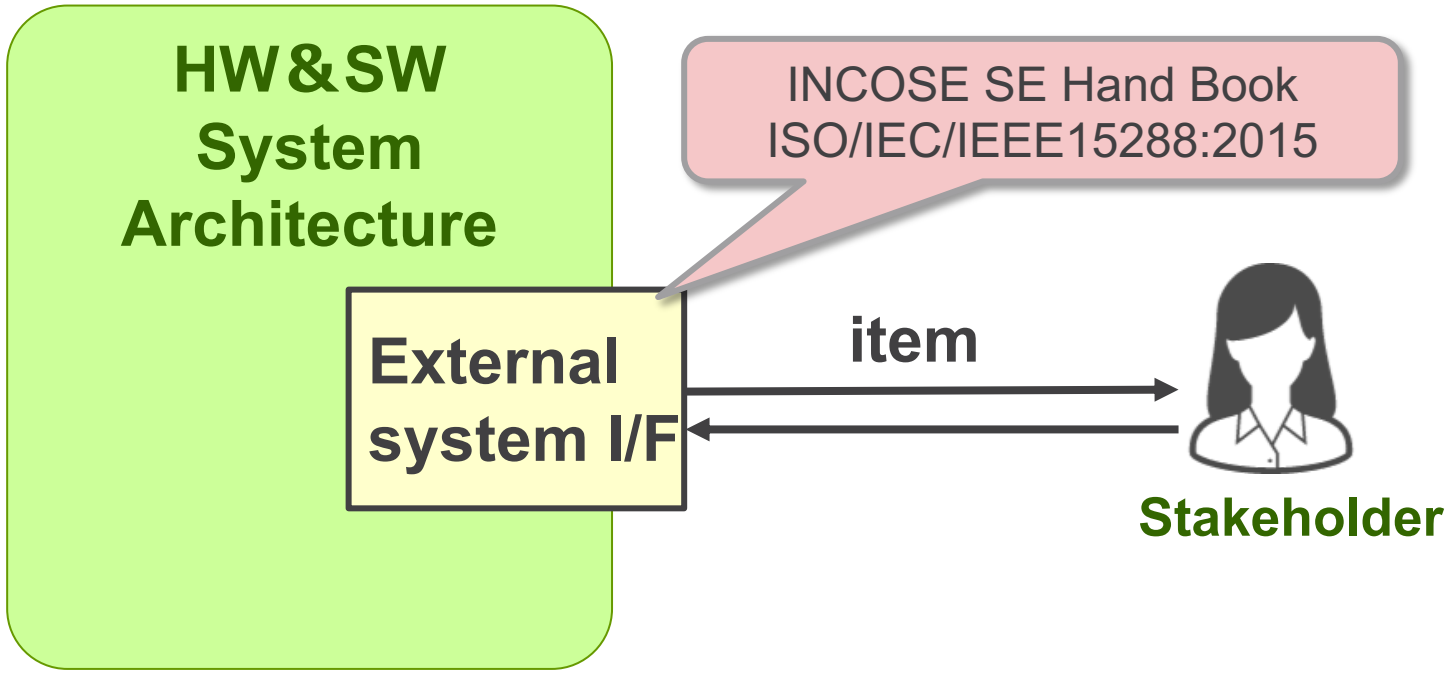
4. Identification of the Constraint Types Imposed by the Architecture ①

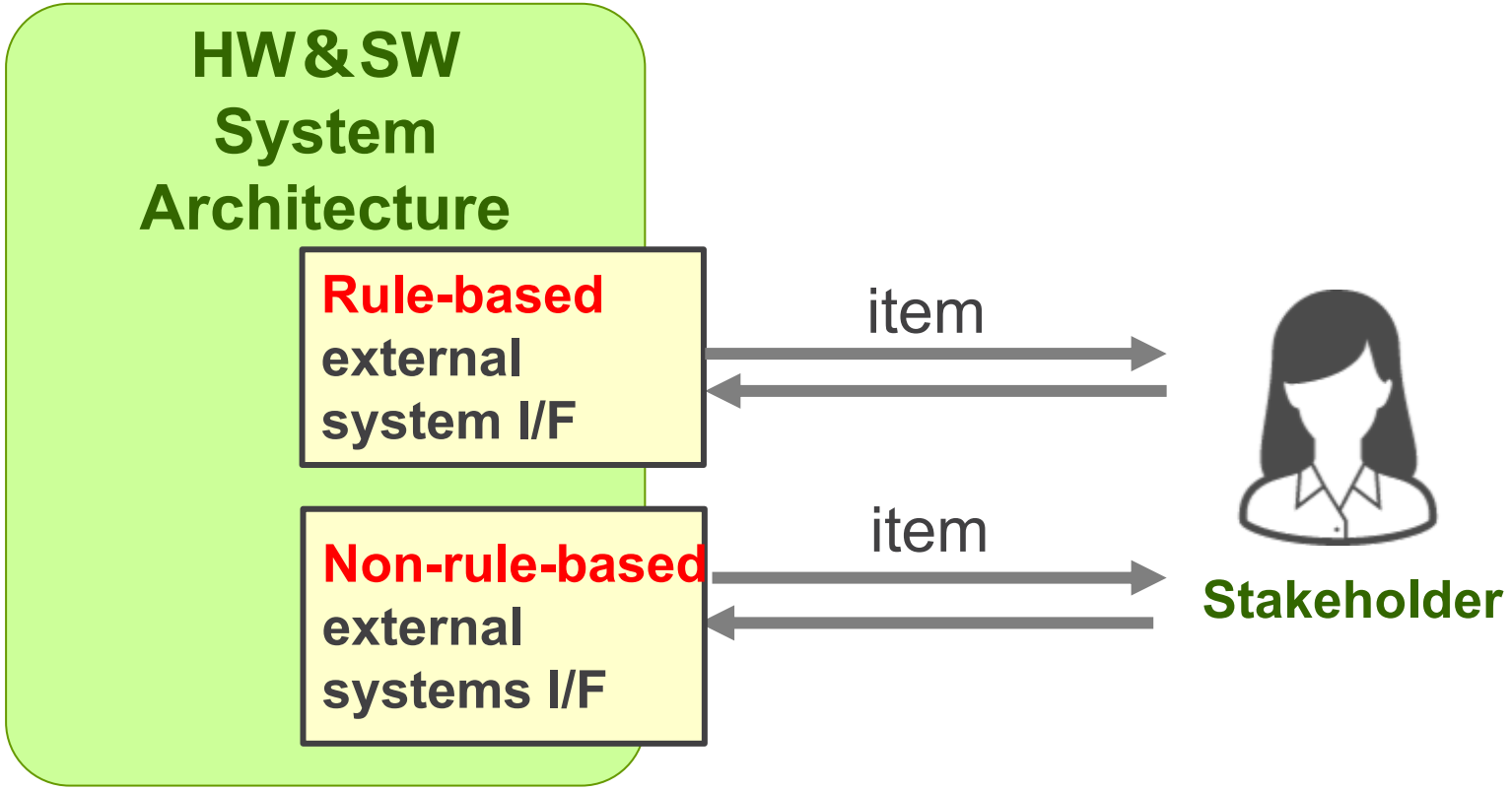
Regulation by architecture has the property of "Operable physicality " [Matsuo 2008].
There is a physical interface between the architecture and the external system.



The constraint on stakeholder behavior by the architecture is performed through the External system IF

4. Identification of the Constraint Types Imposed by the Architecture ②

Identify external system interfaces that are rule-based and those that are not rule-based (i.e., uniquely configured by the system engineer).



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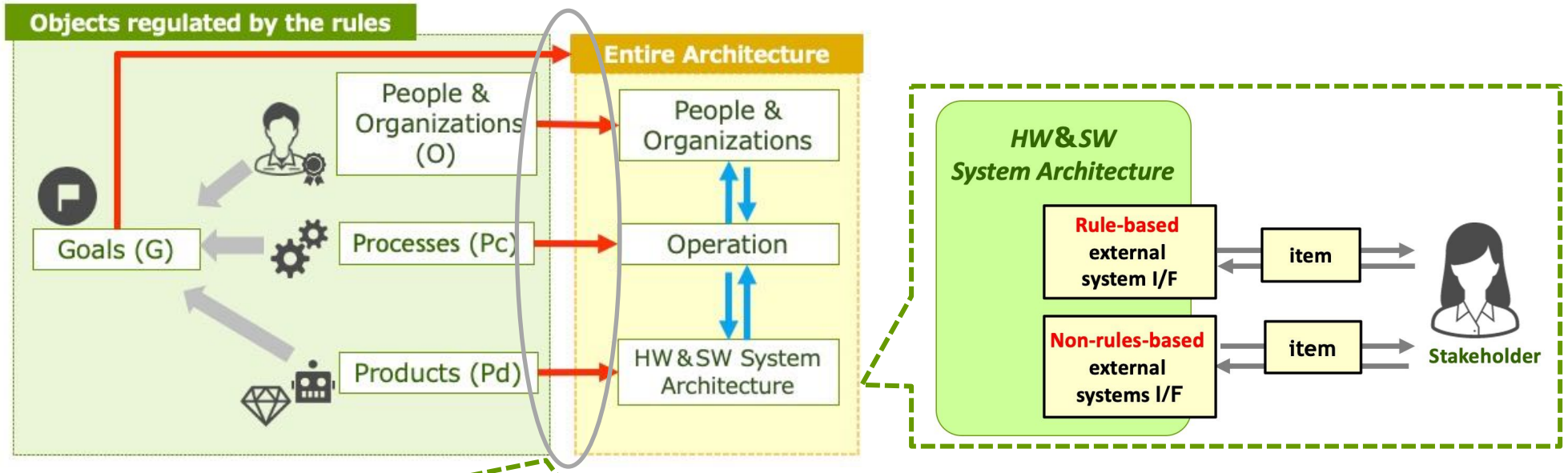

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4. Identify the constraint types imposed by the architecture

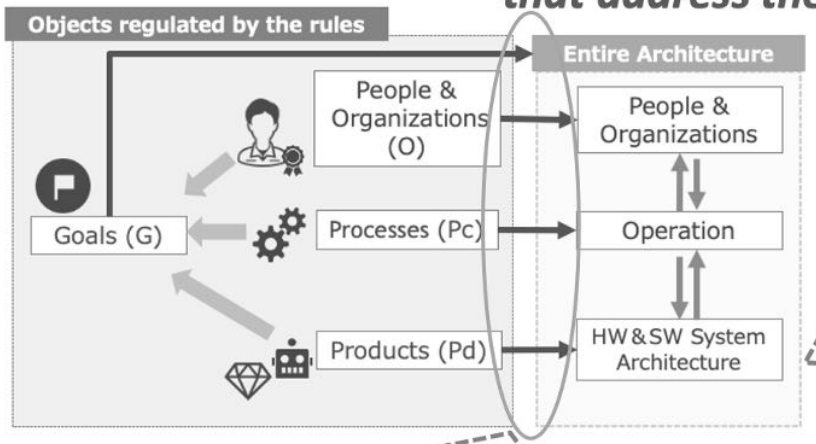
Descriptions Corresponding to the Visualization Concept

A. Rule Classification Table

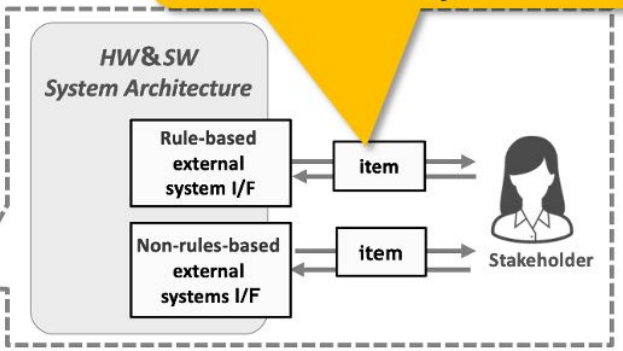
B. Descriptions that distinguish the elements that correspond to the regulations

1. Classify the objects that the rule regulates

2. Identify the architectural elements that address the rule



D. Description of the type of external system interface



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4. Identify the constraint types imposed by the architecture

C. Notes on Prohibition

E. Rule Traceability Matrix
(As a summary)

Example of Description in an Electronic Money System

Overview of Description

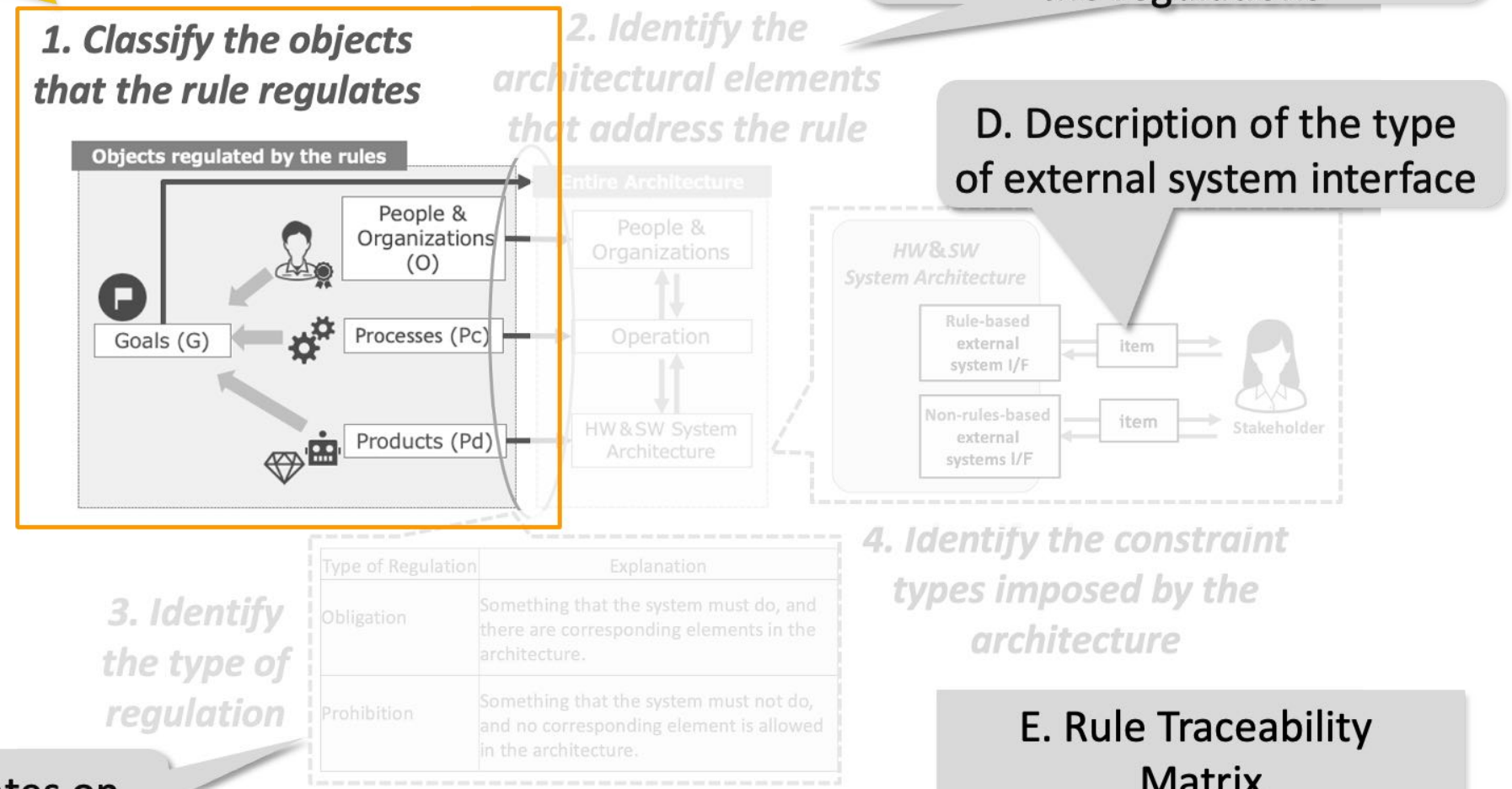
A. Rule Classification Table

B. Descriptions that distinguish the elements that correspond to the regulations

D. Description of the type of external system interface

C. Notes on Prohibition

E. Rule Traceability Matrix
(As a summary)



Example Description (A)

Rule Classification Table

Classify what the rule regulates and the regulation type.

※The information here is an example.

ID	Type	Rule
People & Organization		
O1	Obligation	There should be a Department in charge of displaying the obligations under Article 13 of the Act.
O2	Obligation	A department in charge of system administration is needed.
Process		
Pc1	Conditional Obligation	If the books are prepared electronically, be prepared to restore the books in the event of data damage by taking backups at regular intervals.
Pc2	Conditional Prohibition	A provision that individual users' sensitive information will not be used, except in the cases mentioned under Article 6, paragraph 1 of the Act's guidelines for protection.
Pc3	Obligation	Develop appropriate and sufficient controls for data protection, data misuse prevention, and fraud prevention measures.
Product		
Pd1	nditional	In the case of prepaid means of payment that use paper, IC cards, etc., the information specified in each item of Article 13, paragraph 1 of the Act is described in the document her things without omission.

Regulation type

What the rules regulate

Overview of Description

A. Rule Classification Table

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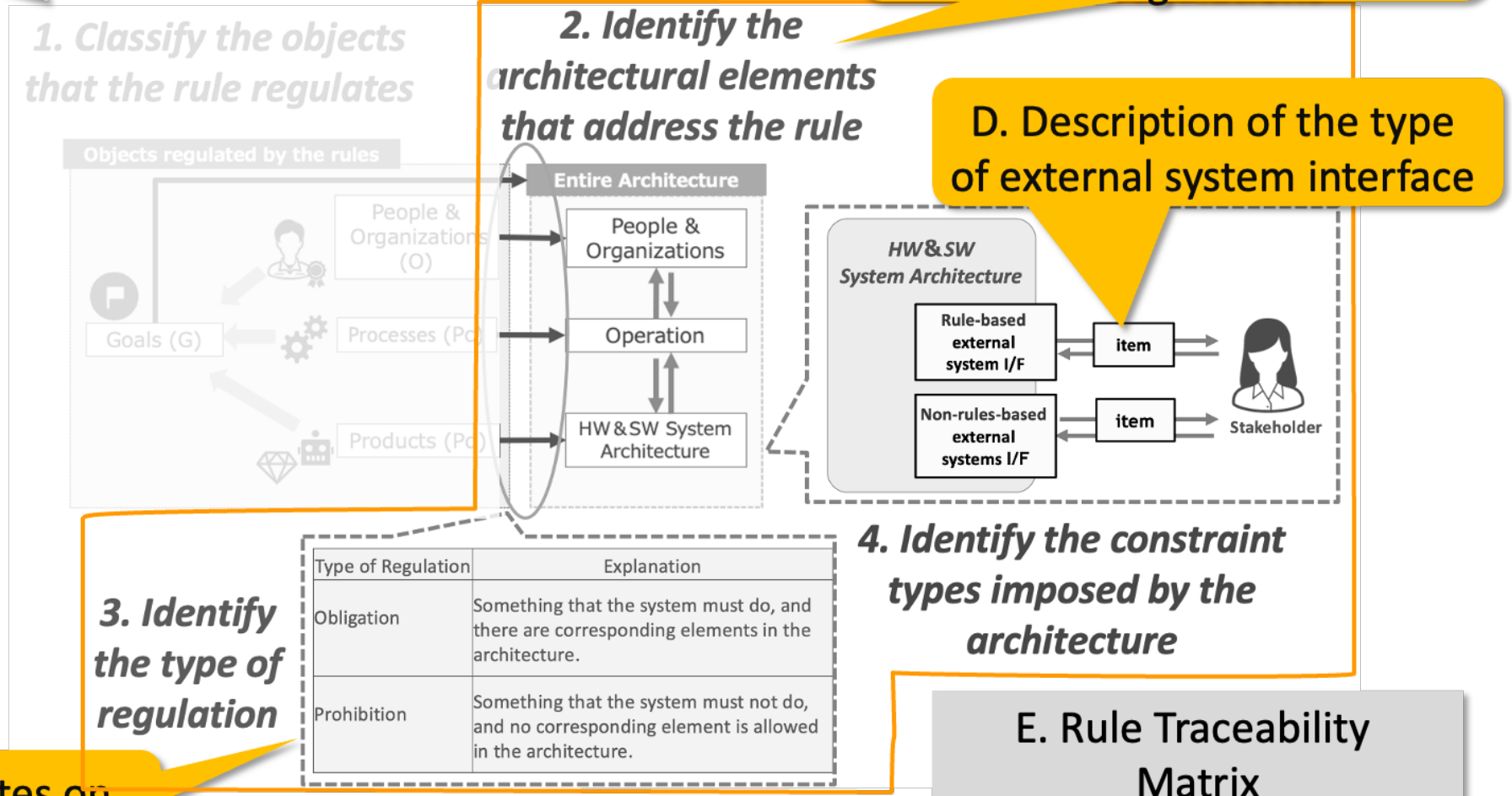
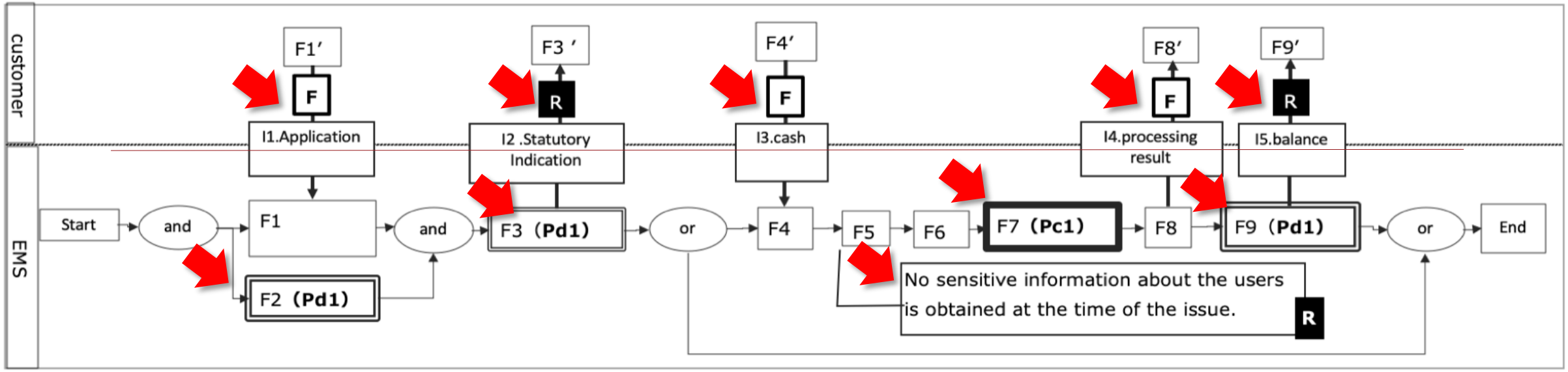


C. Notes on Prohibition

E. Rule Traceability Matrix
(As a summary)

Example Description（B～D）

For architecture descriptions expressed in blocks, such as FFBD, the expression of the targeted block is changed.
Check whether the rule-based description is correctly handled, whether the design of the non-rule-based description is appropriate, and whether the IF method and the content to be passed are appropriate.



B. Highlighting architectural elements addressed the regulation

C. Notes that do not Include prohibitions of the architecture

D. A notation that identifies the external interface types

Example Description（B）

Highlighting Architectural Elements Addressed the Regulation

【Legend】

Element A

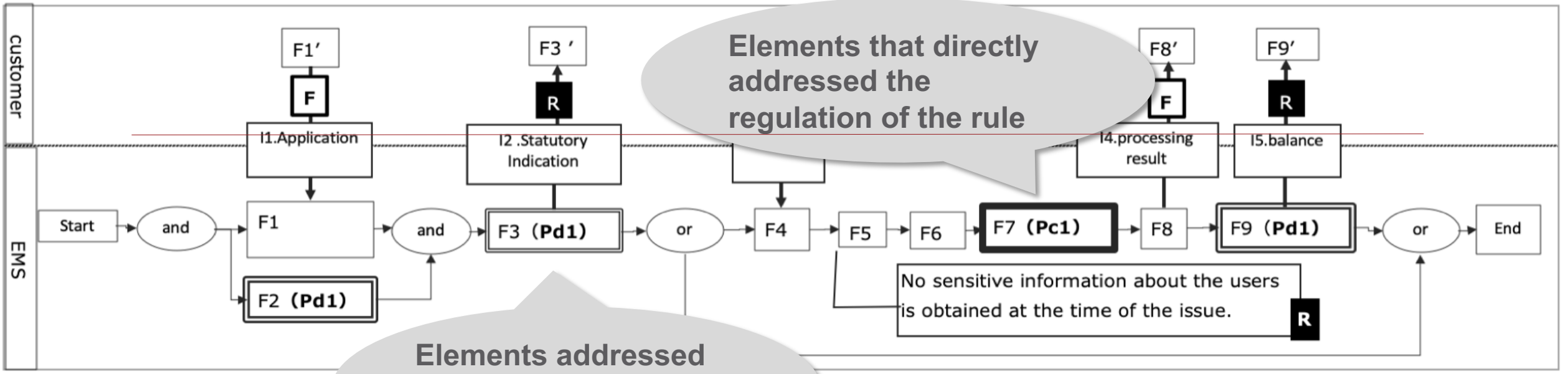
①*normal elements*

Element A

②**Elements directly addressed**（thick line）

Element A

③ **Elements relatedly addressed**（double line）



Example Description（C）

Notes that do not Include Prohibitions of the Architecture

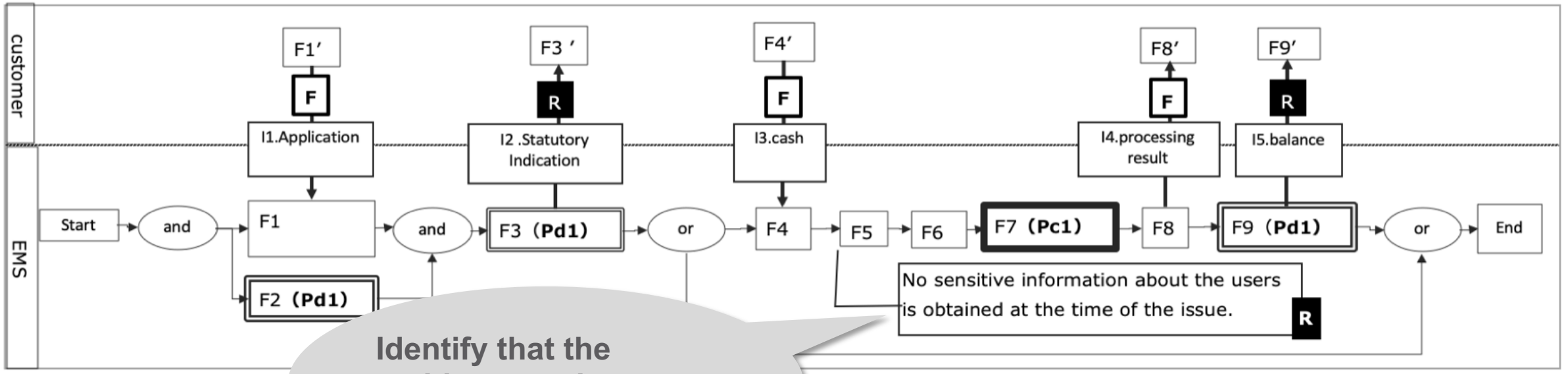
①Note if there are related elements in the architecture description

Note (Rule ID) R

Elements related to regulation

②Note in case there is no related element in the architecture description

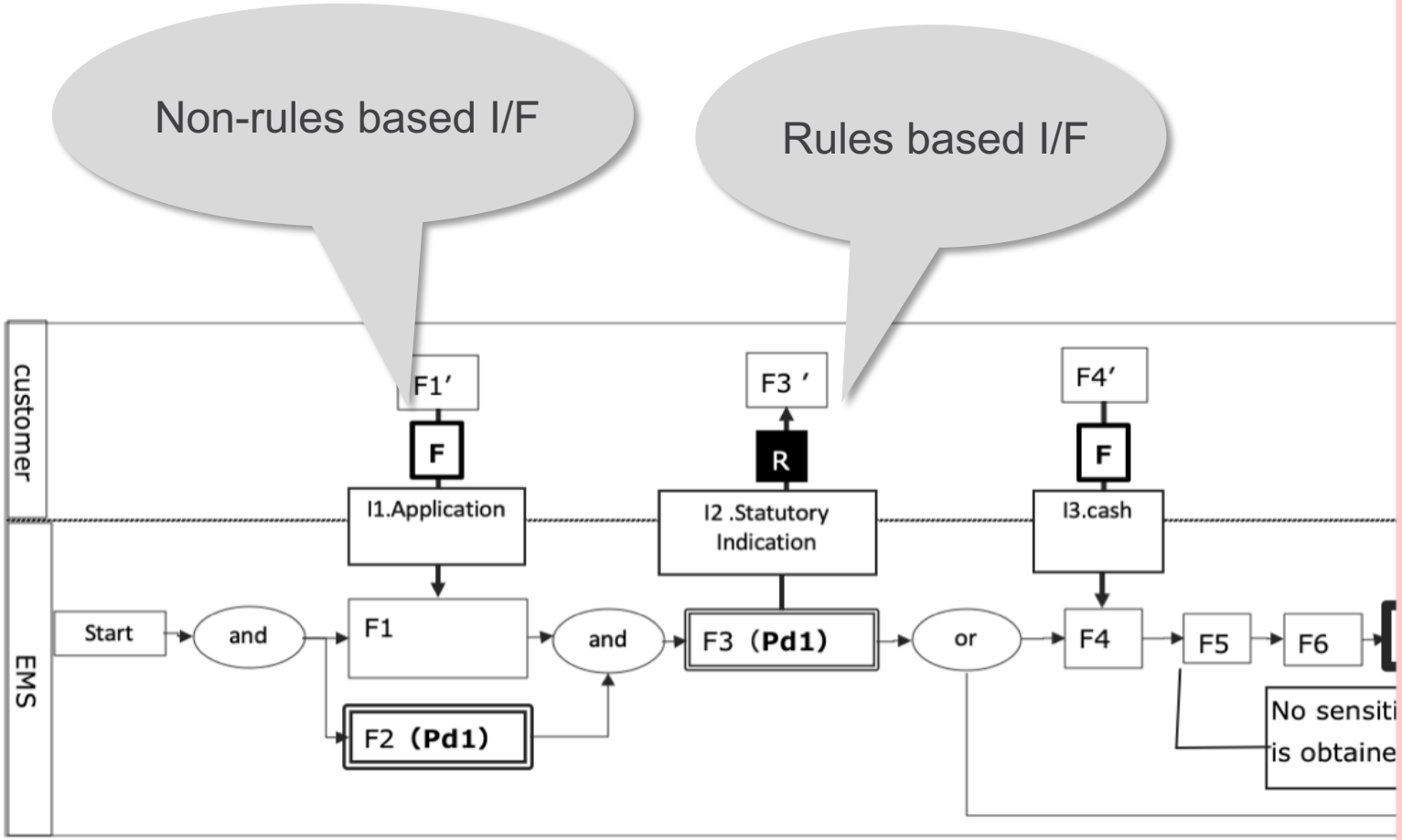
Note on the view that there are no prohibited elements (rule ID) R

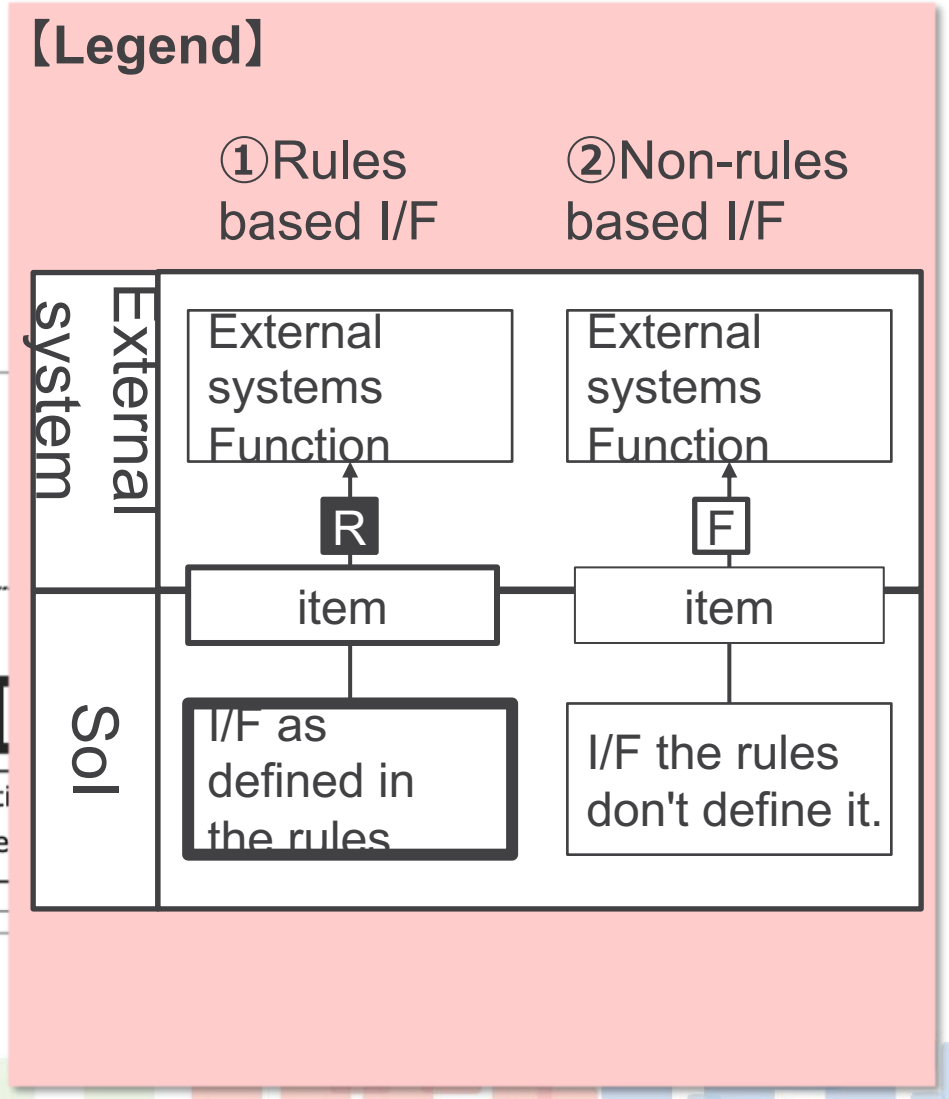


Identify that the architecture does not contain prohibitions

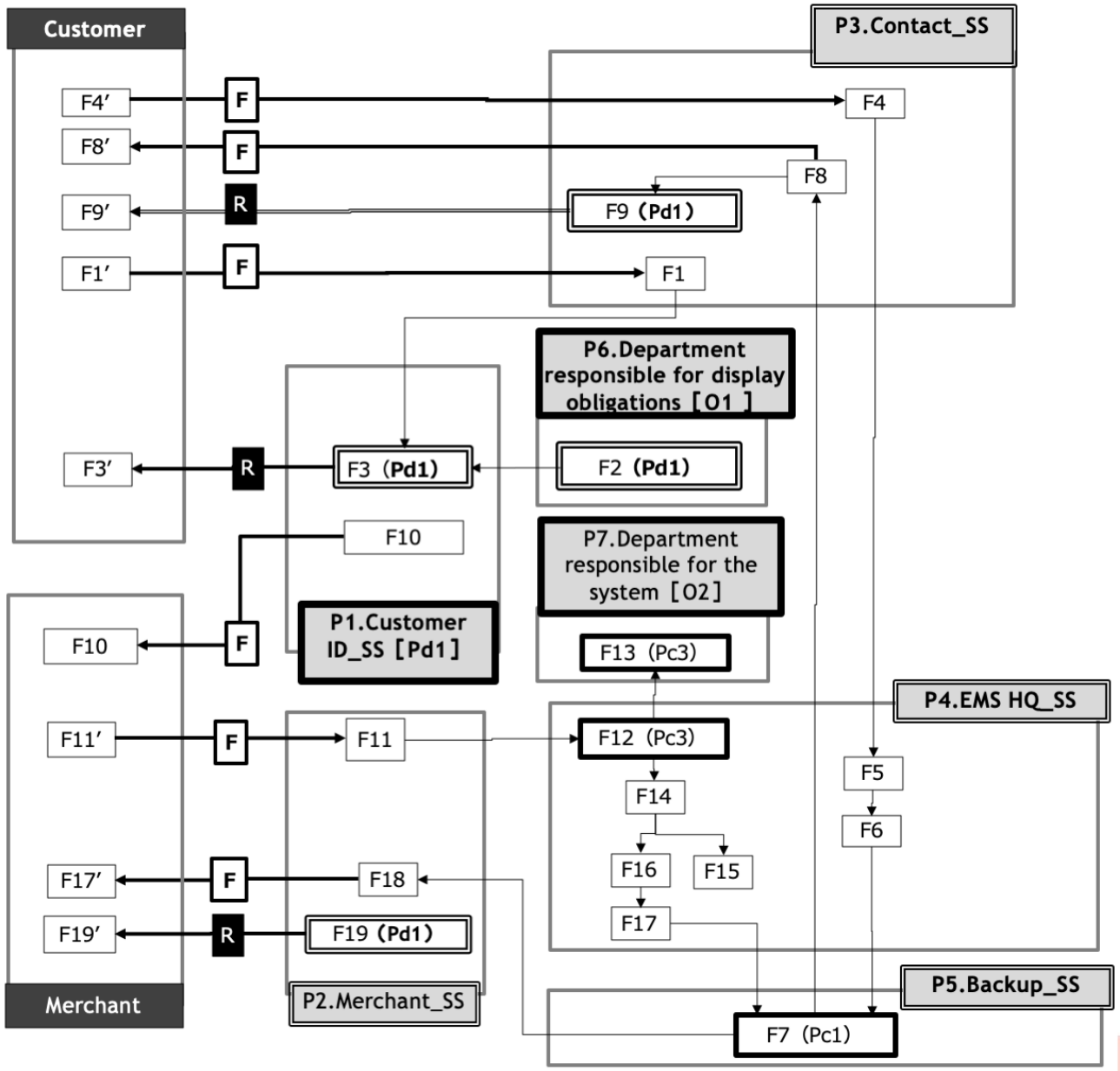
Example Description（D）

External System Interface Type





Examples of Other Diagram（B～D）



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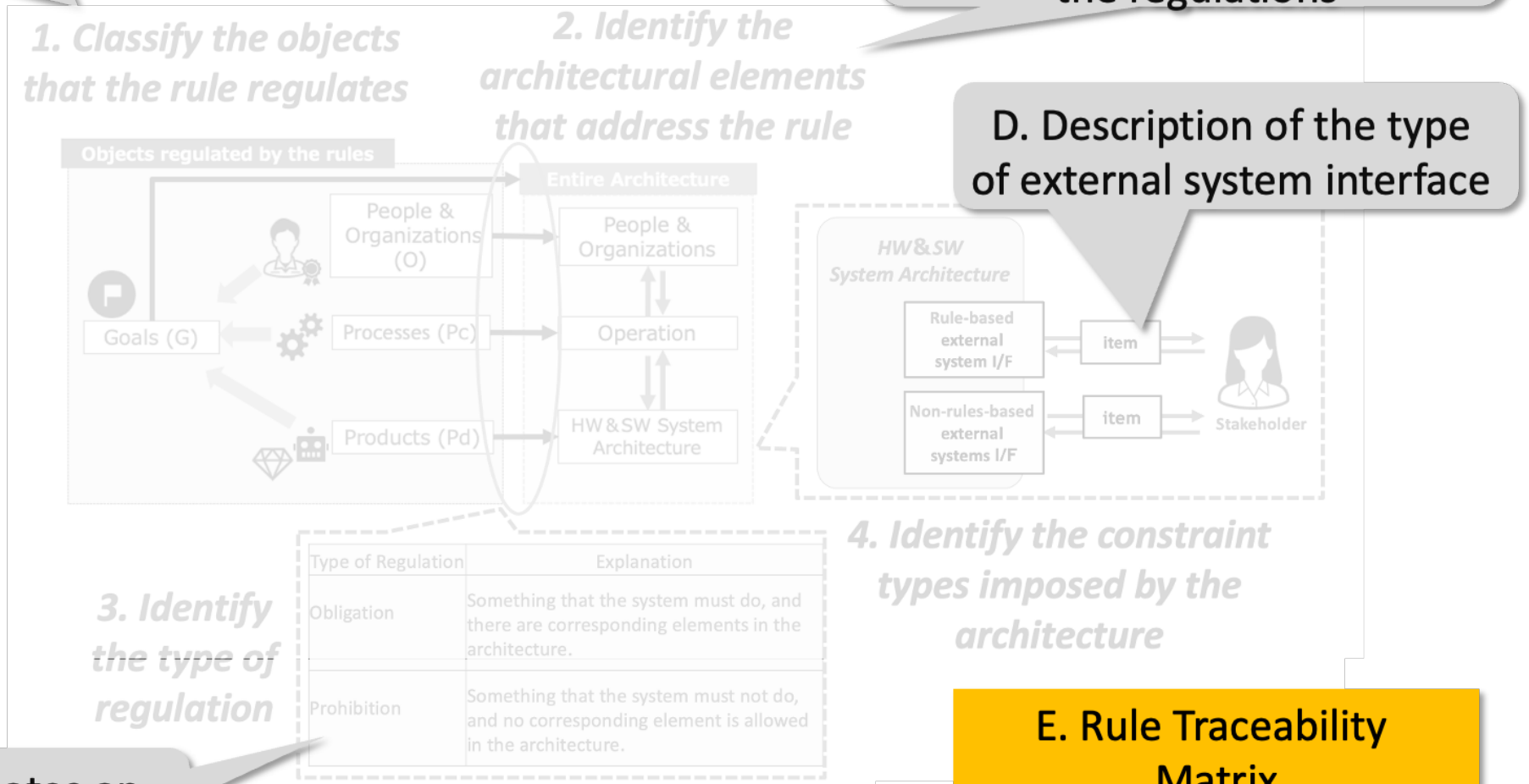
D. Description of the type of external system interface



C. Notes on Prohibition

E. Rule Traceability Matrix (As a summary)

Example Description(E)

Rule Traceability Matrix

Check the matrix to see which elements corresponded to the rules.

Rule ID	Type	Function								Physical						
		F2	F3	F5	F7	F9	F12	F13	F19	P1	P2	P3	P4	P5	P6	P7
People & Organization																
O1	Obligation														D	
O2	Obligation															D
Process																
Pc1	Conditional Obligation				D									R		
Pc2	Conditional Prohibition			N												
Pc3	Obligation						D	D					R			R
Product																
Pd1	Conditional Obligation	R	R			R			R	D	R	R			R	

D：Directly regulated　　R：Relatedly regulated　　N：Note of Prohibition

Expert Assessment of Usage Scenarios and Discussion

Evaluation by Experts

- Interviews were conducted with six legal experts and engineers for the purpose of validation.
- We asked whether the proposed method could be used to make users aware of the restrictions they might suffer and the lack of deviations from laws and regulations.

Legal experts			Engineers		
Administrative Officer (Law Examiner)	Lawyer	In-house General Counsel	IT Systems Engineer	Engineer in the field of road design	Engineer in the field of remote sensing
Regulatory side, rule-making perspective	**Perspectives on rule application and operation**	**Regulated Side Business perspective**	**Experience with legal revisions System development experience**	**Experience in public works contracting**	**Experience in new business development**

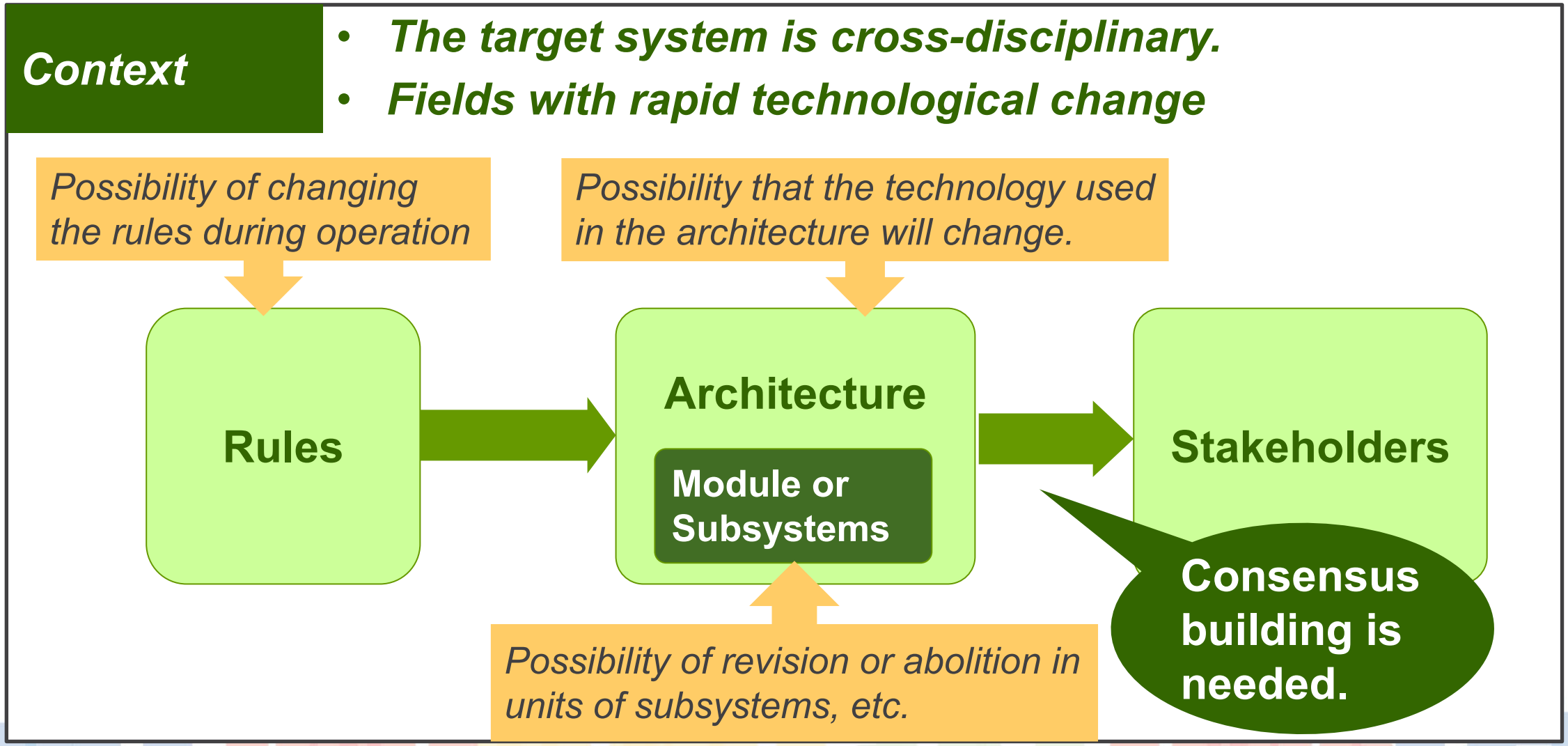
Research Outline and Sample Descriptions

Evaluation Results

Evaluator	effectiveness	comment
Administrative Officer	○	It is good to define a structure to show that thinking about a goal can be accomplished in other ways.
Lawyer	○	It's really good for clarifying issues. It helps me to identify problems and to recognize things that I have not recognized before, so I can eliminate omissions.
General Counsel	○	I think the best people did it intuitively. Putting it into form is good.
IT Systems Engineer	×	I have been dealing with laws and regulations in the work flow and have been able to deal with them, so there is no need for a proposal method.
Engineer in the field of remote sensing	○	I think it is effective in explaining to stakeholders and getting their understanding when there is a legal gray area in a new business.
Engineer in the field of road design	○	For example, it might be a good idea to be able to distinguish between the range designed according to the law and the range modified by the guidance of the regulatory authority.

Discussion

Based on the evaluation results, summarize the characteristics of cases where the effectiveness of the proposed method is suggested.



Conclusion

[Objectives of this study]

- Propose a method to Visualize the Relationship between Regulations and Architectural Constraints.

[Evaluation]

- The effectiveness was suggested for the proposed method by the legal and engineering experts through the interviews.

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