Towards Semi-Automatic Identification of Functional Requirements in Legal Texts for Public Administration

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Introduction

● Public administration has a lot of legal based systems

E.g.) Employment Security System

Public Employment Security Office

Employment Security System
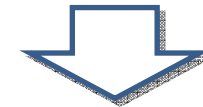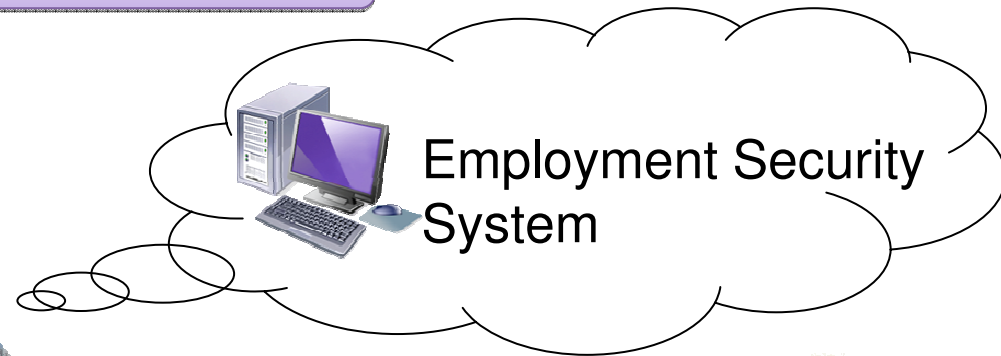
Legal basis
Employment Insurance Act, etc.

What if these laws are amended ?

Research Question

- Existing systems need to be modified in order to comply with laws in the short time before the laws are issued

- On the other hand, legal texts are written in natural language, have a lot of articles, and include complicated modifications

RQ： How can functional requirements be identified correctly and fully in a short time?

Legal texts
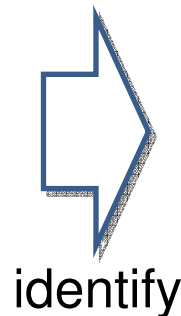
identify

Functional requirements

Approach(1/2)

● We propose the following two phases to identify the functional requirements from legal texts

1. Legal text summarization

1.1 Legal text summarization

Legal text summarization syntax to grasp the gist of legal text and to improve the efficiency of the elicitation of functional requirements

1.2 Support tool (SUMMARIZE function)

This function can create a summary of legal texts according to the above Syntax

Approach(2/2)

2. Use of templates

2.1 Templates

Three types of pre-defined templates to elicit the functional requirements
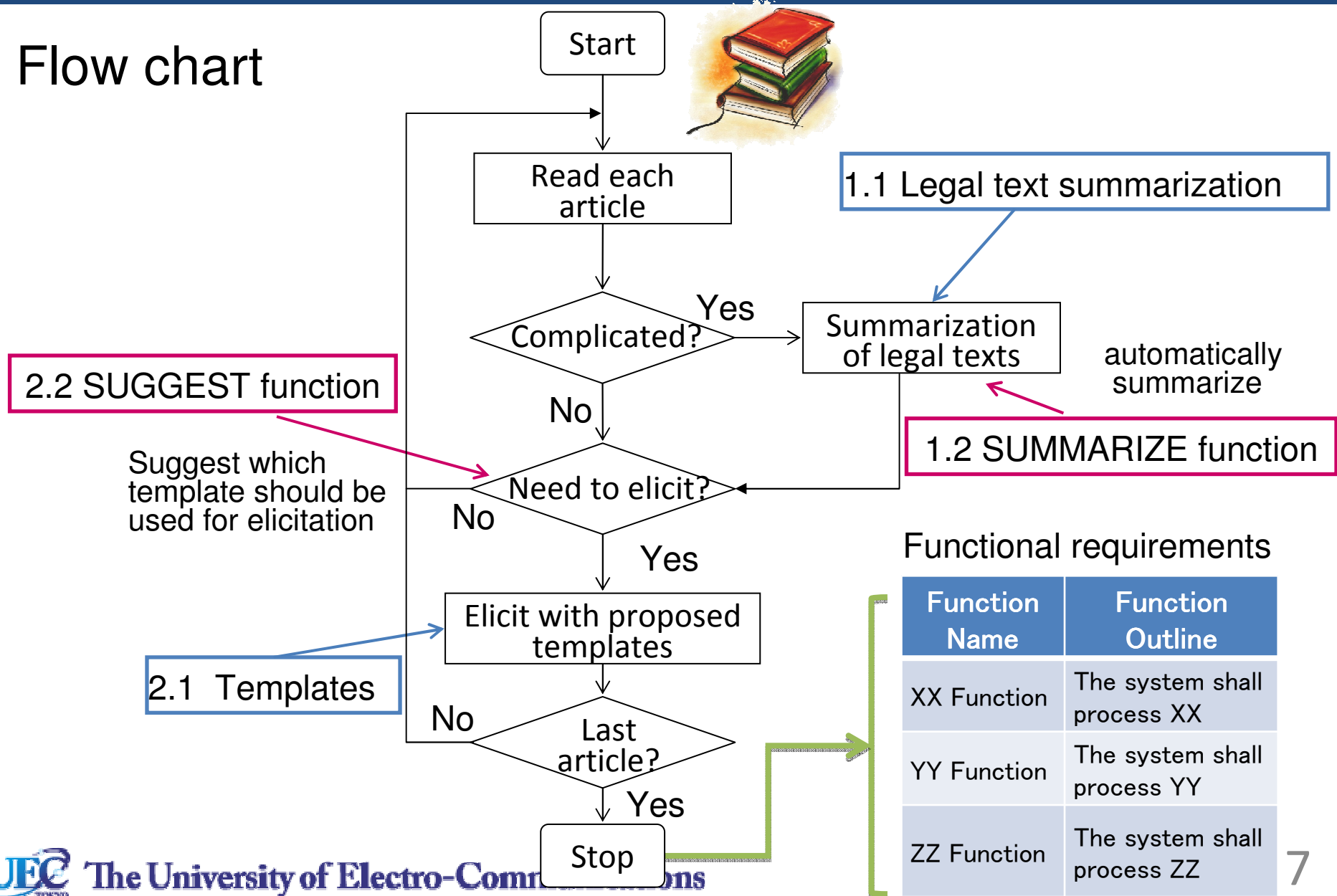
2.2 Support tool (SUGGEST function)

This function suggests which template should be used to elicit the functional requirements from which article

● **Possible users of this approach**
  ➢ Civil servants in charge of documentation of procurement specification regarding system development

  ➢ Consultants who support them

Overall Identification Process

Flow chart

Start

Read each article

1.1 Legal text summarization

Complicated? — Yes → Summarization of legal texts

automatically summarize

2.2 SUGGEST function

No

Suggest which template should be used for elicitation

No ← Need to elicit? ← 1.2 SUMMARIZE function

Yes

Elicit with proposed templates

2.1 Templates

No ← Last article?

Yes

Stop

Functional requirements

| Function Name	Function Outline
XX Function	The system shall process XX
YY Function	The system shall process YY
ZZ Function	The system shall process ZZ

1.1 Legal text summarization(1/3)

- Legal texts are written in natural language, have a lot of articles, and include complicated modifications

- We propose the syntax for legal text summarization, focusing on the concept of "use case" defined in UML (Unified Modeling Language)

- "Use case" is a framework to capture system requirements
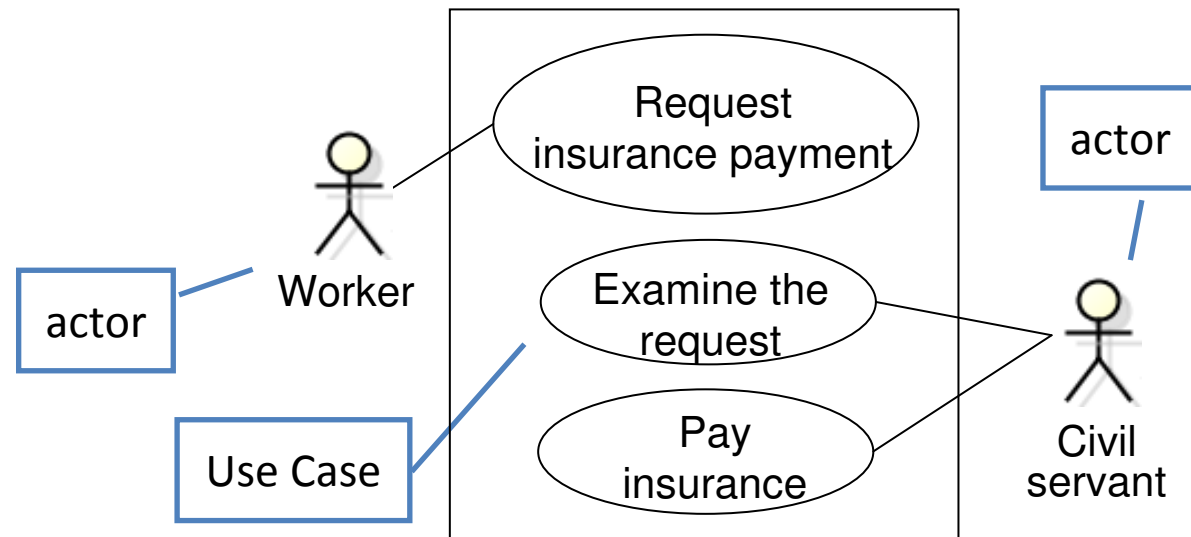
Payment of Employment Insurance

- This framework can translate into natural language

Subject (*S*) + **Verb (*V*) + Object (*O*)**

**= Actor** **= Use case**

1.1 Legal text summarization(3/3)

● We can obtain the gist of each article by replacing the legal texts with this syntax

Subject (_S_) + **Verb (_V_) + Object (_O_)**
= Actor   **= Use case**

Employment Insurance Act

(Confirmation)
Article 9 Confirmation of the fact that workers have become insured persons or the fact that workers have ceased to be insured persons (S) shall be made (V) by the Minister of Health, Labour and Welfare (M) based on a notification under the provision of Article 7 or a demand under the provision of the preceding Article, or on his/her authority (M).
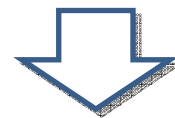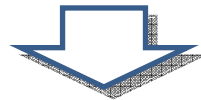
⬇ Summarization

Minister of Health, Labour and Welfare (S) shall confirm (V) the fact that workers have become insured persons or the fact that workers have ceased to be insured persons (O).

Can the summary be automatically translated?

SUMMARIZE function

● This function uses morphemically analyzed legal texts and decides the subject, verb, and object according to the appearance pattern of the parts of speech

Subject (*S*) + Verb (*V*) + Object (*O*)

Subject

Employment Insurance Act article 3

雇 用 保 険 は 、 第一条の目的を達成するため、失業等給付を行うほか、雇用安定事業及び能力開発事業を行うこと ができる。

■ Application result of the SUMMARIZE function

Employment Insurance Act

Article 7　事業主（徴収法第八条第一項又は第二項の規定により元請負人が事業主とされる場合にあつては、当該事業に係る労働者のうち元請負人が雇用する労働者以外の労働者については、当該労働者を雇用する下請負人。以下同じ。）は、厚生労働省令で定めるところにより、その雇用する労働者に関し、当該事業主の行う適用事業（同条第一項又は第二項の規定により数次の請負によつて行われる事業が一の事業とみなされる場合にあつては、当該事業に係る労働者のうち元請負人が雇用する労働者以外の労働者については、当該請負に係るそれぞれの事業。以下同じ。）に係る被保険者となつたこと、当該事業主の行う適用事業に係る被保険者でなくなつたことその他厚生労働省令で定める事項を厚生労働大臣に届け出なければならない。(後略)
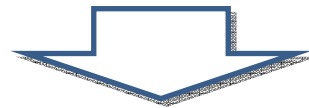
Summarization

　事業主は(S)、当該事業主の行う適用事業に係る被保険者となつたこと、当該事業主の行う適用事業に係る被保険者でなくなつたことその他厚生労働省令で定める事項を(O)厚生労働大臣に届け出なければならない(V)。

1.2 Support tool: SUMMARIZE(3/3)
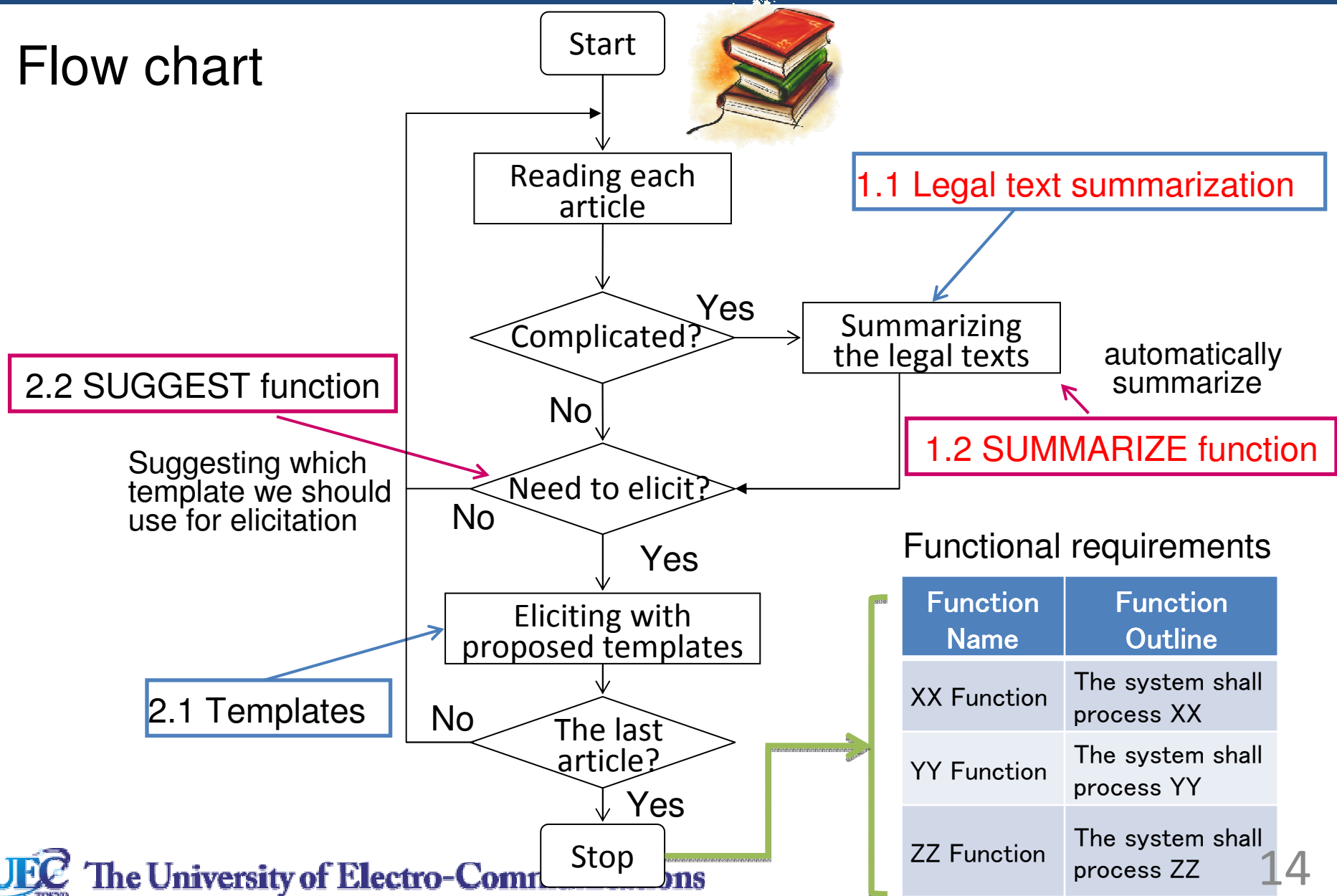
■ **Advantage of this function**

✓ This function enables summarizing the legal text with less discomfort by using peculiar word orders seen in Japanese legal texts

2.1 Templates(1/6)

Flow chart

```
Start
  ↓
Reading each article
  ↓
Complicated? ──Yes──→ Summarizing the legal texts
  │No                        ↓
  ↓                    (1.1 Legal text summarization)
Need to elicit? ←── (1.2 SUMMARIZE function, automatically summarize)
  │                    ↑No
  │Yes
  ↓
Eliciting with proposed templates
  ↓
The last article? ──No──→ (loop back)
  │Yes
  ↓
Stop
```

1.1 Legal text summarization

automatically summarize

1.2 SUMMARIZE function

2.2 SUGGEST function

Suggesting which template we should use for elicitation

No

No

Yes

2.1 Templates

No

Functional requirements

Function Name	Function Outline
XX Function	The system shall process XX
YY Function	The system shall process YY
ZZ Function	The system shall process ZZ

2.1 Templates(2/6)

● We propose the following three templates

- Data Identification Template

- Function Identification Template

- Term Identification Template

● Why do we need three templates?

✓ Legal texts are written in natural language and there are no considerations regarding computer systems

Therefore, we focused on following the typical computer systems process to develop its templates

| Input Data | → | Processing & Output data (Function) |

✓ A number of terms are defined in the legal texts

Legal texts

- **Data** Identification Template

  > [ID], [Article Number], [Article Title],
  > The [actor] (modal verb) [action] [data] to the system from [data source] when [conditions occurred].

- **Function** Identification Template

  > [ID], [Article Number], [Article Title],
  > The system (modal verb) [process] when [conditions occurred]

- **Term** Identification Template

  > [ID], [Article Number], [Article Title], [Term] , [Definition]

Note: Bracketed items in the templates are the elements and those definitions are defined as guidelines in the paper. See Table 2.

Example of Elicitations Using Templates

- Case shows developing the system for public administration in regard to Employment Insurance Act

> **Employment Insurance Act**
>
> (Recognition of Unemployment)
> Article 15 (1) The basic allowance shall be paid with regard to the days on which a person who has recipient qualifications (hereinafter referred to as a "qualified recipient" except in the following Section to Section 4 inclusive) is unemployed.
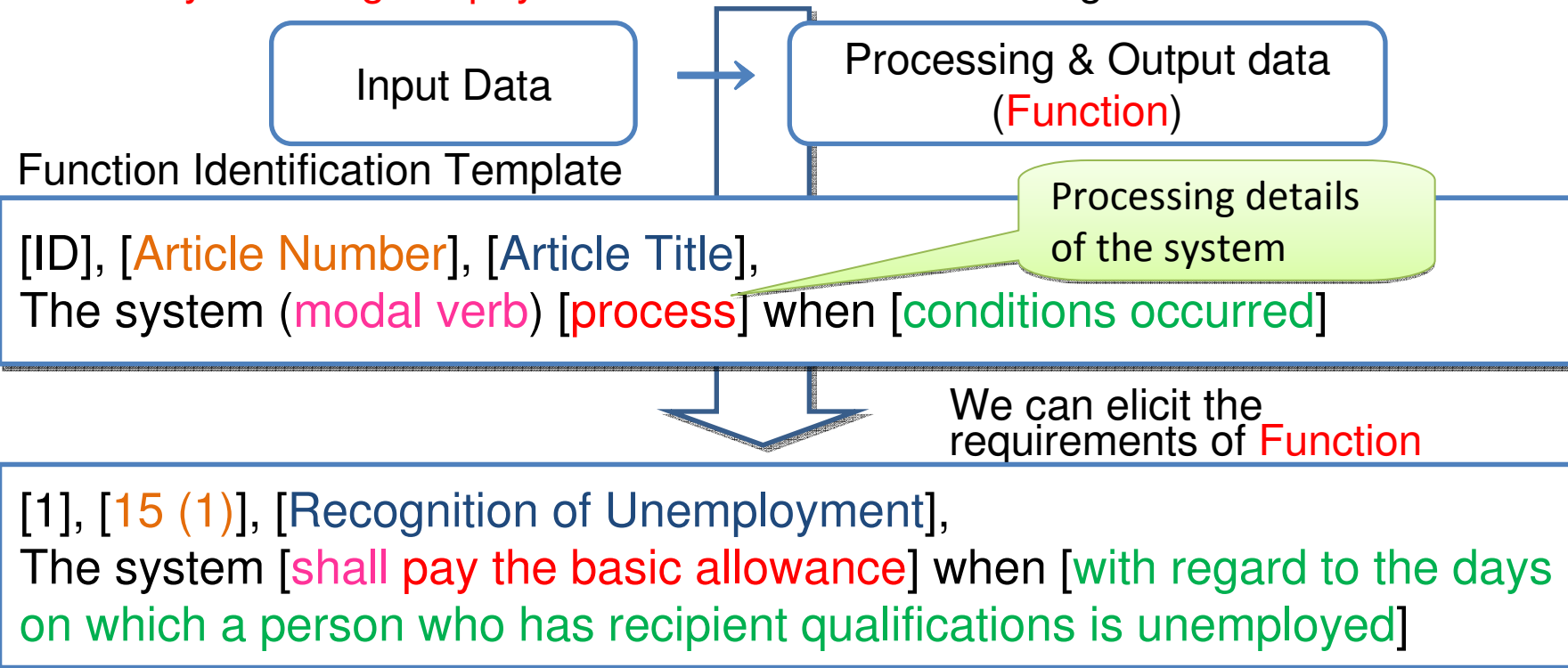
2.1 Templates(5/6)

Employment Insurance Act

(Recognition of Unemployment)
Article 15 (1) The basic allowance shall be paid with regard to the days on which a person who has recipient qualifications (hereinafter referred to as a "qualified recipient" except in the following Section to Section 4 inclusive) is unemployed.

Systemizing the payment will be more time-saving and effective

Input Data → Processing & Output data (Function)

Function Identification Template

Processing details of the system

[ID], [Article Number], [Article Title],
The system (modal verb) [process] when [conditions occurred]

We can elicit the requirements of Function

[1], [15 (1)], [Recognition of Unemployment],
The system [shall pay the basic allowance] when [with regard to the days on which a person who has recipient qualifications is unemployed]

Function Identification Template

Template's elements

ID	Article Number	Article Title	process	conditons
1	§ 164.512(f)(1)	Permitted disclosures: Pursuant to process and as otherwise required by law.	may disclose protected health information	(i) As required by law including laws that require the reporting of certain types of wounds or other physical injuries, except for laws subject to paragraph (b)(1)(ii) or (c)(1)(i) of this section; or (ii) In compliance with and as limited by the relevant requirements of: (A) A court order or court-ordered warrant, or a subpoena or summons issued by a judicial officer; (B) A grand jury subpoena; or
2	§ 164.512(f)(2)	Permitted disclosures: Limited information for identification and location purposes.	(i) The covered entity may disclose only the following information: (A) Name and address; (B) Date and place of birth; (C) Social security number; (D) ABO blood type and rh factor; (E) Type of injury; (F) Date and time of treatment; (G) Date and time of death, if applicable; and	law enforcement official's request for such information for the purpose of identifying or locating a suspect, fugitive, material witness, or missing person

Term template | Function template | Data template

Template type

We must read each article to
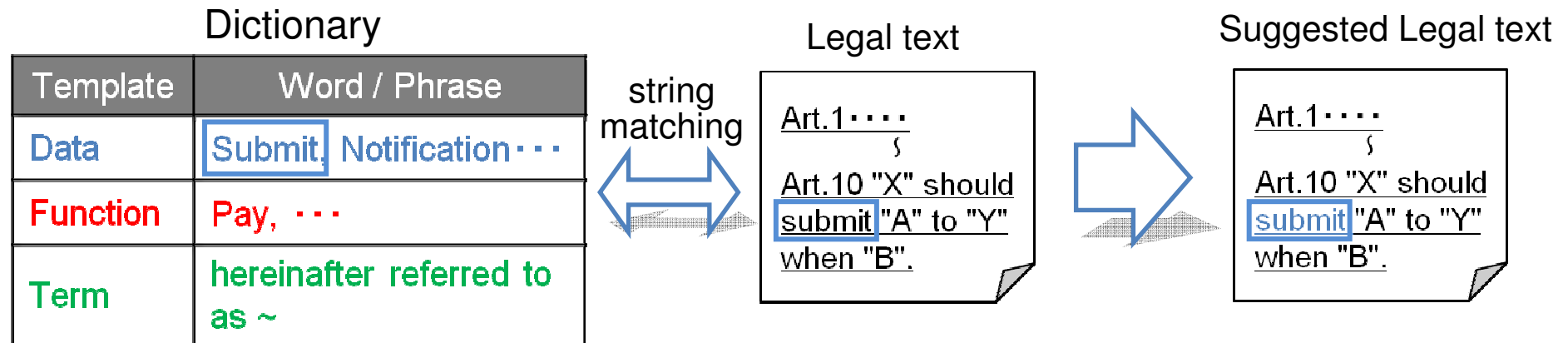decide which template should be used

SUGGEST function

● This function suggests the appropriate template to be used

2.2 Support tool: SUGGEST(2/4)

- This function compares legal texts with a manually edited dictionary using a string matching algorithm

- If a string in the legal text matches a word or phrase in the dictionary, this function will highlight the word or phrase in color according to its template type

Dictionary

Template	Word / Phrase
Data	Submit, Notification・・・
Function	Pay, ・・・
Term	hereinafter referred to as ~

string matching

Legal text

Art.1・・・・
〜
Art.10 "X" should submit "A" to "Y" when "B".

Suggested Legal text

Art.1・・・・
〜
Art.10 "X" should submit "A" to "Y" when "B".

This set of dictionaries was constructed with words or phrases that are specific to the "Employment Insurance Act" and the "Act on the Collection, etc., of Insurance Premiums of Labor Insurance"

2.2 Support tool: SUGGEST(3/4)

■ Application result of the SUGGEST function

Employment Insurance Act

(Recognition of Unemployment)
Article 15 (1) The basic allowance shall be paid with regard to the days on which a person who has recipient qualifications (hereinafter referred to as a "qualified recipient" except in the following Section to Section 4 inclusive) is unemployed.

This suggests that we should use Function Identification Template and Term Identification Template

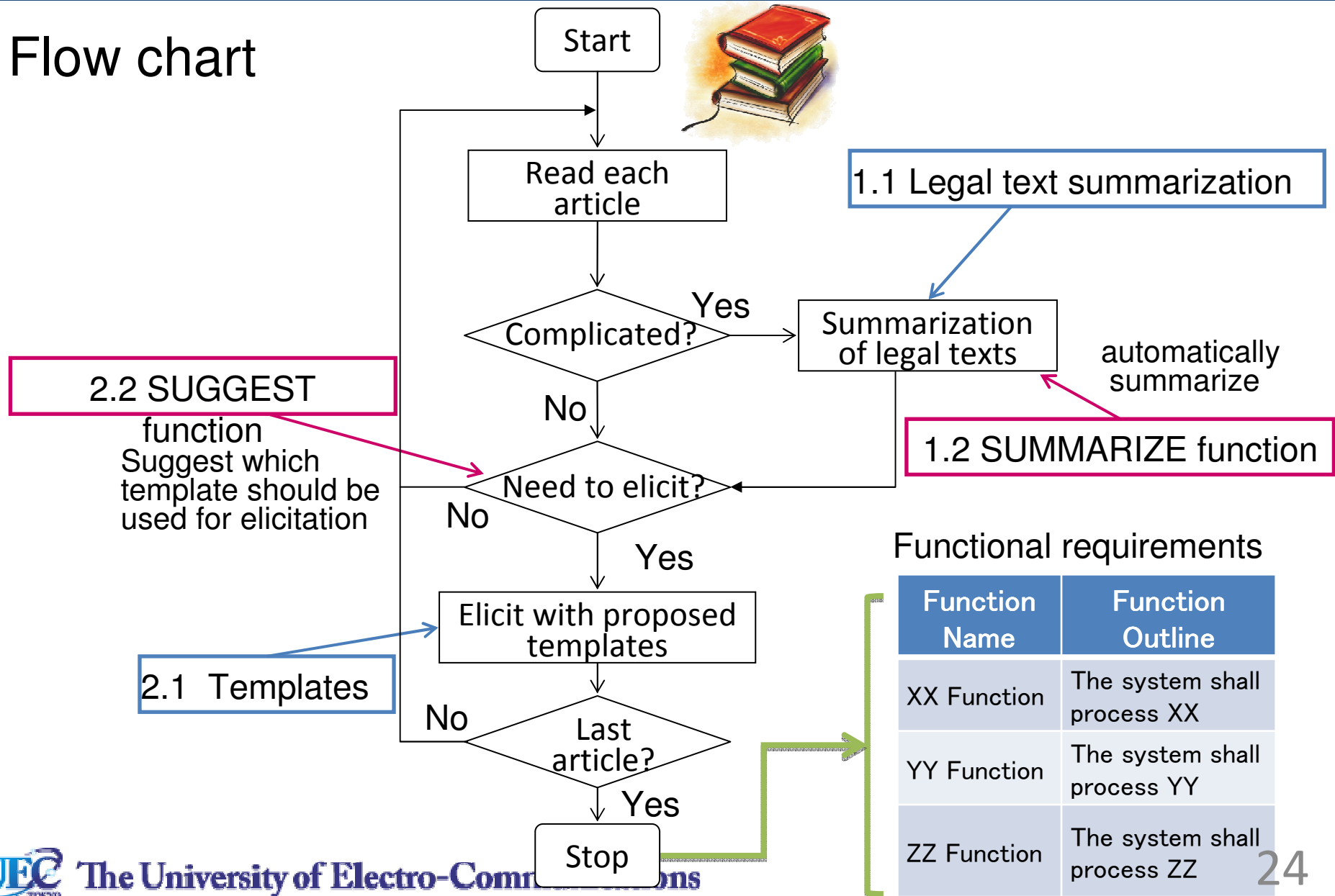| Template	Word / Phrase
Data	Submit, Notification・・・
Function	Pay, ・・・
Term	hereinafter referred to as ~

Dictionary

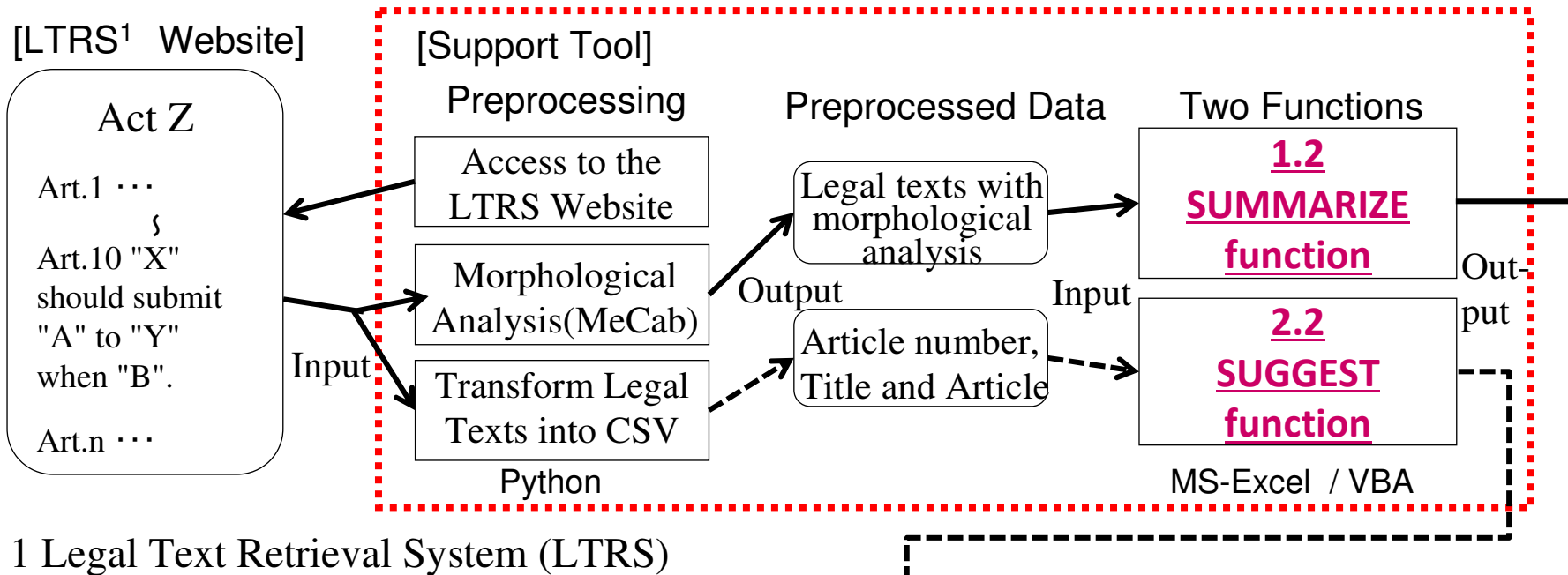# 2.2 Support tool: SUGGEST(4/4)

■ Advantage of this function

✓ This function enables suggesting with high accuracy articles that should be elicited by registering in advance high-appearance words or phrases according to the template type

Overall Identification Process

Flow chart

Start

Read each article

1.1 Legal text summarization

Complicated? — Yes → Summarization of legal texts

automatically summarize

No

2.2 SUGGEST function
Suggest which template should be used for elicitation

1.2 SUMMARIZE function

Need to elicit? ← No

No ← Yes

Elicit with proposed templates

2.1 Templates

Last article? — No

Yes

Stop

Functional requirements

Function Name	Function Outline
XX Function	The system shall process XX
YY Function	The system shall process YY
ZZ Function	The system shall process ZZ

Support tool (1/2)

[LTRS[1] Website]

Act Z

Art.1 ···
　　　∫
Art.10 "X"
should submit
"A" to "Y"
when "B".

Art.n ···

[Support Tool]

Preprocessing

- Access to the LTRS Website
- Morphological Analysis(MeCab)
- Transform Legal Texts into CSV

Input

Python

Preprocessed Data

- Legal texts with morphological analysis

Output

- Article number, Title and Article

Two Functions

1.2 SUMMARIZE function

Input

2.2 SUGGEST function

Output

MS-Excel / VBA

1 Legal Text Retrieval System (LTRS)

Data Identification Template　　Blue
Function Identification Template　　Red
Term Identification Template　　Green

[Resulting Output]

Act Z	
Legal text	Summarized text
Art.1 ···	—
Art.10 "X" should *submit* "A" to "Y" when "B".	Art.10 "X" (S) should submit (V) "A" (O).
Art.n ···	Art.n (S) + (V) + (O)

Support tool (2/2)

SUGGEST function

SUMMARIZE function

	F	G	H	I
1	Article number	Title	Legal text	Summarized text
21	第7条第1項	（被保険者に関する届出）	事業主（徴収法第八条第一項又は第二項の規定により元請負人が事業主とされる場合にあつては、当該事業に係る労働者のうち元請負人が雇用する労働者以外の労働者については、当該労働者を雇用する下請負人。以下同じ。）は、厚生労働省令で定めるところにより、その雇用する労働者に関し、当該事業主の行う適用事業（同条第一項又は第二項の規定により数次の請負によつて行われる事業が一の事業とみなされる場合にあつては、当該事業に係る労働者のうち元請負人が雇用する労働者以外の労働者については、当該請負に係るそれぞれの事業。以下同じ。）に係る被保険者となつたこと、当該事業主の行う適用事業に係る被保険者でなくなつたことその他厚生労働省令で定める事項を厚生労働大臣に**届け出なければならない。**当該事業主から徴収法第三十三条第一項の委託を受けて同項に規定する労働保険事務の一部として前段の**届出**に関する事務を処理する同条第三項に規定する労働保険事務組合**（以下「労働保険事務組合」という。）**についても、同様とする。	事業主は、当該事業主の行う適用事業に係る被保険者となつたこと、当該事業主の行う適用事業に係る被保険者でなくなつたことその他厚生労働省令で定める事項を厚生労働大臣に届け出なければならない。
22	第8条第1項	（確認の請求）	被保険者又は被保険者であつた者は、いつでも、次条の規定による確認を請求することができる。	被保険者又は被保険者であつた者は、次条の規定による確認を請求することができる。
23	第9条第1項	（確認）	厚生労働大臣は、第七条の規定による**届出**若しくは前条の規定による請求により、又は職権で、労働者が被保険者となつたこと又は被保険者でなく	厚生労働大臣は、労働者が被保険者となつたこと又は被保険者でなくなつたことの確認を行うものとする。
			前項の確認については、行政手続法（平成五年	

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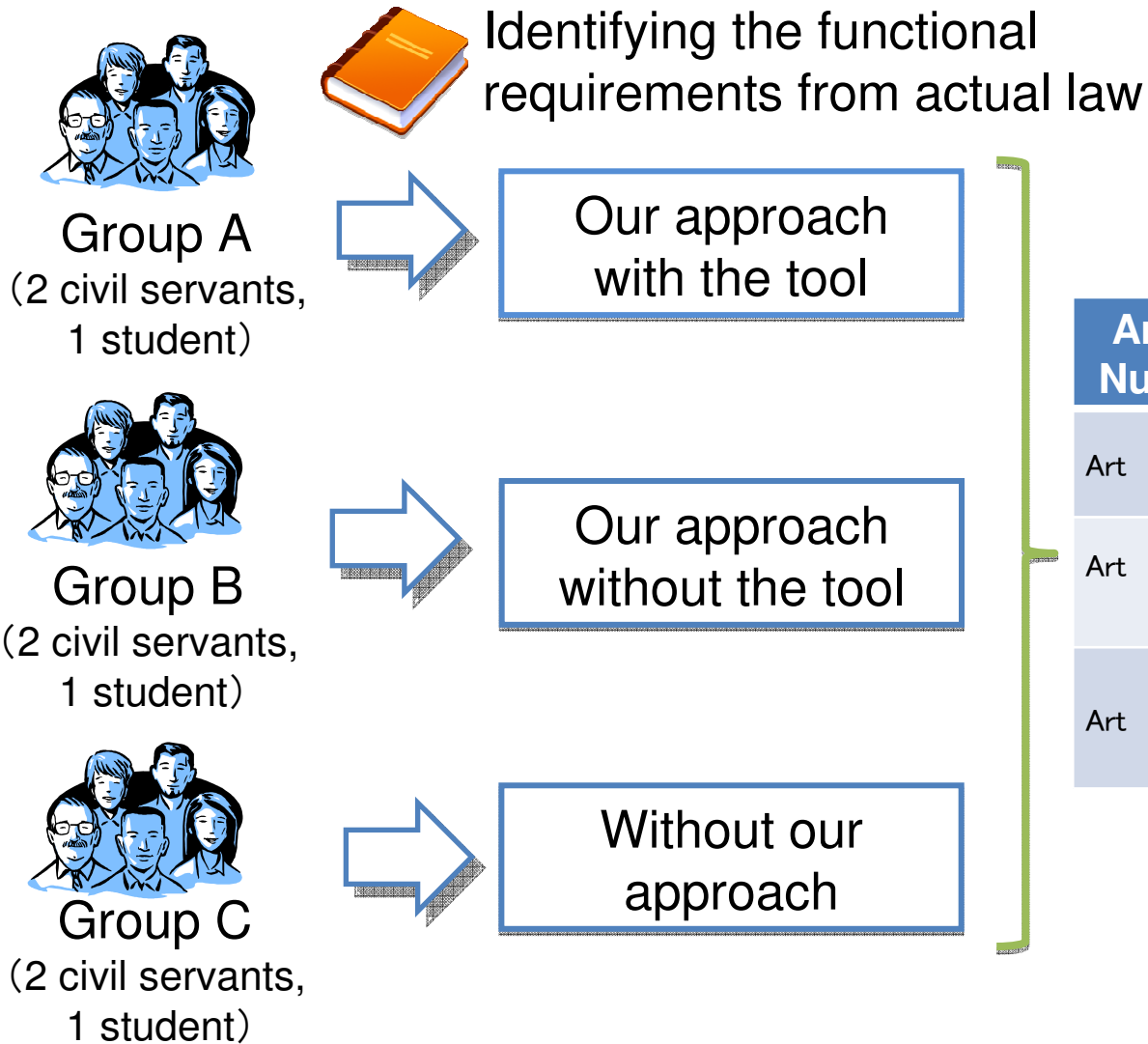
Experiments and Results (1/3)

Experiments Overview

- Examinees were requested to identify the functional requirements from actual Japanese law [1] using our approach

- Examinees' answers were compared with the actual administration system's [2] function

[1] Act on the Collection, etc., of Insurance Premiums of Labor Insurance
Articles 1 to 32 of the main provisions and articles 1 to 10 of the supplementary provisions

[2] Labour Insurance Application and Contribution Levy System

Identifying the functional requirements from actual law

Group A
（2 civil servants, 1 student）

Our approach with the tool

Group B
（2 civil servants, 1 student）

Our approach without the tool

Group C
（2 civil servants, 1 student）

Without our approach

Examinees' answers

Article Number		Function Name	Function Outline
Art	Art	XX Function	The system shall process XX
Art	Art	YY Function	The system shall process YY
Art	Art	ZZ Function	The system shall process ZZ

Experiments and Results (3/3)

Results & Evaluation

RQ: How can the functional requirements be identified
correctly and fully in a short time?

↓ Accuracy   ↓ Working Time

Accuracy

	Preci-sion	Recall	F-measure
(A) Our approach with the tool	90.4%	98.5%	**94.2%**
(B) Our approach without the tool	79.5%	92.4%	**85.2%**
(C) Without our approach	82.3%	80.3%	**81.2%**

⇒ Using the tool shows higher F-measure rates

Results & Evaluation

RQ: How can the functional requirements be identified
correctly and fully in a short time?

Accuracy   Working Time

Working Time

	Average
(A) Our approach with the tool	9h:31m
(B) Our approach without the tool	11h:03m
(C) Without our approach	11h:20m

The tool was able to shorten the working time

Related　or （1/2）

- Requirements elicitation from legal texts includes approaches using ontology [1], first-order logic [2], etc
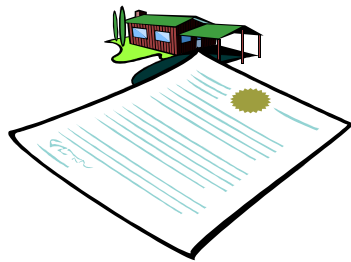
  [1] M. Saeki CAiSE 2008
  [2] M. Saeki ICSOFT 2009

- However, it is expensive to build these structures because reconstruction is needed whenever the laws change

- Moreover, there are few civil servants who can build these ontological or logical structures

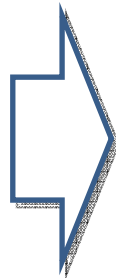There is an issue concerning the practical use of these approaches

Related or (2/2)

- Another approach for requirements elicitation using templates [3]

Template

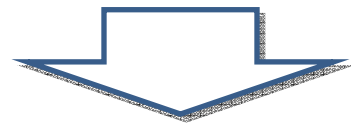The system shall **require**(or **allow**) the [actor] to [action] [object] from [object's source] to/with [target] for/in order to [purpose] given/if [conditions].

Privacy Policy

[3] J.D.Young RE 2010

This makes it easier to elicit the requirements than ontological or logical approaches
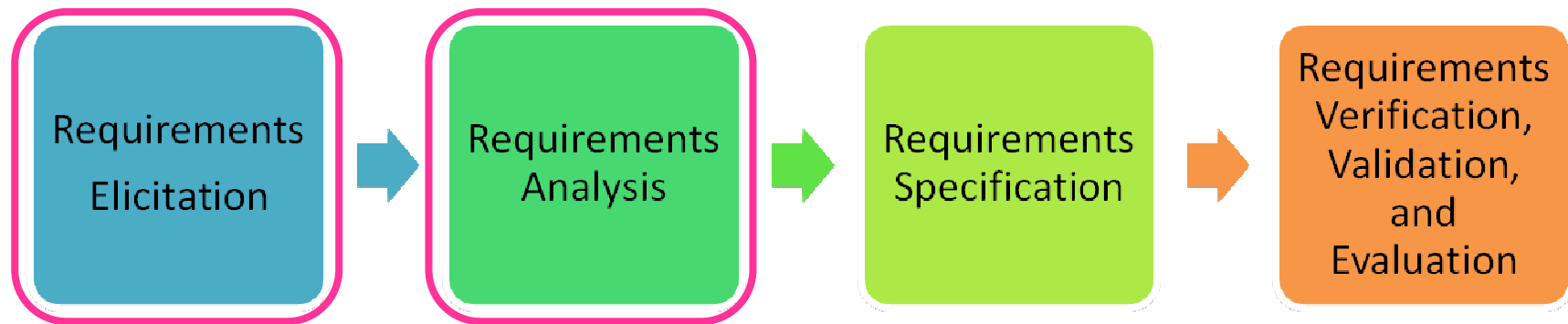
However…

- This template would not be able to elicit and manage the definition of the terms

- Managing the functional requirements would be difficult when the requirements are dispersed in plural articles

Conclusion

- We proposed 1) a legal text summarization and 2) three templates to identify functional requirements from legal texts, in addition to a support tool

- We have applied this approach to Japanese laws and using this approach has revealed that functional requirements can be identified with high accuracy

- This approach is relatively faster than when the tool is not used

Future   or

- Improvement of the tool for better accuracy and the shortening of working time

- Improvement of the applicability of the tool through application to other laws

- New focus on the requirements analysis phase

Requirements Elicitation	→	Requirements Analysis	→	Requirements Specification	→	Requirements Verification, Validation, and Evaluation

Process of Requirements Engineering

Than you
Any Questions?
y-yoshida@ohsuga.is.uec.ac.jp

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Q＆A（Possibility of the application to other laws）

- We have applied the SUGGEST function to "Immigration Control and Refugee Recognition Act" Chapter III（Article 6 to Article 18-2）

- This act is the legal basis for the "Foreigners Entry and Departure Information System (FEIS)"

- The SUGGEST function suggests the articles that include the functions of this FEIS system

Precision	Recall	F –measure
80.0%	66.7%	72.7%

- Because the results so far have been positive, we would like to continue experimenting further with our approach using examinees