END-USER-INITIATIVE APPROACH TO E-GOVERNMENT SYSTEMS SUPPORTING GREEN-BY-IT

Takeshi Chusho
Department of Computer Science,
School of Science and Technology, Meiji University
Kawasaki, 214-0033, Japan

ABSTRACT

Applications for e-Government should be developed based on user-centered design. In the late 1990s, one-stop-service by governments became popular. In Japan, the e-Government service was promoted by priority policy programs since 2001. However, there have not been sufficient achievements. Recently some ministry in Japan issued the special report of a proposal for activation of local areas by ICT. This paper focuses on Web applications supported by the local government because citizens will obtain a lot of benefit in daily life by using them. Such applications should be developed by business professionals themselves since applications must be developed agilely and modified frequently in order for a local government to support Web applications of high usability for citizens in a timely fashion with low costs. An application for Green-by-IT based on the three-tier architecture of user interface, business logic and database is selected as a typical example and then it is developed by using application framework and visual modeling technologies.

KEYWORDS

End-user-initiative development, e-Government, Green-by-IT, Requirement definition, Business logic.

1. INTRODUCTION

The number of end-users using the Internet has been increasing. Usability of applications has become important. In particular, applications for e-Government should be developed based on user-centered design.

In Japan, e-Government was promoted by priority policy programs called "e-Japan" since 2001. However, such achievements have not been sufficient [1]. Many ministries in the central government developed similar systems individually with sufficient budgets, many of which systems were not sufficiently used because of a lack of usability. On the other hand, local governments developed applications slowly because of lack of funding.

The main problem is lack of end-user's point of view, that is, why, what and how the application should be developed. In this paper, we focus on Web applications supported by governments because citizens will be benefited in their daily life. Such applications should be developed by business professionals themselves since applications must be modified frequently. There are some papers referred to end-user computing (EUC) which described summary of the trends of end-user development without IT professionals' assistance [10] and end-user software engineering research for end-user programmers and domain experts [3, 5].

Our research target is the end-user computing for business professionals and business domains. The user's intention is definitely defined as requirement specifications without inference as business professionals with domain expertise develop software which executes their own jobs. Therefore, this paper pays attention to a Web application in which the user interface is a Web browser because most users are familiar with how to use the Internet. Furthermore, the three-tier architecture is supposed, which has been popular recently. Generally, there are three approaches corresponding to the user interface (UI), business logic (BL) and database (DB). In our studies, application frameworks and visual modeling tools based on components were developed for EUC [2, 6].

This paper presents basic approaches for end-user-development in Section 2, government report reviews and suggestions in Section 3, end-user-initiative development technologies in Section 4.

2. END-USER-INITIATIVE APPROACH

2.1 Necessity of end-user-initiative development

Our approach to how to make Web applications is shown in Figure 1. The left side implies the abstract level. The right side implies the concrete level with the related technologies. The business model at the business level is proposed by end-users who are business professionals. Then, at the service level, the domain model is constructed and the required services are specified. That is, the requirement specifications of the application for the business model are defined. At the software level, the domain model is implemented by using components to be combined.

In this approach, there are two technological gaps, these being, the granularity gap between components and the domain model, and the semantic gap between the domain model and end-users. The granularity gap is bridged by business objects, patterns and application frameworks based on CBSE (Component-Based Software Engineering). In particular, our previous studies verified the effectiveness of application framework technologies by development of service counter frameworks [6]. Conversely, the semantic gap is bridged by domain-specific technologies [9].

The approaches to end-user-initiative Web application development methodologies based on the three-tier architecture are classified into the three categories of UI-driven, model-driven and data-driven processes by first focusing on any one of the UI (user interface), the model (business logic) or DB. The first two approaches are suitable for EUC, although the third approach seemed to be difficult for end-users. The UI-driven approach makes it possible to develop applications for the UI-centered front-end systems easily. It is strengthened by using domain-specific framework technologies. The model-driven approach makes it possible to develop applications for workflow-centered back-end systems easily. It is strengthened by using a visual modeling tool.

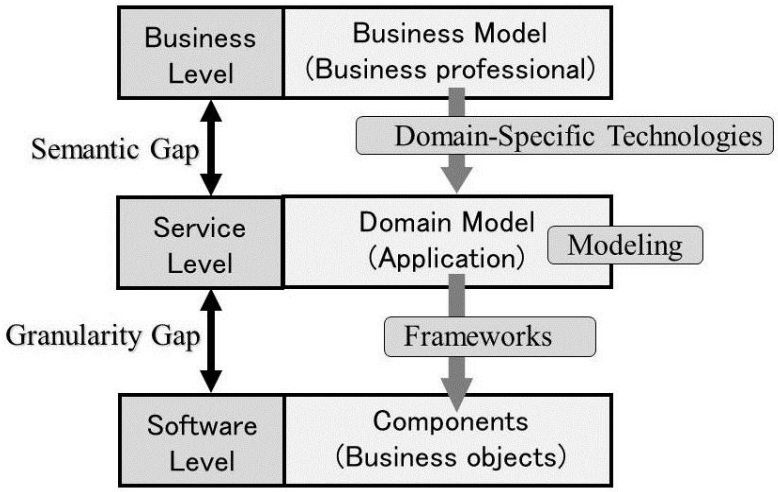

Figure 1. Technologies for end-user computing

2.2 The present state of e-Gov

In order to promote measures for forming an advanced information and telecommunications network society, the Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society (IT Strategic Headquarters) [4] was established within Cabinet in 2001. The strategy called e-Japan, aimed to make Japan the world's most advanced IT nation within five years. One of four priority policy areas was the realization of e-Government. However, e-Government was not sufficiently achieved. In fiscal 2001

and 2002, the more than 70 billion dollars budget was spent and how to use the tax was criticized [1]. For example, the registration system of new cars started in Dec. 2005 and was used for 11,175 cars among about 1.54 million cars in 2007. The rate of use was only 0.7%. The filing system for a passport started in 2004 and stopped in 2006 because only 133 passports were issued. This implies that the cost for one passport is more than 100 thousand dollars.

In 2006, the new IT reform strategy started for realizing a ubiquitous and universal network society where everyone can enjoy the benefits of IT. One of the several areas responding to social issues that should be resolved is the world's most convenient and efficient e-Government for handling of 50% or more of all filings online and creating a small and efficient government. However, it was insufficient to realize these goals of the second stage as well as the first stage of e-Japan. In 2009, the Board of Audit of Japan conducted a survey of use rate of 49 developed systems and disclosed that the use rate of the 12 systems is lower than 10%. The use rate of seven systems among them is lower than 1%. Many systems were developed without needs.

The IT Strategic Headquarters presented i-Japan strategy 2015 in 2009. As for e-Government, one of the targets is the promotion of one-stop-service with cloud computing. In July 2012, the revised version of the schedule of the new strategy on ICT (information and communication technologies) was presented by the IT Strategic Headquarters, while the first version is issued in June 2010. In the section 3 of this paper, the report for local area activation by ICT from the Ministry of Internal Affairs and Communications in June 2011 are reviewed in detail.

2.3 Green-by-IT as a sample application

For the experience with the end-user-development, a reuse support system is selected by the following reason. This is because it is expected that IT (information technologies) contributes to saving resources and environmental preservation for a sustainable society. For this purpose, application software is required, and then funds are needed for its development by IT professionals. However, the preparation of funds is difficult unless a profit is calculated over the development cost. The end-user-initiative development of application software is indispensable for the solution of this dilemma.

For example, let's consider a charity shop or a thrift store which sells limited goods to limited customers in a local area. The number of goods and the number of customers will increase if business professionals develop the application for the web site in which customers can register goods to be reused or search the list of registered goods for their own use easily.

Then, actual support systems for the promotion of reusing second-hand items were surveyed by searching the Internet. As a result, the following facts were confirmed:

- Many local governments support reuse promotion activities for ecological movements. Most of them use the Internet for announcements of the activities, but do not use it for practical operations. Instead practical operations are executed at the counters.
- An Internet site in practical operation for reuse could not be found.
- There are a lot of regulations for reuse promotion services and the regulations are strongly dependent on each local government's policy.

Let's give some cases of big cities in Japan. In Kawasaki city where our faculty exists, supports open-air markets that a citizen can sell unnecessary goods to other citizens. These events are face-to-face dealings, although the announcement is performed via the Internet. Furthermore, there are some rules and regulations. In the reuse promotion event, a receiver must be more than seventeen years old and can propose less than three items at one event. In the open-air market, only citizens can participate in the event and goods to be sold are limited to unnecessary ones in their houses. In some wards of the Metropolis of Tokyo, similar events are supported.

3. GOVERNMENT REPORT REVIEWS AND SUGGESTIONS

3.1 Summary of the government report

The proposal for activation of local area by ICT (information and communication technologies) was presented by the MIC (Ministry of Internal Affairs and Communications) in Japan in June 2011 [7]. This report is based on the ideas that ICT must be an important tool for activation of local areas by improvement of efficiency and addition of value in the domains of administration, medical treatment, education, industry etc. Furthermore, ICT enables citizens to cooperate each other and becomes a mediator for regeneration of human relations.

3.2 Issues on local areas

The first chapter of the report describes issues on local areas. In particular, the following items are indicated as issues on practical use of ICT:

(1) The solution power of ICT is not understood because of a few experiences.
(2) The need of ICT is not recognized by stakeholders.
(3) The past policies on ICT did not match the need which is dependent on each local area.
(4) The communication between service requesters and service providers is insufficient.
(5) The service providers of ICT limit services to the classical improvement of manual work.
(6) The use rate of the Internet by the aged is very low.

The report indicates some issues of local governments. The local government cannot afford sufficient office workers with a lot of know-how, while the government does not cooperate with stakeholders for need analysis or with experts of ICT. Furthermore, the government indicates that the cost is the most important problem. In the report, the survey on the issues of ICT activation policies by local governments confirmed that the selection rate of each issue is as follows: 55% for initial cost, 55% for running cost, 42% for lack of know-how, and 38% for lack of staffs.

Our end-user-initiative approach with domain specific technologies will solve these problems. As for the reuse promotion service, it is easy to understand the effectiveness and efficiency of the Web site because many citizens must be familiar with Internet shopping. If the end-users as business professionals develop the system, practical services are improved. The development cost is reduced since the system does not developed by an IT company under contract. The running cost is also reduced by using cloud computing.

On the other hand, there are many kinds of business rules for reuse promotion services. The survey on Internet confirmed that each local government has original rules for this service. Therefore, the customization of business logic is a key point for our approach with domain-specific frameworks.

3.3 ICT approach

The second chapter of the report describes approaches to policies on ICT. In particular, the following paradigm shifts are important to realize the effectiveness of ICT policies:

- From service-provider-centered to client-centered
- From organization-centered to citizen-centered
- From technology-centered to human-centered

Then the following basic concepts are indicated for promotion of ICT policies:

(1) Citizen-centered activation of ICT
(2) Each local area thinks and executes independently
(3) The local areas where the ICT activation is not enough should be supported.
(4) Cooperation with various people and organizations should be supported.
(5) Socially-weak people should be supported kindly.

These concepts are derived from lessons which are learned from past failed projects that some systems stopped because of lack of running cost, the excellent systems did not spread widely or hardware-centered systems without matching need were not used.

Our end-user-initiative approach matches those paradigm shifts and will support these basic concepts. As for the reuse promotion service, it is easy to change the counter service of a local government to the Web site service because the business professionals of the counter service themselves can develop a Web application. They have a lot of know-how for reuse promotion services and know the true need of citizens and business rules for running systems.

3.4 Policies for solving issues

The five policies for solving issues on local areas based on the basic concepts are described.

3.4.1 Promotion of training and selection of talent people

The MIC should put the following actions into practice:

(1) Establishment of a system for an ICT local area manager

The manager is sent to a local government and takes the initiative in local area activation by ICT.

(2) Training and selection of talent people sending out information from local areas

This is very effective to activate local areas.

(3) Commendation for contributors to promotion of local area activation by ICT

This commendation will be effective not only for enlightenment but also for encouragement.

Tools for end-user-initiative development must be effective for ICT local area managers or volunteers for sending out information from local areas to promote the activation of local areas by ICT.

3.4.2 Promotion of solving issues by local areas themselves

For the recognition of the true need and cost reduction, the following actions should be put into practice:

(1) Promotion of matching the services of providers with the need of citizens

The MIC should survey sufficiently the need of local areas on activation by ICT.

(2) Promotion of use of cloud services

Cloud services should be used for cost reduction and the progression of ICT services.

(3) Promotion of making systems open and the standardization

This leads to cost reduction and activation of shared information among various systems.

Our end-user-initiative approach reduces mismatches between service requesters and service providers. Tools for end-user-initiative development such as domain-specific frameworks and visual modeling tools will be developed as open systems in accordance with standards.

3.4.3 Promotion of infrastructures for ICT activation

For the infrastructure construction of local areas, the following actions should be put into practice:

(1) Solution of geographical digital divide

In the local areas less than 10% in Japan, the broad-band communication network such as optical fiber cannot be used yet. The fund should be prepared.

(2) Promotion of use of cloud services in local governments

The MIC has already promoted use of cloud services for cost reduction, standardization of administration and citizen-centered e-Government and now it promotes interoperability and security.

(3) Promotion of infrastructure for natural disasters

The infrastructure for sending information to the people should be constructed based on lessons learned from the tremendous disaster of earthquakes and tsunamis in north-east Japan in March 11, 2011.

Our end-user-initiative approach matches use of cloud computing since tools for end-user-initiative development such as domain-specific frameworks and visual modeling tools can be provided as PaaS (platform as a service). Furthermore, these tools can be transformed into tools for matching donors of goods with donees who need the goods since the essential task of the reuse promotion service is matching between donors and donees.

3.4.4 Promotion of information integration with governments and private sectors

Cooperation with various people and organization such as citizens, local governments, NPO, companies and public organizations is required. Above all, the information integration with governments and private sectors which are main players is important. For this purpose, the following actions should be put into practice:

(1) Establishment of rules on disclosure of information for “Government 2.0”

It is difficult to use a lot of information on Web sites. The governments and public sectors should disclose information in data structure which can be manipulated by computers such as XML or CSV.

(2) Establishment of rules on information integration among organizations and sectors

While considering the tremendous disasters, standardization of data formats and protocols and agreements on authentication processes are important.

The reuse promotion services in the end-user-initiative approach have similar problems. At the first stage, each local government will support the Web site for reuse promotion services alone for citizens in the local area. At the next stage, these Web sites may be connected each other for more effective reuse promotion as donors and donees in the different local areas can match. In this case, standardization of data formats and protocols must be necessary.

As for "Government 2.0," the concept is "Can we imagine a new compact between government and the public, in which government puts in place mechanisms for services that are delivered not by government, but by private citizens? In other words, can government become a platform?" [8]

3.4.5 Local area activation by ICT in the various domains

In addition to the above-mentioned items, the effectiveness of activation of local areas by ICT is expected in the following domains: (1) Productivity improvement in agriculture, forestry and fisheries, (2) Safe medical treatment and nursing, (3) Promotion of local industry including tourist industry, (4) Education, (5) Usability improvement for aged people, (6) Promotion of teleworking, (7) Promotion of ecological activities that CO2 reduction by using ICT and CO2 reduction of ICT industry should be promoted, (8) Promotion of neighborhood associations that, for example, local communities can send information via Web sites and can cooperate with each other, and (9) Review of regulations against activation by ICT.

The reuse promotion services in the end-user-initiative approach are related to the items (7) and (8).

3.5 Promotion of end-user-initiative development

Promotion of end-user-initiative approach solves many issues of local areas as mentioned above. The reuse promotion service is a typical example. Many local governments support ecological activities. For example, an open-air market takes place sometimes somewhere. Reuse promotion services are supported as actual counter services.

At the first step, these counter services should be replaced with Web site services. Next, these Web site services provide Web service interface such as XML. Finally, these Web sites should be integrated into one global net via connection of local nets.

4. END-USER-INITIATIVE DEVELOPMENT

4.1 Requirement definitions

The reuse support system for a charity shop or a thrift store is considered as one of typical Web applications which need end-user-initiative development by using domain-specific framework and visual modeling. These domain-specific technologies require customization of business logic because it is supposed that there are a lot of variations in business logic.

In this section, the business logic is defined from the view of the service providers or the support system. Furthermore, it is supposed that a Web application have the typical three-tier architecture of user interfaces (UI), business logic (BL) and database (DB) as shown in the upper part of Figure 2.

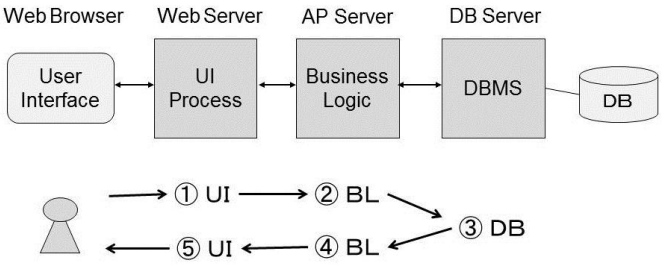

Figure 2. The three-tier architecture and UI-driven approach

Then the business logic from the view of the support system at the requirement specifications level is mapped into the combination of UI, BL and DB. The following template is introduced because the UI-driven approach is suitable for the end-user-initiative development:

(1) UI : The system gets a request from a client.
(2) BL : The system processes the request.
(3) DB : The system accesses sometimes the database.
(4) BL : The system processes the results from the database.
(5) UI : The system displays the results.

This template implies that the typical process for business logic is {UI -> BL -> DB -> BL -> UI} as shown in the lower part of Figure 2. It is easy for an end-user to understand this process because the end-user as a business professional or a domain expert is familiar with the following typical work flow such as getting a resident's card:

(1) A client fills out an application for the card and hands it to the service counter in the city office.
(2) A clerk of the service counter checks and passes it to a computer operator at the back.
(3) The operator enters the information about the client and gets the resident's card.
(4) The clerk receives it and confirms the contents.
(5) Then the clerk hand it to the client.

Some examples for the reuse support system are shown. The first example is the requirement for identification and qualification of donors and donees. The following business rules are given:

1. If a citizen is a resident or works in the city and is more than 17 years old, then register him or her.
2. Dealers cannot be registered.
3. If a citizen requests registration, then check the identification.

These rules are merged into one complicated rule and the main process of the rule is defined as follows:

(1) UI : The system displays a form for registration and gets a request from a client.
(2) BL : The system checks the request according to these rules.
(3) DB : The system accesses the database for registration.
(4) BL : The system gets the results from the database.
(5) UI : The system displays the identification number.

In this process, some details are omitted such as error handling, identification check and identification number generation. The common error handling will be defined at the design phase. The method of the identification check depends on the status of e-Government. Citizens may already have an identification method via Internet or they must visit an actual service counter once before the use of the support system. As for the identification number generation method, the system will prepare a common method such as a sequential number generator and sometimes may make a user select a form of the identification number.

The second example is the requirement for registration of items. The following business rules are given:

1. The system must require that the donor declares the item has been used in domestic life.
2. Large pieces of furniture are registered and kept at home.

If the reuse promotion services are limited to Web site services, the second rule is not necessary because it is considered that every item will be kept at home. Then the main process is defined as follows:

(1) UI : The system displays a form for registration and gets a request from a client.
(2) BL : The system checks the request according to the rule.
(3) DB : The system accesses the database for registration.
(4) BL : The system gets the results from the database.
(5) UI : The system displays the results including the item registration number.

In this process, some details are omitted also. The displayed form includes the check box for the declaration in addition to the information about the item.

These are examples of the case studies. Although it is supposed that there are a lot of variations in business logic, it is confirmed that the template is useful for defining the requirements based on the typical three-tier architecture of user interfaces (UI), business logic (BL) and database (DB). The definitions of business logic by using this template will promote the end-user-initiative development, especially when the domain-specific application framework and the domain-specific visual modeling tool are introduced. This is because it must be easy to understand the necessary facilities for business logic.

4.2 Implementation techniques

Our recent work for a domain-specific framework was applied to development of a reuse support system [6]. The version 1 was developed based on a simple framework of the JSP/Servlet model. In this framework, the logic class is invoked from the URL. Then the view and logic are implemented independently. The view is written in JSP. In the domain dependence portion of version 1, one JSP corresponded to one logic class. Moreover, the SQL was created in advance, and was saved in the properties file. However, it is necessary for the end-users to define the domain-dependent portion since the source codes in JSP and Java are dependent on domains. It must be difficult for end-users to do so.

In the version 2, we strengthened the function of the framework by modifying the first version to a component-based framework for the solution of this problem. It can make us construct an application not by programming but by defining the components. Therefore, since a GUI modeling method is provided by a visual tool, we can convert the GUI model to the configuration file used in the first version. It is possible for the end-user to build a web system by using a GUI modeling tool.

In this version, the view control engine was developed on the client side, which comprises the page-driver, the component-driver and the logic-driver. The page-driver sends a request for getting the page definition file to the server, which defines a group of the components of the page. After the page-driver receives the response, the component-driver send a request to the server for getting the component definition file for each component one by one, which is defined in page definition file. In fact, the content of component definition file is the group of elements. After receiving the response, the component-driver creates the elements which are defined in component definition file one by one. When these processes are completed, a domain page is created dynamically as a GUI.

When the event is driven in the domain page, the logic-driver sends a request to the server to process the busses logic module. After the logic-driver receives the response as a result, the logic-driver reflects the result to the domain page. On the server side, business logic is processed by operating DB with an SQL statement.

The end-user needs to design the external specifications of the application. By using visual tools, the end-user designs DB, GUI, and business logic. Design results will be kept in the JSON model, the CSS model, and the SQL statement. Specifications were examined based on each function of the visual tool. Depending on the capabilities provided by the visual tool, it consists of five pages of data modeling, component creation, page creation, logic modeling, and a main page which links to the another four pages as shown in Figure 3.

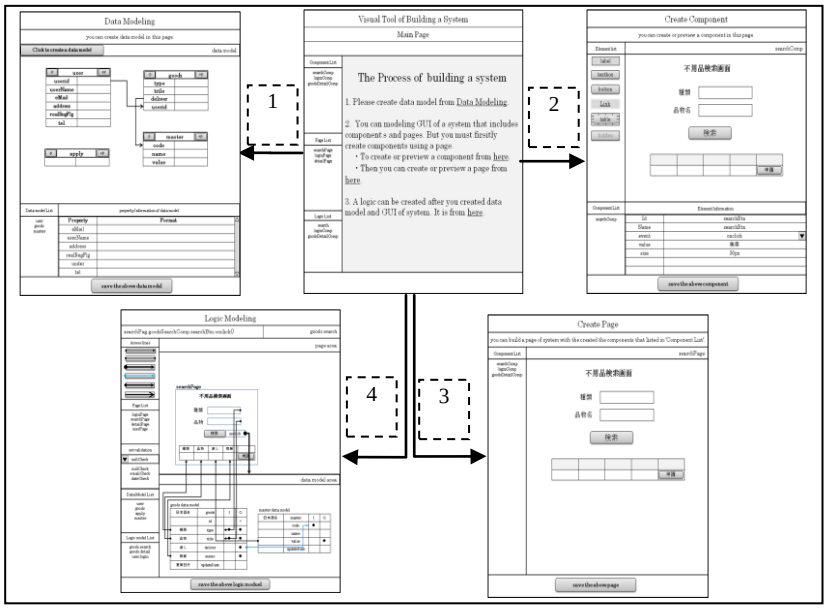

Figure 3. The page transitions of the visual tool

The middle page in the figure is the main page of the visual tool for building a system. The arrows 1, 2, 3 and 4 show the transitions from the main page to the data modeling page, the component creation page, the page creation page and the logic modeling page respectively.

As part of the study of a domain-specific framework for end-user-initiative development, we developed a Web application of the reuse support system while three tables were created for management of users, items to be reused and applications for getting the items. The domain dependence could be set up with the JSON model, the CSS model, and SQL. Then, this study confirmed that the end-user-initiative approach was effective.

5. CONCLUSION

Applications for e-Government should be developed based on user-centered design. From this view, the MIC special report of a proposal for activation of local areas by ICT was reviewed. As a result, it was confirmed that promotion of our end-user-initiative approach would solve many issues of local areas.

In our recent studies with an application for Green-by-IT based on the three-tier architecture, the template was introduced while paying attention to the fact that the typical process for business logic is {UI -> BL -> DB -> BL -> UI}. The end-user can define the business logic easily by using this template although there are a lot of variations in business logic which are dependent on each local government's policy. Furthermore, by using visual tools, the end-user can design DB, GUI, and business logic.

ACKNOWLEDGEMENT

This work was supported by JSPS KAKENHI Grant Number 23500052.

REFERENCES

[1] Chusho, T., 2010. End-User-Initiative Approach for Truly Useful e-Government Systems, *the IADIS e-Sosiety 2010 Conference*, pp.123-130.

[2] Chusho, T. et al, 2011. End-User-Initiative Development with Domain-Specific Frameworks and Visual Modeling, *The 10th International Conference on Software Methodologies, Tools and Techniques (SoMeT_11)*, pp.57-71.

[3] Fischer G. et al, 2009. Guidelines for Supporting Domain Experts in Software Development, *IEEE Software*, Vol. 26, No. 5, pp.37-44.

[4] Japanese IT Strategic Headquarters, http://www.kantei.go.jp/foreign/policy/it/index_e.html .

[5] Ko A. J. et al, 2009. End-User Software Engineering, *IEEE Software*, Vol. 26, No. 5, pp.16-17.

[6] Li, J. and Chusho, T., 2012. A Web Application Framework for End-User-Initiative Development with a Visual Tool, *Proc. 2012 IAENG International Conference on Software Engineering (ICSE'12)*, pp.816-822.

[7] The MIC meetig for activation of local area by ICT http://www.soumu.go.jp/main_sosiki/kenkyu/ict_chiikikassei/index.html .

[8] O'Reilly T., http://techcrunch.com/2009/09/04/gov-20-its-all-about-the-platform/ .

[9] Sprinkle J. et al, 2009. What Kinds of Nails Need a Domain-Specific Hammer?, *IEEE Software*, Vol. 26, No. 4, pp.15-18.

[10] Sutcliffe A. and Mehandjiev N., 2004. End-User Development, *Communications of the ACM*, Vol. 47, No. 9, pp.31-32.