

Work plan support of One-stop application procedures using application procedure ontology: The case of Japan

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Abstract: - The authors classify licensing application procedures in Japan as factors that comprise procedures including application documents and attachments, and have developed an application procedure ontology that defines the reference relationship among each factor at the level of items described or listed in documents. In addition, a method to derive acceptance or rejection of item transcription in One-stop application procedures as well as work steps through inference was reviewed by utilizing the application procedure ontology. Consequently, if specific items in attachments are in the reference relationship with other relevant application documents, it was found to be possible to make an inference that item transcription is possible through the mediation of such attachments, by using the reference relationship defined by this application procedure ontology. By determining the work priority based on the referenced number among instances, visualization of overall workflow of application work was made possible in regards to the One-stop application combined with the range selected by an applicant.

Key-Words: - Application Procedure Ontology, One-Stop Application, Online Application, Workflow, Application Support, e-Government

1 Introduction

The "IT New Reform Strategy" [26], Japan's approach toward a new e-municipality which was resolved on January 19, 2006, targets utilization of online application/submission to the government as well as to local authorities to be 50% or higher by 2010. It is described that as a measure to realize the target, the "government and local authorities promote data standardization of information systems. In order to realize One-stop application of various administrative procedures at a window at the time of address change or relocation, as well as joint development of public service such as disaster prevention among local authorities, the foundation to coordinate information systems will be developed and standardized by 2007, and at the same time system reform in local authorities will be promoted based on this standard." Data standardization in electronic administrative procedures has become an important task.

Attempts toward One-stop application of administrative procedures represented by address changes and relocation have been considered in the past under the leadership of the government. Although the demonstration experiment of multi-application (One-stop application) system for the

birth of newborns was conducted by Hachinohe City, Aomori Prefecture in 2004 jointly with some system vendors and its convenience and demand was verified, it has not reached full-scale operation as of August 2007 [7].

As shown in this experiment, One-stop application is considered to be a very enthusiastic approach to indicate usefulness of electronic administrative procedures. Procedures in relation to the birth of newborns are commonly taken at multiple administrative windows such as census registration and resident registration, in addition to child support programs, public health centers, etc. The One-stop application proposed in the experiment has the structure that data on application items required by multiple places of application are entered at once, and only the item data necessary for each application procedure are transcribed onto individual application documents, which are delivered to each administrative window within a public government office. However, application in this experiment restricts a series of procedures that begin from birth to be made at once in a specified order, and it is not possible to apply to cases where an application is made individually. There are also approximately 80 items in all to be described in

application documents (eight kinds) used for application, and these item data are manually standardized at the time of developing the experimental system [8]. Therefore, if new application procedures are added, combination of places of application changes, or application items change in the future, the standardization work of item data has to be conducted again. Meantime, application procedures that extend to multiple administrative bodies are beyond the scope of this review.

While only the data items described in application documents are standardized in this experiment, attachments (e.g., copy of resident register and certificate of registered matters) may be required in addition to application documents prepared in the case of other application procedures. Furthermore, not only a single application form is used, but also several application forms are combined depending on circumstances of an applicant in many application procedures.

While the relationship between application documents and attachments will be described later, items described in attachments are also the subject of standardization in reality and handling of attachments needs to be reviewed at the same time. Furthermore, if there is some kind of relationship among item data described or listed in each document when application procedures are taken by combining various application documents and attachments, even single application procedures are considered to have a factor of One-stop application.

In this report, a method to derive by inference standardization of item data in One-stop application within a range selected by an applicant as well as work steps of application procedures are considered, by utilizing application procedure ontology as a knowledge model developed by focusing on the reference relationship between application documents and attachments comprising application procedures and further between items that need to be described in application documents and items listed in attachments.

This report shall be in the following format: In Section 2, the background in regards to administrative procedures in Japan at the time of writing this report is explained. In Section 3, related studies as well as cases within and outside of Japan shall be described. In Section 4, the details of application procedure ontology developed shall be clarified. In Section 5, a method to solve problems on automatic transcription of items to be described or listed in application documents shall be proposed. In Section 6, a method to automatically propose work steps of application procedures shall be

proposed. Section 7 includes the summary and future issues.

2 Background in Japan

The background relating to the customs relating to contracts as well as to administrative procedures in Japan will be explained in this section.

2.1 Regulatory administrative activities

Although Japan is a capitalistic state, the administration imposes various regulations on domestic economic activities and these regulatory activities are considered to be the center of administrative activities. However, laws governing regulatory activities do not always stipulate regulations in detail. This is because determining details in regulations always creates people who contrive to escape from the lattice of regulatory activities. Therefore, administrative bodies in Japan also have a nature as institutions to execute the authority called discretion, by leaving room for discretion to regulatory administrative activities.

In the normal state, many regulatory administrative activities form multiple licensing authorities or the linkage of administrative disposition behaviors in each field. Furthermore, the activities are governed by an administrative body comprised by a single person under the Cabinet; therefore administrative procedures occur by each administrative body with little coordination among procedures or documents in each administrative body. This form is called the "vertical administrative structure" in Japan [21].

In addition, an operation called the administrative guidance is in the core of regulatory administrative activities in Japan. The administrative guidance is a demonstration of desire by administrative bodies, irrelevant to legal basis, i.e., voluntary compliance by applicants [25]. For example, matters described in application documents submitted by an applicant are checked prior to receiving the application (with consent from the applicant), and change or correction of described matters is recommended in accordance with the intention of the administrative body. Thus, administrative bodies allow the possibility of flexible (or arbitrary) operation by giving their influence on application matters within the scope of their discretion.

2.2 Culture of seal impression

It is a well-established custom in Japan to stamp a seal in place of a signature in order to secure declaration of intention by parties.

The legal effect of a seal impression is the same as a signature; however provisions that require a seal impression rather than a signature still remain in many existing laws. As a method to certify the authenticity of a seal impression, it is mandatory to register the seal impression with a local authority in advance as well as to attach a seal certificate that certifies the seal is truly owned by the party in the case that declaration of intent by seal impression gives material legal influence. Furthermore, the certificates are issued by a local authority. In this sense, this system relies on administrative bodies, with a fundamentally different nature from witness by an individual.

2.3 Flow of application procedures to administrative bodies and factors that comprise the application behavior

Application procedures to administrative bodies in Japan are stipulated in the Administrative Procedures Act. In the Act, application and submission are distinguished as a separate behavior; however since both application and submission are accepted by an administrative body as long as they satisfy formality requirements of the documents (regardless of the content), application and submission are equivalent in terms of administrative procedures if the period is limited to the point of acceptance. Therefore, the "application and submission" in administrative procedures until the point of acceptance are called the "application" hereafter.

Essentially, factors comprising the application behavior are considered to include (1) clear intention of application by an applicant, (2) an applicant and the factual relationship surrounding the applicant and (3) facts resulting in application and plan after application. In regards to (1), a legal effect is acquired by a party when signature/seal (or signature) is affixed on application documents. In regards to (2) and (3), a party makes a declaration with matters described in application documents. However, since the factual relationship cannot be authenticated by party's declaration only, an administrative body requires attachments including public certificates in order to prove the factual relationship, and it is a formality requirement to confirm whether or not there is a discrepancy in

matters described in application documents by comparing them with the attachments.

2.4 Reliance on public certificates

Since coordination of documents among each administrative body is little due to the vertical administrative structure, it is necessary to rely on public certificates individually issued by each administrative body in order to clarify the factual relationship surrounding an applicant. In addition to seal certificates described in the above, systems exist including certificates of corporate registration matters to demonstrate the existence of a corporation itself as well as copies of a resident register to demonstrate existence of an individual, and there is no relationship between each system.

The basic resident register network [15] began operation in 2002 as a measure to facilitate coordination of documents at each administrative body by computerizing public certificates; therefore information on resident register can be obtained on the network at each administrative body. Furthermore, the Ministry of Justice began the system to provide online registration information [17] in 2007, enabling acquisition of corporate registration matters on the network. However, there are few cases where the basic resident register network and the system to provide online registration information are utilized in administrative procedures¹.

The public personal authentication service [23] equivalent to seal certificates in electronic administrative procedures is at work on the basic resident register network, and the dissemination rate of basic resident register cards as the media to store electronic certificates is 1.1% (population ratio) as of March 2007 [16].

In accordance with the above background, authors consider it difficult to complete application procedures without relying on public certificates regardless of computerization in Japan at the point when this report is written.

¹ It researched on December 31, 2007. Among the application procedures in g-Gov (21588 cases) [6], 30 cases can use system to provide online registration information, 270 cases can use the basic resident register network [15].

3 Related studies

Studies on ontology, especially ontology engineering, have been actively conducted since the mid 1990's. The areas of application vary including biology, business process, plant engineering and education [19]. Mizoguchi [20] suggests the following seven points as the effects of ontology.

- ✓ Method to obtain agreement
- ✓ Clarification of implicit information
- ✓ Recycling and sharing
- ✓ Systematization of knowledge on the computer
- ✓ Standardization
- ✓ Meta model function
- ✓ General effects

This study attempts to utilize ontology in the area of administrative procedures and further utilize the ontology benefited from the above effects as a knowledge model for software agent.

Recent studies that utilize ontology in the area of administrative procedures include the case by Medjahed, etc. to automatically customize the web service for the elderly in Virginia by utilizing ontology [14], the case by Varavithya, etc. that utilized the frame-based ontology of law at the time of application to determine the eligibility for trade preferences in Thailand [29], the case by Yang, etc. that utilized the ontology developed by using the IDEF5 ontology development method at the time of application for a social security card in the Shanghai local government [32] and the case by Goudos, etc. that inferred and presented the application procedure in receiving annuity in Greece by utilizing domain ontology developed in advance and the user profile entered by an applicant [5]. In the case of Goudos, etc., ontology has been utilized as a knowledge model for inference in the area of administrative procedures, and can be considered as a similar study to our study in terms of the area and purpose. However, the target of this ontology is the business case, and is different from the modeling of application documents as tangible items in this study.

Furthermore, there is no case in Japan where ontology is utilized as a knowledge model for software agent in the area of administrative procedures. In areas except for administrative procedures, there is online assistant development by Izumi, etc [11][12]. In this case, ontology is established for agent's behaviors based on task analysis, which is a different method from modeling

of application documents as tangible objects proposed by the authors.

In Japan, priority reviews modeling application documents and attachments for the purpose of deriving work steps of data standardization and application procedures in electronic administrative procedures are not found within the scope of investigations by authors.

Outside of Japan, there are cases where metadata is added to documents published by the administration such as MIREG [18] in EU, e-GMS [2] in England, IPSMS [10] in Ireland, AGLS [1] in Australia and GILS [4] in the U.S. in order to realize horizontal document management among countries as well as government agencies, although they have different objectives from this study. In all of these metadata, the Dublin Core Metadata Element Set (hereafter "DCMES") has been expanded to define unique elements. These expanded elements are able to define the reference relationship at the level of documents, and it has already been made possible to search and diversify coordination of administrative documents held by administrative bodies.

Attempts to standardize item data for application documents have been planned at the same time of reexamining ordinances and clerical routine in Hatogaya City, Saitama Prefecture [9] in addition to the experimental case in Section 1; however the scope is limited only to the public government office.

In EU, a project called SemanticGov was established in 2005 as part of i2010 (the 2010 Plan). The purpose of SemanticGov is to try to solve long-term and challenging issues such as a method to realize workflow-based complicated services involving multiple administrative bodies, by solving mutual compatibility issues among administrative bodies in multiple countries as well as by making it easy to find necessary services for users of administrative services [24]. In this case, standardization at the level of items in multiple application procedures is still one of the issues, and mapping system among items called DataMediator has been proposed as a method of solution. This DataMediator covers many administrative procedures and adopts a method to map each item; therefore the size necessarily continues to expand.

On the other hand, the application procedure ontology proposed in this study is a distributed and lightweight ontology where application procedures, attachments, seal impression on documents, etc. are collected and classified for each target application

procedure as factors comprising application procedures and where the reference relationship among each factor is further defined at the item level described or listed in documents. Rather than adding metadata to existing documents, instances with metadata are generated from this application procedure ontology as instructed by an applicant, and association is promoted upon creation and preparation of application documents defined by each instance; therefore it has a role as a knowledge model in a software agent.

4 Development of ontology

The steps to establish the administrative procedure ontology are shown in this section. Authors decided to use Protégé-OWL² as a development tool and adopt OWL DL [31] as an ontology description language.

4.1 Target domain

The following six different application procedures were established as respective target domains in order to develop the application procedure ontology. Governing laws stipulated were also investigated.

- ✓ Registration of architect's office
- ✓ Submission to commence detective business
- ✓ Submission of specified worker dispatch business
- ✓ Registration of money lending business
- ✓ Registration to incorporate a LLC (Limited Liability Company)
- ✓ Submission to establish labor insurance relations

4.2 Vocabulary extraction

The application behavior in administrative procedures in Japan is by writing, and examination by administrative bodies is also formality examination in writing; therefore application documents and attachments as tangible objects were extracted as vocabularies from respective governing laws. Furthermore, items to be described in extracted application documents and items described in attachments were individually extracted.

Extraction was done manually, without using tools relating to natural language processing,

statistical processing, etc. Not only in this study but also in development and maintenance of the application procedure ontology, since (1) the application procedure ontology is a lightweight ontology developed for each application procedure, (2) it is possible to increase target application procedures in stages, (3) the overseeing administrative government agency is determined for any application procedure and there is a person in charge of procedures, and (4) the work equivalent to law interpretation necessary to develop the application procedure ontology has been handled by administrative windows in the past, there is less advantage of automation by tools; therefore authors intentionally chose the manual work.

4.3 Class definition and development of is-a relationship

Vocabularies extracted in Section 4.2 were classified and defined as classes. The concept of upper or lower level classes defined was further defined as the is-a relationship. In regards to items described in documents such as the location of headquarters, locations of sales offices and individual addresses for example, the Address class was established as the upper level concept and defined.

4.4 Development of has-a relationship, reference relationship and signature relationship by property definition

There are items to be described or listed in application documents and attachments and their relationship was defined as the has-a relationship. This makes it possible to describe what kind of item description is required in application documents. In addition, the reference relationship among documents was defined in accordance with items in documents. Although the References relationship among documents can be described with metadata definition in each country with expanded DCMES, it is not possible to describe what item in a document contributes to the References relationship. Therefore, sub-property of the References relationship was defined to determine "what item contributes to the reference relationship." Furthermore, the relationship among a seal to be affixed and a document was defined as the Signature relationship.

Figure 1 illustrates the relationship of a copy of resident register for one individual applicant and

² <http://protege.stanford.edu/>

his/her resume. Name, address, date of birth, head of household, relationship, permanent address, etc. are described in the copy of resident register, and name, address, date of birth and personal history are described in the resume, which is defined with the has-a relationship. Furthermore, in regards to name, address and date of birth, the References relationship is defined individually from the copy of resident register on the resume. Since the resume has a seal impression by this applicant, the Signature relationship is defined with the seal owned by the applicant.

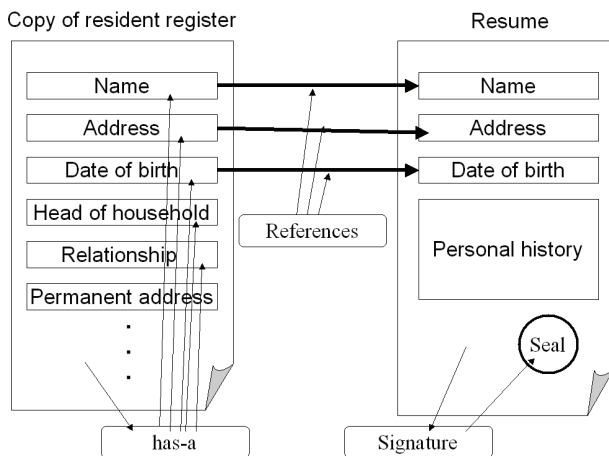


Figure 1. Has-a relationship, References relationship and Signature relationship

4.5 Relationship among application procedures, application documents and results

Since the application procedure is comprised of a combination of application documents and attachments, the relationship between the application procedure and target documents was defined as the partOf relationship. If the same application procedure has different conditions precedent (e.g., an applicant is an individual or a corporation), documents contained in the application procedure may be different; therefore only the existence of partOf relationship was defined for class definition and definition of Cardinality Restrictions was kept to a minimum.

In addition, the application procedure and the results obtained as a result of the application procedure was defined as the resultOf relationship. The results represent class definition of the fact of permission in the case of application for approval, i.e., property definition of items including the approval number, the date of approval, etc. as the

has-a relationship. Furthermore, the relationship between the fact class defined with the resultOf relationship and the evidence document was defined as the Certificate relationship.

Furthermore, in order to meet the diversified combination of One-stop application, six of these application procedures were not developed as single application procedure ontology, but individual application procedure ontology was developed for each application procedure. Based on the above, independent attachment ontology was developed in regards to a class necessary to possibly be used as attachments for each application procedure such as a copy of resident register and certificate of registration history, and imported to individual application procedure ontology as necessary. This makes it possible to reuse the attachment ontology in other application procedure ontology to be developed in the future, and improvement of generality can be expected.

5 Issue of automatic transcription of described/listed items

In terms of labor savings for an applicant in application procedures, the structure to automatically transcribe items entered once to other items with the same concept is very convenient, as indicated in the case of Hachiohe City in Section 1. However, the risk of item transcription without noticed by an applicant cannot be ignored. In the application procedure ontology proposed in this study, therefore, the References relationship was defined as "those noted to refer to items" and it was considered that the same item name did not always have the same value. One-stop application is still a separate legal application, and each administrative body independently holds the actual discretion by way of the administrative guidance; therefore perfect matching of items cannot be expected. Furthermore, in the case that unknown application procedures are combined for One-stop application in the future, items with the same name may not always point to the same concept.

An applicant is asked to fill in documents with the intention of application, upon understanding the content of application. Therefore authors propose a structure to display candidates of items to be transcribed in accordance with the reference relationship of items and to allow an applicant to make a choice based on his/her own intention, rather than automatic transcription.

Automatic transcription of item data based on the reference relationship between attachments and application documents can be considered as follows:

As noted in Section 2.4, electronic public certification is not prevalent in Japan. Electronic documents of attachments other than public certificates (e.g., copies of articles of incorporation, minutes, etc.) are also few. Supposing that electronic documents exist, a common format of item data has not been established. Therefore, it is not possible to automatically transcribe items from attachments.

However, the reference relationship between items in attachments and application documents can be individually defined in the application procedure ontology. The relationship between application document/attachments and items to be described/listed is considered using the following predicates, with items indicating names as examples:

- $Has(x, y)$: A document x has an item y .
- $Name(y)$: y is an item to indicate a name.
- $Has(x, y) \wedge Name(y) \Rightarrow HasName(x, y)$: A document x has a name item y .

Whether or not a name item X can be transcribed from a document p to a document q is expressed with the rule in the following equation:

$$(\forall X)(HasName(p, X) \rightarrow HasName(q, X)).$$

In the case that a name item in a referenced document p is a :

$$(\forall X)(HasName(p, X) \rightarrow HasName(q, X)) \wedge HasName(p, a) \Rightarrow HasName(q, a).$$

Similarly, whether or not a name item X can be transcribed from a document p to a document r will be:

$$(\forall X)(HasName(p, X) \rightarrow HasName(r, X)).$$

In the case that a referenced document p is common:

$$(\forall X)(HasName(p, X) \rightarrow HasName(r, X)) \wedge HasName(p, a) \Rightarrow HasName(r, a).$$

Therefore, a document q and a document r have an extension a with the same value in the name item. Thus, it is possible to infer that if each of specific items in an attachment (e.g. a name in a copy of resident register) is in the reference relationship from a separate application document, specific items can be transcribed through the mediation of the attachment (Figure 2).

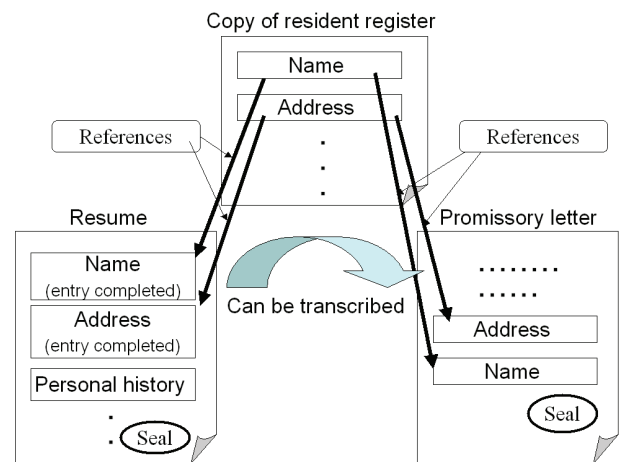


Figure 2. Item transcription through the mediation of attachments

In the case that the number of description items in application documents is limited and the total number can be counted up, the proportion of items that can be fulfilled by transcription among those described in application documents (the ratio of transcription coverage) $CovRate$ is expressed in the following equation:

$$CovRate = \frac{(Transcription_{TOTAL} - Transcription_{ITEMS})}{Description_{TOTAL}}$$

$Transcription_{TOTAL}$: Total number of items that can be fulfilled by transcription. (Total number of References relationships in attachments)

$Transcription_{ITEMS}$: Number of kinds of items to be transcribed. (Number of kinds of items for References relationships)

$Description_{TOTAL}$: Total number of items to be described. (Total number of has-a relationships in application documents)

Among items that can be fulfilled by transcription, the value of at least the first described item needs to be described. Thus, the total number of items to be actually fulfilled by transcription was obtained with $Transcription_{TOTAL} - Transcription_{ITEMS}$, divided by the total number of described items $Description_{TOTAL}$ to obtain the ratio of transcription coverage.

This ratio of transcription coverage is indicated in the following, taking the example of a corporation consisting of three directors (including one representative) to apply for registrations of money lending business and architect's office.

In Table 1, items that can actually be fulfilled by transcription in accordance with the References relationship and has-a relationship between

application documents and attachments defined in the money lending business registration ontology are extracted and totaled by kind of items for transcription (row factor) as well as by attachment (column factor).

In accordance with the above, there are 39 items in all that can actually be fulfilled by transcription out of 114 total described items. The rate of transcription coverage was 34.2%. In this example, therefore, it means that 34.2% of work to "describe in application documents" at maximum can be replaced with the work to "select transcription contents" or "confirm transcription contents" for which work load is relatively light.

In the same way, when the rate of transcription coverage was obtained for the registration of architect's office, there were 20 items in all that can

Table 1. Number of items that can be fulfilled by transcription (Registration of money lending business) $Description_{TOTAL} = 114$

Attachments	Certificate of registered matters	Organization chart	Copy of resident register for a representative	Certificate to register not incompetent for a representative	Certificate of adult wardship for a representative	Copy of articles of incorporation	Copy of resident register for a director 2	Copy of resident register for a director 3	Copy of resident register for a business handling supervisor	Certificate to register not incompetent for a director 2	Certificate of adult wardship for a director 2	Certificate to register not incompetent for a director 3	Certificate of adult wardship for a director 3	Office lease contract	Internal rules	Location map of business offices	Financial statements	Maximum number of items to be fulfilled
Name of representative	7	7	7	7	7													7
Address of applicant	4					4								4		4		4
Name of applicant	4	4				4									4	4		4
Name of director 2	3	3					3			3	3							3
Name of director 3	3	3						3				3	3					3
Name of business handling supervisor		2							2							2	2	2
Date of birth for representative director			2	2	2													2
Date of birth for director 2							2			2	2							2
Date of birth for director 3								2				2	2					2
Date of birth for business handling supervisor									2							2	2	2
Gender of representative director			2															2
Gender of director 2							2											2
Gender of director 3								2										2
Gender of business handling supervisor									2									2
Total number of items to be fulfilled (excluding duplications on the left columns)	21	2	4			4	4	4										39
Rate of transcription coverage (%)	18.4	1.7	3.5			3.5	3.5	3.5										34.2

actually be fulfilled by transcription out of the total of 41 described items. The rate of transcription coverage was 48.7% (Table 2). Thus, contribution to labor saving in application procedures is suggested, and this proposal using the application procedure ontology is considered to be useful.

In the registration of the money lending business, the rate of transcription coverage with only certificates of registration matters as attachments was 18.4%, while in the case of architect's office registration the rate of transcription coverage with only certificates of registration matters was 24.3%.

Based on the above, authors were able to suggest that defining the References relationship in the application procedure ontology, even though the scope of definition was not complete, can contribute to labor saving in application procedures, if the References relationship was defined in advance in regards to attachments that are empirically determined to have a high rate of transcription coverage such as certificates of registration matters.

Table 2. Number of items that can be fulfilled by transcription (Registration of architect's office) *Description*_{TOTAL} =41

Types of items to be transcribed	Certificate of registered matters			Office lease contract	Certificate of business tax payment	Copy of resident register for a registered architect	Architect's license for a registered architect	Copy of health insurance card for a registered architect	Copy of articles of incorporation	Maximum number of items to be fulfilled
	Attachments									
Name of applicant	3	3	3					3	3	3
Name of representative	3	3	3							3
Address	2	2	2					2		2
Name of registered architect						4	4	4		4
Registration number for registered architect							4			4
Address of representative	2									2
Address of registered architect						2	2	2		2
Total number of items to be fulfilled (excluding duplications on the left columns)	10					6	4			20
Rate of transcription coverage (%)	24.3					14.6	9.7			48.7

6 Method to automatically propose work steps by utilizing the application procedure ontology

In this section, authors will review a method of independent submission to commence the detective business as well as a method of One-stop application of registration to incorporate a LLC, submission to establish labor insurance relations, and submission of specified worker dispatch business by utilizing the application procedure ontology proposed.

6.1 Preparation of application procedure list

In the case of submission to commence the detective business, initial conditions were given including whether an applicant is an individual or a corporation (initial condition 1), whether or not minors are included as directors in the case of a corporation (initial condition 2), whether or not foreigners are included as directors (initial condition 3), the number of directors (initial condition 4), how many minors are included as directors (initial condition 5) and how many people of foreign nationality are included as directors (initial condition 6), and trial software to infer necessary documents for application and their numbers was prepared and operated.

The application procedure class defined in Section 4.5 in advance is used for inference based on production rules. Furthermore, a list of initial condition was developed and utilized in order to interpret the initial conditions given. In Appendix A and Appendix B, the application procedure class and a list of initial conditions are described for

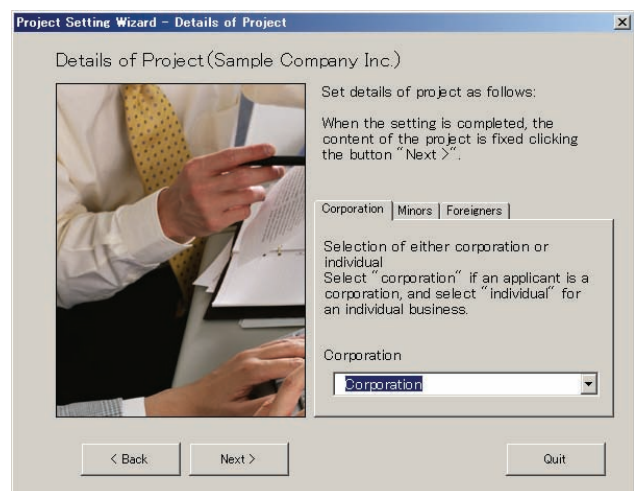


Figure 3. Example of Wizard screen to establish initial conditions

explanation.

In the trial software prepared, questionnaires are indicated based on the list of initial conditions using a Wizard screen (Figure 3) for selection. In the knowledge database with the application procedure class for submission of detective business, three selection conditions and three repetition conditions are defined as indicated.

In extraction of application documents and attachments using selection conditions, application documents and attachments that match answers in questionnaires are extracted based on the IF-THEN rule, which is repeated by the number of selection conditions (three times). Then, an instance is prepared from the target document class by the number of repetitions established with the three repetition conditions. A list of these instances generated will become the list of application procedures.

6.2 Proposal of work priority based on the reference relationship

Each instance in the application procedure list maintains the References relationship defined by the ontology of submission to commence the detective business in advance. In order to reduce the wait time in work upon application procedures, the work priority of referenced instance should be higher than the reference instance in terms of the reference relationship among instances.

Therefore, the reference relationship among instances in the application procedure list is

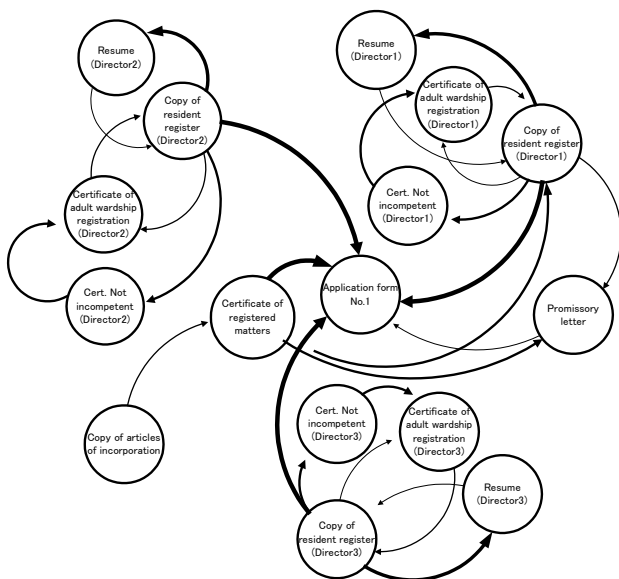


Figure 4. Digraph indicating the References relationship

illustrated in Figure 4 using the multiple-digraph. The thickness of the directed edge indicates multiplicity. The work priority among instances can be obtained based on this digraph using the method indicated by Page, etc. [22].

First of all, weight is given to each vertex in proportion to the number of multiple directed edges that define the reference relationship. Secondly, weight for each vertex is distributed to directed edges with the vertex as a starting point and weight for each edge is determined. Then, the weight for each vertex is re-defined as a total value of the weight for edges with the vertex as an ending point. The convergence value when these are repeated until the weight for each vertex converges will be the weight in order to obtain the work priority. When W is the eigenvector indicating weight for each vertex, the matrix D is a square matrix of the proportion of the weight for each directed edge to the weight for the starting point, and D^t is the transposed matrix of D , the following relationship can be obtained (c is a constant):

$$W = cD^tW$$

c is equivalent to the inverse number of a corresponding characteristic value; however since the characteristic value is 1, it is considered as a problem of characteristic value as follows:

$$W = D^tW$$

As a result of obtaining W , it is possible to

Table 3. Work priority based on the reference relationship (Submission to commence detective business)

Instance	Weight W
(public) Copy of resident register (for three directors)	0.34307
(public) Certificate of registered matters	0.27920
(public) Certificate to register adult wardship (for three directors)	0.23934
Resume (for three directors)	0.23546
Copy of articles of incorporation	0.23276
(public) Certificate to register not incompetent (for three directors)	0.22865
Promissory letter	0.21449
Application form No.1 for detective business	0.20397

propose work priority in the application procedure list by arranging instances in the order of larger weight given to each instance. When the number of reference relationships among each instance is accumulated based on the digraph in Figure 4 and the work priority is obtained with the eigenvector W of weight using GNU Octave³, it is found that obtaining a public certificate such as a copy of resident register, a certificate of registered matters, and a certificate to register adult wardship should be the first priority as shown in Table 3 within the scope of Figure 4.

6.3 Work steps in the case of relying on the results of preceding applications

For One-stop application of multiple applications, a time sequence might occur in terms of working on one application using the results of another application. In the case of Hachinohe City in Section 1, resident registration cannot be made without completion of census registration as a result of birth of a newborn, and child support allowances cannot be applied without resident registration. Therefore, a method to infer the sequence of individual applications in the case of One-stop application within the scope selected by an applicant

Table 4. Work priority based on the reference relationship
(Application of registration to incorporate a LLC)

Instance (public) represents a public certificate.	Weight W
Copy of articles of incorporation	0.48905
Determination letter of a representative, location of headquarters and capital	0.41153
Certificate of seal impression	0.34831
(public) Certificate of seal impression for a representative	0.32851
Letter to certify payment	0.27788
Letter to accept inauguration by a representative	0.27000
Application to register a LLC	0.27000
Same form as registration form (OCR)	0.20397
Certificate by a representative for declared capital	0.22801

³ <http://www.octave.org/>

will be explained using the application procedure ontology proposed in this report, taking the example of One-stop application of registration to incorporate a LLC, submission to establish labor insurance relations and submission of specified worker dispatch business as follows:

First of all, the individual work priority was obtained for comparison, resulting in Table 4, Table 5 and Table 6.

When this series of application procedures is taken, a subsequent application will be made after

Table 5. Work priority based on the reference relationship
(Submission to establish labor insurance relations)

Instance (public) represents a public certificate.	Weight W
(public) Certificate of registered matters	0.83205
Office lease contract	0.55470
Submission to establish labor insurance relations	0.00010

Table 6. Work priority based on the reference relationship
(Submission of specified worker dispatch business)

Instance (public) represents a public certificate.	Weight W
(public) Copy of resident register for a representative	0.64844
(public) Copy of resident register for a director 2 and a director 3	0.40297
(public) Certificate of registered matters	0.38484
Copy of articles of incorporation	0.16968
Copy of resident register for a responsible person at a dispatching company	0.15047
(public) Submission of specified worker dispatch business	0.09797
Stipulation for proper management of personal information	0.09797
Office lease contract	0.09797
Plan of specified worker dispatch business	0.07171
Resume for a representative	0.07171
Resume for a director 2 and a director 3	0.07171
Resume for a responsible person at a dispatching company	0.07171
(public) Notice of labor insurance number	0.02625

the first application is complete, i.e., sequential processing. However, the knowledge to take the procedures in the order of registration to incorporate a LLC, submission to establish labor insurance relations, then specified labor dispatch business is something to be known empirically upon understanding the purpose for each application as well as business background. It is difficult to determine the timing when the relevant application should be made when unknown application is included.

In the case of registration to incorporate a LLC, the result obtained is a fact of registration with the resultOf relationship. The certificate of registered matters is a public certificate that evidences the fact with the Certificate relationship. The certificate of registered matters is a document necessary for application as attachments for both submission to establish labor insurance relations and submission of specified worker dispatch business. Similarly, the notice of labor insurance number obtained as a result of submission to establish labor insurance relations is a matter necessary for submission of specified worker dispatch business.

Similar to the steps in Section 6.1 and 6.2, instances of application procedures and their reference relationship are generated in these three applications. At this time, there is originally no direct reference relationship between the documents prepared for each application and certificate documents obtained as a result of application; however the weight equivalent to the number of directed edges presumably generated based on the reference relationship was accumulated and given to the relationship.

Similar to Section 6.2, the work priority was obtained, as indicated in Table 7. *P* is a document defined by the partOf relationship. *Rc* is a Certificate document derived from the certificate relationship from the results obtained from the resultOf relationship.

By noting only the reference relationship between items, the workflow of application procedures can be visualized; i.e., among the three applications selected, the procedures are taken in the order of registration to incorporate a LLC, submission of labor insurance relations and submission of specified worker dispatch business.

In addition, in the case of sequential processing of individual application, documents that are requested to be attached in each application procedure such as a copy of articles of incorporation

and a copy of office lease contract had to be arranged each time during respective application procedures, while duplication to arrange

Table 7. Work priority based on the reference relationship
(One-stop application of three businesses)

Instance (public) represents a public certificate.	LLC Insurance	Dispatch
Copy of articles of incorporation (4)	<i>P</i>	<i>P</i>
Determination letter of a representative, location of headquarters and capital	<i>P</i>	
Certificate of seal impression	<i>P</i>	
(public) Certificate of seal impression for a representative	<i>P</i>	
(public) Copy of resident register for a representative (1) (4)		<i>P</i>
Letter to certify payment	<i>P</i>	
Letter to accept inauguration by a representative	<i>P</i>	
Application to register a LLC	<i>P</i>	
Same form as registration form (OCR)	<i>P</i>	
Certificate by a representative for declared capital	<i>P</i>	
(public) Copy of resident register for a director 2 and a director 3 (4)		<i>P</i>
Submission to establish labor insurance relations	<i>P</i>	
(public) Certificate of registered matters (4)	<i>Rc</i>	<i>P</i>
Office lease contract (4)	<i>P</i>	<i>P</i>
(public) Notice of labor insurance number (3)	<i>Rc</i>	<i>P</i>
Plan of specified worker dispatch business		<i>P</i>
Resume for a representative		<i>P</i>
Resume for a director 2 and a director 3		<i>P</i>
(public) Copy of resident register for a responsible person at a dispatching company (2)		<i>P</i>
Resume for a responsible person at a dispatching company		<i>P</i>
Stipulation for proper management of personal information		<i>P</i>
Submission of specified worker dispatch business		<i>P</i>

attachments could be eliminated with this method.

Furthermore, it was made possible to clearly indicate that prior to the commencement of each procedure, attachments that were determined to be in low priority in individual application were in high priority in the case of One-stop application.

In the case of registration to incorporate a LLC where a preceding application is a copy of resident register for a representative, it is positioned in the higher level in the work steps even though attachments are not necessary. This is because this document is a public certificate that evidences the address, name and date of birth for the representative as an individual, and these items are defined as referable from part of the document prepared for registration to incorporate a LLC (Table 7 (1)). On the other hand, a copy of resident register for a responsible person at a dispatching company has the reference relationship with documents in the lower order; therefore the priority is relatively low (Table 7 (2)).

In regards to submission of specified worker dispatch business, the plan of specified worker dispatch business refers to the notice of labor insurance number as the result of submission of labor insurance relations, the preceding application; therefore the document cannot be completed until completion of the preceding application (Table 7 (3)). On the other hand, it is indicated that the office lease contract used in the preceding application, the certificate of registered matters, the copy of articles of incorporation, and the copy of resident register that was defined as being referred from the preceding application in a public certificate can be arranged regardless of the work for the plan of specified worker dispatch business (Table 7 (4)).

The method proposed at this time was quantitatively compared under the following hypotheses:

- ✓ An application procedure is made independently. Therefore, parallel work does not occur except for arranging attachments. (Hypothesis 1)
- ✓ Once preparation of application documents begins, it is not suspended until completion. (Hypothesis 2)
- ✓ In accordance with the data obtained from the analysis and experiment of applicant's behavioral characteristics in administrative procedures by Kawaguchi, etc. [13] as well as with experiences of authors as administrative

scriveners, it takes one hour to prepare application documents, four hours to arrange and acquire public certificates (attachments) issued by public agents, and two hours to arrange and acquire other attachments. (Hypothesis 3)

- ✓ As far as matters that can be transcribed based on References relationship of application documents and attachments are not confirmed, the work to prepare documents including the relevant items does not begin. (Hypothesis 4)

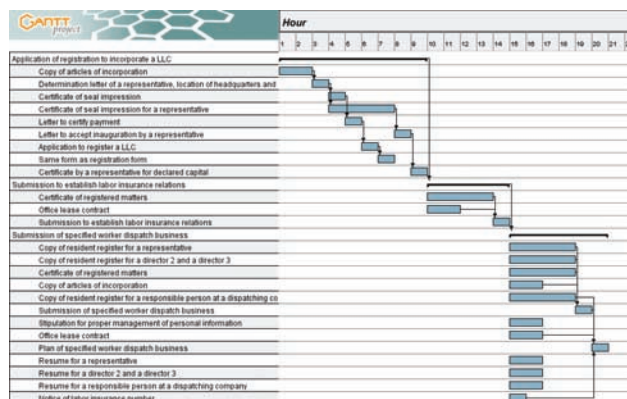


Figure 5. Gantt chart in the case of sequential processing of individual application

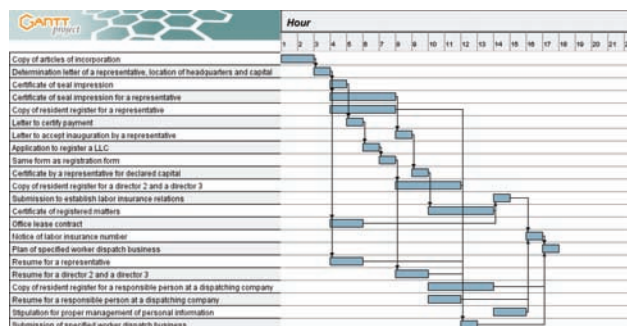


Figure 6. Gantt chart indicating the steps of One-stop application of three business types

Figure 5 and Figure 6 are Gantt charts that describe each application procedure work in accordance with the above hypotheses. Based on these, it is found that it takes 21 hours if each application is sequentially processed. On the other hand, it takes 18 hours if work priority obtained for One-stop application of three business types is used. Thus, based on specific hypotheses, the total work hours can be shortened by obtaining priority based on References relationship at the time of One-stop application and by conducting application work along with the steps. Therefore, it is possible to explain the usefulness of the method in this proposal.

6.4 Restriction to work in the behavior of affixing a seal

The behavior of affixing a seal is subject to external constraint (time constraint controlled by a person who has the authority to affix a seal) in the execution of application work; therefore in the case that the same seal is affixed on multiple documents, it is possible to reduce the time required to exchange documents to affix a seal by taking the behavior of affixing a seal at the same timing. In the definition of Signature relationship in the administrative procedure ontology, the constraint conditions in the act of affixing a seal are not established. Therefore, in order to avoid the issue that «a seal is affixed on blank application documents in advance,» it is necessary to impose a restriction to conduct the work of Signature relationship after proposing work priority with the References relationship.

Supposing that multiple works are not performed in parallel when the application work is conducted by one person, the application work can be indicated by Gantt chart as shown in Figure 7, based on the work priority. The timing of possible seal impression is upon completion of documents that require seal impression by a person responsible for affixing a seal. Therefore, a structure was developed to notify that all documents are ready for seal impression, upon completion of preparation of all documents that require seal impression by one person responsible for affixing a seal, by giving a property value that indicates whether or not preparation is complete to each instance generated and arranged up to Section 6.3 and by monitoring

this property value.

At this time, if a “person responsible for affixing a seal is an individual and a representative of a corporation,” it is possible to take the behavior of seal impression at once since the same person affixes seals even if different seals are used. This can be realized by giving a person responsible for affixing a seal the role as an individual or a representative of a corporation, to notify the readiness of seal impression to the person responsible for the role.

7 Conclusion

In this study, authors reviewed a method to infer that a specific item in an application document can be transcribed through the mediation of attachments at the time of preparing the application document by developing and utilizing the application procedure ontology, as well as a method to automatically propose the work steps in application procedures to an applicant.

Professionals of legal business who specialize application procedures (e.g., administrative lawyers and judicial lawyers) have been accumulating the knowledge in regards to application procedures by acquiring the knowledge on application procedures from relevant laws and by preparing application documents through conference with administrative bodies. Development of application procedure ontology is nothing else but to turn the knowledge owned by professionals of legal business into explicit knowledge and publicize it, using a method of automatic transcription inference for items to be described as well as of automatic proposal of work steps. The review in this study is considered to be meaningful in the sense that by reducing the burden on general citizens to learn professional knowledge in regards to application procedures; it becomes easier for them to take application procedures on their own.

Expansion of a method to navigate application procedures themselves is also considered to be effective as a measure to increase the utilization rate of electronic application system at the government or local authorities where the utilization rate remains low. Data standardization in electronic administrative procedures is an important task as described, while it is necessary to review combination of items described in application documents among various administrative bodies as well as among administrative procedures. The government is planning cooperation with SaaS

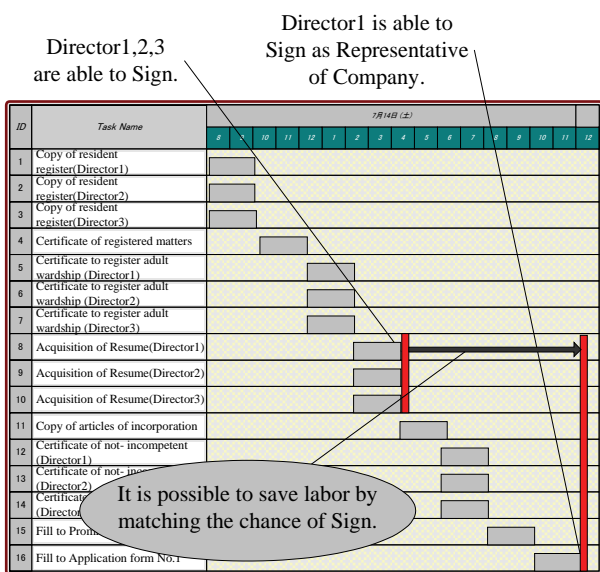


Figure 7. Timing of affixing a seal by Gantt chart

(Software as a Service) offered by a private company in the next-generation electronic administrative services [27]; however authors propose that operation with SaaS should also be realized in the electronic administrative system on the side of each administrative body, on the premise that the vertical administrative structure cannot be resolved in Japan (Figure 8). Authors consider that flexible response to the data standardization work targeted by the government will be possible, by developing ontology in application procedures governed by each administrative body and by defining the reference relationship through the mediation of attachments.

The approach where citizens or corporations as recipients of administrative services determine the policy in application procedures by utilizing a method to automatically propose the steps for application work in this report can be considered as a kind of decision support system (DSS). With DSS, knowledge is obtained and analyzed with a mathematical approach in accordance with required information, and supports decision-making based on quantitative results, such as the case utilizing many valued logics for assessment of companies' reliability [3], the case utilizing greedy heuristics and approximation algorithm for strategic proposals by financial managers [28], and the case utilizing ID3 algorithm to discover tacit knowledge [30]. The automatic proposal of the steps for application work in this report can be considered as decentralized DSS that encourages decision-making in combination with application procedure ontology as a knowledge database. Authors consider that future tasks include installation and evaluation of this type of decentralized DSS.

It is our hope that the review in this study will contribute to improvement of convenience in

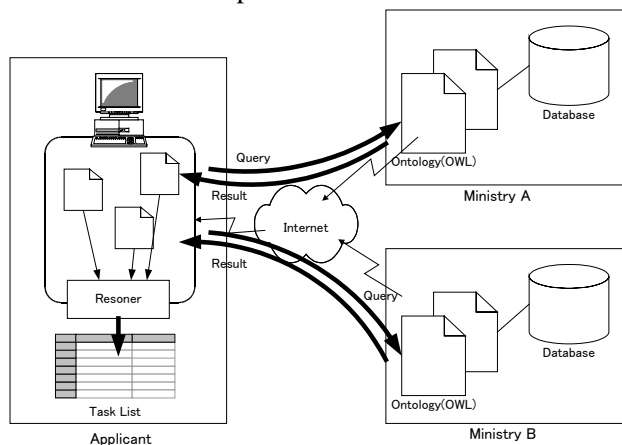


Figure 8. Diagram in the case that application procedure ontology is utilized in SaaS.

electronic administrative procedures.

References:

- [1] AGLS, AGLS Metadata Standard, http://www.naa.gov.au/recordkeeping/gov_online/agls/summary.html, Accessed 7 Aug. 2007.
- [2] e-GMS, e-Government Metadata Standard, <http://www.esd.org.uk/standards/egms/>, Accessed 7 Aug. 2007.
- [3] Encheva,S., Tumin,S., Decision Support System for Assessing Companies Reliabilities, *WSEAS Transactions on Business and Economics*, Issue 3, Volume 5, 2008, pp.44-51.
- [4] GILS, Global Information Locator Service, <http://www.gils.net/browse.html>, Accessed 7 Aug. 2007.
- [5] Goudos,S.K., Peristeras,V., Taranabis,K., A Semantic Web Application for Public Administration Using OWL for Public Domain Data Knowledge Representation, *WSEAS Transactions on Information Science and Applications*, Volume 4, Issue 4, 2007, pp.725-730.
- [6] e-Gov, Information (in Japanese), <http://www.e-gov.go.jp/help/jyouhou.html>, Accessed 4 Feb. 2008.
- [7] Hachinohe City, Aomori Prefecture, The Promotion Plan of e-Hachinohe (in Japanese), http://ns.city.hachinohe.aomori.jp/plan/e_hachi/, Accessed 7 Aug. 2007.
- [8] Hachinohe City, Aomori Prefecture, One Stop Multi Application System with Lifetime Events (in Japanese), <http://www.e-ap.gr.jp/topics/040806/hachinohe.pdf>, Accessed 7 Aug. 2007.
- [9] Hatogaya City, Electronic City Office Promotion Plan (in Japanese), <http://www.city.hatogaya.saitama.jp/modules/hisei/plan/denshisuishin.php>, Accessed 4 Feb. 2008.
- [10] IPSMS, Irish Public Service Metadata Standard, <http://www.gov.ie/webstandards/metastandards/index.html>, Accessed 7 Aug. 2007.
- [11] Izumi,N., Yamaguchi,T., Pattern-Oriented Development of Software Agent Based on Ontologies, *The transactions of the Institute of Electronics, Information and Communication Engineers. D-I*, Volume J-84-D-I, No.8, 2001, pp.1181-1191.
- [12] Izumi,N., Yamaguchi,T., Developing A Repository of Task-Patterns for the Construction of Agents Supporting Teachers, *Transactions of Japanese Society for*

- Information and Systems in Education*, Volume 18, No.3,4, 2001, pp.352-363.
- [13] Kawaguchi,H., Komiya,S., Development of the Multipurpose Expert System Based on Behavioral Trait Analysis in Administrative Procedures, *The 8th Asian Pacific Industrial Engineering and Management Systems Conference & CIIE*, Kaohsiung, Taiwan, Dec. 2007.
- [14] Medjahed,B., Bouguettaya,A., Customized Delivery of e-Government Web Services, *IEEE Intelligent Systems*, Volume 20, No.6, 2005, pp.77-84.
- [15] Ministry of Internal Affairs and Communications, The Basic Resident Register Network (in Japanese), <http://www.soumu.go.jp/c-gyousei/daityo/index.html>, Accessed 4 Feb. 2008.
- [16] Ministry of Internal Affairs and Communications, Delivery Situation of Basic Resident Register Cards (in Japanese), http://www.soumu.go.jp/c-gyousei/daityo/pdf/050217_1.pdf, Accessed 4 Feb. 2008.
- [17] Ministry of Justice, The System to Provide Online Registration Information (in Japanese), <http://www.moj.go.jp/MINJI/minji25.html>, Accessed 4 Feb. 2008.
- [18] MIREG, Management Information Resources for eGovernment, <http://ec.europa.eu/idabc/en/document/2361/5927>, Accessed 7 Aug. 2007.
- [19] Mizoguchi,R.(Editor), <Special Issue>Feature Articles on Developed Ontologies, *Journal of Japanese Society for Artificial Intelligence*, Volume 19, No.2, 2004, pp.135-193.
- [20] Mizoguchi,R., *Ontological Engineering (in Japanese)*, Ohmsha, Tokyo, 2005, pp.32-35.
- [21] Nishio,M., *Activity of the administration (in Japanese)*, Yuhikaku, Tokyo, 2000.
- [22] Page,L., Brin,S., Motwani,R., Winograd,T., The PageRank Citation Ranking: Bringing Order to the Web, <http://www-db.stanford.edu/~backrub/pageranksub.ps>, Accessed 2 Jul. 2007.
- [23] Prefectural Association for JPki, The Public Personal Authentication Service (in Japanese), <http://www.jpki.go.jp/>, Accessed 4 Feb. 2008.
- [24] SemanticGov, Services for Public Administration, <http://www.semantic-gov.org/>, Accessed 8 Aug. 2007.
- [25] Shindou,M., *The administration of Japan (in Japanese)*, Tokyo University Publishing, Tokyo, 2001.
- [26] Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society, New IT Reform Strategy (in English Summary), <http://www.kantei.go.jp/foreign/policy/it/ITstrategy2006.pdf>, Accessed 11 Jul. 2007.
- [27] Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society, Project team of Next-generation electronic administrative services (in Japanese), <http://www.kantei.go.jp/jp/singi/it2/nextg/index.html>, Accessed 25 Apr. 2008.
- [28] Suh,C.K., An Integrated Two-Phased Decision Support System for Resource Allocation, *WSEAS Transactions on Business and Economics*, Volume 4, Issue 11, 2007, pp.169-175.
- [29] Varavithya,W., Esichaikul,V., Using the Composite Act Frame Technique to Model 'Rules of Origin' Knowledge Representations in e-Government Services, *Electronic Commerce Research and Applications*, Volume 6, No.2, 2007, pp.128-138.
- [30] Vlahovic,N., Discovering Tacit Knowledge in Business Decision Making, *WSEAS Transactions on Business and Economics*, Issue 4, Volume 5, 2008, pp.64-73.
- [31] W3C, OWL Web Ontology Language Guide, <http://www.w3.org/TR/owl-guide/>, Accessed 4 Feb. 2008.
- [32] Yang,D., Tong,L., Ye,Y., Approach for Analyzing, Extracting and Modeling e-Government Ontology, *Journal of Southeast University (English Edition)*, Volume 22, No.3, 2006, pp.361-364.

Appendix A: Application procedure class for submission of detective business (tabular format)

Application documents and attachments	Type	In charge	Repetition	Initial condition		
				1	2	3
Certificate of registered matters	Document to be arranged			1		
Copy of resident register for director	Document to be arranged	Director	Director	1		
Copy of resident register for applicant	Document to be arranged	Individual		2		
Copy of resident register for legal representative	Document to be arranged	Legal representative	Minor	1	1	
Copy of alien registration document	Document to be arranged		Foreigner	1		1
Certificate to register adult wardship for director	Document to be arranged	Director	Director	1		
Certificate to register adult wardship for applicant	Document to be arranged	Individual				
Certificate to register adult wardship for legal representative	Document to be arranged	Legal representative	Minor	1	1	
Certificate to register not incompetent for director	Document to be arranged	Director	Director	1		
Certificate to register not incompetent for applicant	Document to be arranged	Individual		2		
Certificate to register not incompetent for legal representative	Document to be arranged	Legal representative	Minor	1	1	
Resume for director	Document to be prepared	Director	Director	1		
Resume for applicant	Document to be prepared	Individual		2		
Resume for legal representative	Document to be prepared	Legal representative	Minor	1	1	
Copy of articles of incorporation	Document to be arranged			1		
Promissory letter (Paragraphs 1 to 4 of Article 3 of the law is not applicable)	Document to be prepared	Director	Director	1		
Promissory letter (Paragraphs 1 to 5 of Article 3 of the law is not applicable)	Document to be prepared	Individual		2		
Promissory letter (Paragraphs 1 to 5 of Article 3 of the law is not applicable)	Document to be prepared	Legal representative	Minor	2	1	
Form 1	Document to be prepared			1		

Appendix B: List of initial conditions

Initial condition	Questionnaires	1	2
1	Selection of either corporation or individual Select "corporation" if an applicant is a corporation, and select "individual" for an individual business.	Corporation	Individual
2	Existence of minors Whether or not minors are included in applicants or directors	There is a minor.	There is not a minor.
3	Existence of foreigners Whether or not foreigners are included in applicants of directors	There is a foreigner.	There is not a foreigner.
Repetition Director	Specify the number of directors for target.		
Repetition Minor	Specify the number of minors for target.		
Repetition Foreigner	Specify the number of foreigners for target.		