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Requirements Definition Technique for Public Systems

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OVERVIEW: Many of the public services undertaken by national and local government agencies, etc. are carried out in accordance with statutes. Accordingly, the systems used for public services must also be developed in accordance with these statutes. As things currently stand, however, the requirements definition documentation for the development of systems based on statutes in the public sector are prone to a high degree of variability depending on who is responsible for them because the task of linking statutes to work processes is performed manually. To overcome this problem, Hitachi has been researching development methodologies for analyzing statutes and work processes with the aim of improving the quality of requirements definitions. Through this research, Hitachi has succeeded in establishing methods for determining the requirements for implementing statutes, methods for modeling statutory requirements, and requirements definition procedures and associated verification methods. In the future, Hitachi intends to conduct further evaluation and make improvements in preparation for deploying the methods in practice.

INTRODUCTION

MANY public services undertaken by national and local government agencies, etc. such as pensions, taxation, and handling citizen information, are carried out in accordance with statutes. As a result, these public services need to be designed to comply with statutory requirements (the requirements specified in the statutes), as must be the systems that support the associated work processes. Furthermore, because statutes are frequently amended, system development must be performed in ways that have the flexibility to change on short notice and without compromising quality.

Requirements definition for the development of systems that are based on statutes begins with statutes analysis (analysis of the relevant statutes) as well as analysis of work processes and systems. Based on the results of requirements definition, this is followed by design, implementation, and testing. As the cost of resolving any inadequacies in the requirements definition increases the longer the problem goes undetected, requirements definition is extremely important, with a significant impact on the cost of the latter stages of system development.

As a consequence, requirements definition, specifically statutes analysis and work process analysis, is currently done manually by an expert. This

makes the job of assessing the impact of any changes to the statutes or work processes dependent on the expert. Furthermore, because there is a high degree of flexibility in the form of current requirements definition documents, they tend to be prone to variability depending on who is responsible for them. Given this background, Hitachi has been researching development methodologies for the analysis of statutes and work processes with the aim of improving the quality of requirements definition. This article describes work to date on statutes analysis and work process analysis.

OVERVIEW OF REQUIREMENTS DEFINITION

Ensuring the quality of system development during the requirements definition and other early-stage processes is vital for preventing rework in subsequent processes or the building-in of latent problems.

Fig. 1 shows an overview of requirements definition incorporating statutes analysis and work process analysis.

First, statutes analysis involves listing the terminology definitions, statute data requirements, and statute use cases based on the categories of the system requirements identified from the relevant statutes.

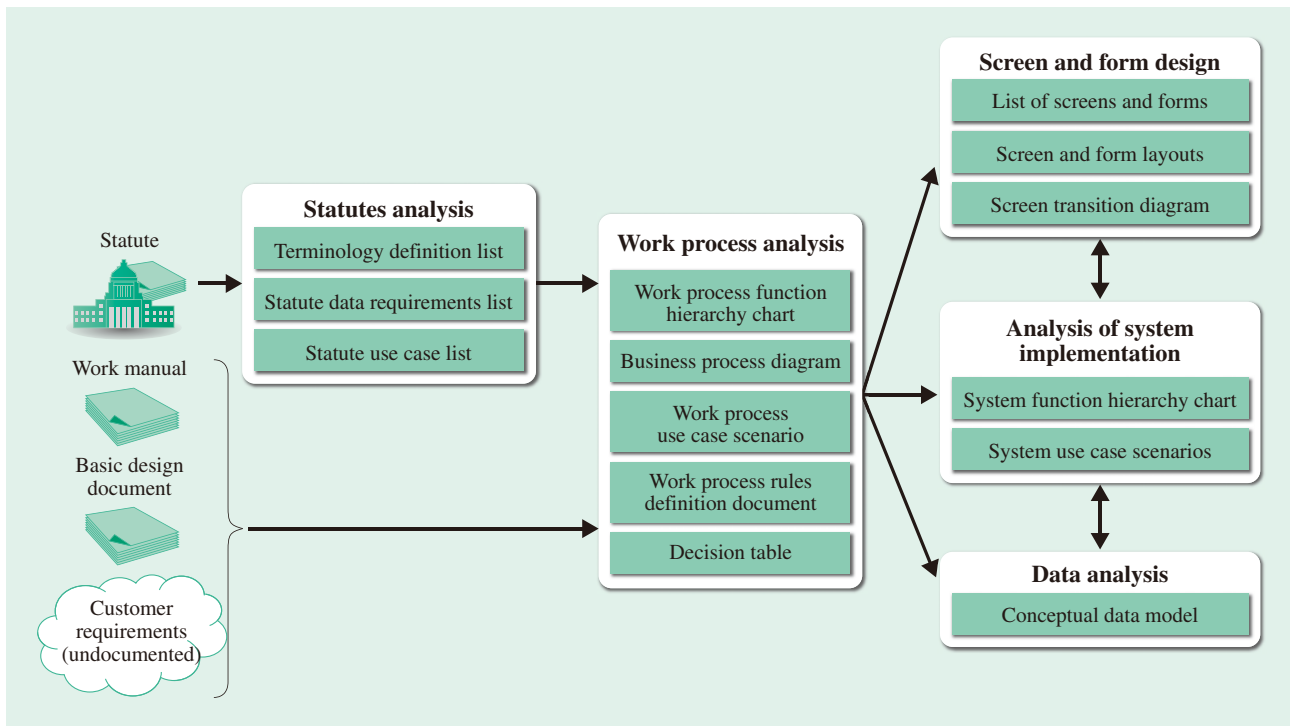


Fig. 1—Overview of Requirements Definition.

The development of systems based on legal statutes includes statutes analysis and work process analysis, and also screen and form design, analysis of system implementation, and data analysis to define the system requirements.

Next, work process analysis involves identifying the work process functions for the system with reference to the results of statutes analysis, and clarifying the tasks and work process rules associated with each function. These functions are specified in a work process function hierarchy chart and the relationships between functions are represented in a business process diagram. The tasks associated with each work process function are specified in work process use case scenarios and the work process rules are specified in a work process rules definition document. This demarcates the deliverables at each level of requirement granularity from the perspective of work processes, and improves maintenance by enabling the isolation of deliverables that need to be revised when a modification occurs. Labeling the identified requirements with an identification (ID) ensures the traceability of statutes and work processes. Furthermore, a decision table is used to verify that the work process rules definition document does not contain any omissions or inconsistencies.

Screen and form design, system implementation analysis, and data analysis are performed to clarify the functional requirements of the system with reference to the results of statutes analysis and work process analysis. The traceability of work processes and systems is ensured by assigning the IDs for the

work process analysis elements to these individual deliverables. The following sections describe statutes analysis and work process analysis in detail.

STATUTES ANALYSIS

This chapter describes the workflow for statutes analysis together with details of how statutory requirements are identified, a central part of statutes analysis⁽¹⁾.

Statutes Analysis Workflow

Statutes analysis involves: (1) Collecting information, (2) Sorting, (3) Identifying statutory requirements, and (4) Collating statutory requirements. Each step is summarized below.

(1) Collecting information

Documentation on the relevant statutes is obtained from the web or customer (national or local government agency).

(2) Sorting

Quick checks are made of the collected documentation to determine whether a detailed analysis is needed (whether or not the statute affects the system being developed). The results of this check are recorded on a statute documentation management form.

(3) Identifying statutory requirements

A detailed analysis is conducted of those documents for which it is deemed necessary and the identified statutory requirements are recorded on a statute documentation analysis form. This form is used to record information such as the text of the statute, the identified statutory requirements, requirement type (terminology, data, or use case), and the statutory requirement ID (in cases where the requirement relates to other requirements). This clarifies the correspondence between the statute text and the statutory requirements.

(4) Collating statutory requirements

The statutory requirements recorded on the statute documentation analysis form created for each document are collated by requirement type (terminology, data, or use case). Collating all of the statutory requirements from multiple sources in one place eliminates the need to keep going back to the various original documents, and makes it easier to understand the statutory requirements.

Technique for Identifying Statutory Requirements

Identifying statutory requirements includes the preparation of statute documentation analysis forms. These forms have a format that makes clear the correspondence between the statute text and the statutory requirements. The form thereby minimizes the number of requirements that are overlooked by providing a visual indication to both the person who produced the form, and the person reviewing it, of the locations in the statute documents from which statutory requirements were and were not identified.

The steps for producing a statute documentation analysis form are: (1) identifying the provisions relevant to the system being developed, (2) classifying the statutory requirements by type, and (3) determining the statutory requirements from the statute text. Details of each step are described below.

(1) Identifying the provisions relevant to the system being developed

In order to analyze statutes efficiently, it is important to determine which parts require a detailed analysis. The provisions that require a detailed analysis are first narrowed down by chapter and section, and subsequently by clause. Specifically, after a preliminary step of determining who will deal with the system being developed (“system principals”), whether or not the statute text requires a detailed analysis is determined based on whether or not it covers the system principals, and a judgment is made about whether the text relates

TABLE 1. Types of Statutory Requirements

Statutory requirements are classified as “terminology,” “data,” or “use cases” depending on their content.

Type	Explanation
Terminology	Information about the definition of terms
Data	Requirement for data that serves as an input or output for a use case. Examples include the data fields that appear in a report and data field constraints.
Use case	Requirement related to work procedures.

to the external or internal environment. In cases where it is not possible to decide whether detailed analysis is required based on the system principals, whether or not referenced statute text requires analysis is determined from the reference data included in the statute text.

(2) Classifying the statutory requirements by type

The statute text selected for analysis is classified based on the type to which it belongs, as listed in Table 1. While classification is performed by clause, some clauses may be assigned to two or more types.

The classification of statutory requirements includes collating the statute text for each requirement type based on how it is formatted (“patterned”). Although statute text is written in natural language, because it is drafted in accordance with certain rules, it is characteristically easy to form into patterns. This helps the person doing the work to choose the right classifications for the statutory requirements.

(3) Determining the statutory requirements from the statute text

After classifying the statutory requirements, statute text that contains statutory requirements is entered into the “Name” and “Statutory requirements” columns of the statute documentation analysis form. Individual variation between the people doing the work is minimized by providing them with data entry rules (requirements with an “and” relationship are entered in itemized form, requirements with an “or” relationship are noted as such) and a library of patterns for statutory requirements identification.

WORK PROCESS ANALYSIS

This chapter describes the sequence of steps for work process analysis and the work process rules definition document, which is one of the features of work process analysis.

Work Process Analysis Workflow

Work process analysis involves visualizing the work processes and administrative procedures. Each step is summarized below.

(1) Visualizing work processes

The work process functions associated with the system being developed are determined based on the results of statutes analysis and are recorded in a work process function hierarchy chart.

In parallel with the creation of the work process function hierarchy chart, the sequence of work process functions is recorded in a business process diagram. The name used for a work process function in the business process diagram is the same as the name used in the work process function hierarchy chart.

(2) Visualizing administrative procedures

Details of the tasks to be performed for the work process functions to be implemented in the system are specified in work process use case scenarios in the work process function hierarchy chart.

Whether or not work process rules (such as formulas or decision criteria) exist for each scenario for the work process use cases is determined with reference to the results of statutes analysis, and the details entered in the work process rules definition document. The name of each work process rule is also entered in the work process rule list along with a summary. In the case of simple work process rules (such as performing a check of a single criterion), the work process rule is specified in the “Summary” column of the work process rule list and therefore a work process rules definition document does not need to be produced. In the case of complex work process rules (such as two or more criteria), however, a decision table is produced to check for any omissions or inconsistencies.

Method for Preparing Work Process Rules Definition Documents

The work process rules definition document is the deliverable that records things like decision criteria or calculation procedures for administrative procedures. The main items included in a work process rules definition document are the work process rule ID, work process rule name, information about the source, inputs, output, intermediate variables, and sub-rules (including sub-rule ID, condition, and result).

The work process rule ID and work process rule name are used to identify work process rules. The work process rule ID is referenced from the work process use case scenario and ensures the traceability of the work process use case scenario and work process rules definition document. There are also cases where the work process rule ID is referenced from other work process rules. The “information about the

source” indicates where information relating to the rules specified in the work process rules definition document is recorded. The “Inputs” field records information about the data items used as inputs for the work process rule. There is one “output” for each work process rule. If a work process rule has more than one output, the work process rules definition document is split. “Intermediate variables” are used when specifying a calculation procedure in order to add clarity by providing variables to store intermediate calculation results. The “Sub-rule” field describes the relationship between the conditions and results of a work process rule.

Sub-rule conditions and results eliminate ambiguity by clarifying the notation and also enable interpretation by machine. This also makes it possible to verify whether there are any inconsistencies, omissions, or other problems^{(2), (3)}.

CASE STUDY

Hitachi has trialed the requirements definition method it developed on an actual public-sector project. The input information was made up of 77 primary provisions and 23 supplementary provisions from laws and (draft) enforcement ordinances.

Statutes analysis took approximately 14 hours and identified 191 statutory requirements. Two of the 14 hours were spent on verification and revision. Classification of the statutory requirements found 25 terminology, 16 data, and 38 use case requirements. Linking of these statutory requirements to work process requirements was performed for all of the data and use cases that related to the scope of the work process analysis.

Work process analysis took about 18 hours, resulting in 24 items being recorded in the work process function hierarchy chart as level 3 work process functions and 29 as level 4. Work process use case scenarios were produced for three of these 29 level 4 work process functions. A total of 23 work process rules definition documents were produced for two of the three work process use case scenarios, of which 11 were verified as having no inconsistencies or omissions.

CONCLUSIONS

This article has described a development methodology for statutes analysis and work process analysis that ensures the quality of requirements definition. Use

of the method reduces the degree of variability in requirements definition documents depending on who produced them, and ensures the traceability of statutory requirements and work process requirements. Although identification of statutory requirements and preparation of work process rules definition documents have been automated to some extent, other aspects of these tasks are still performed manually. Hitachi expects to achieve further improvements in quality in the future through continued research into verification methods for requirements definition documents, while also making progress on the automation of these manual tasks.

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