\AUDIT SUPPORT PLUG-IN SYSTEM BY THE USE OF ONTOLOGY MODEL

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ABSTRACT

Auditing against Generic Management System requirements, like requirements of ISO 9001, is an established means for evaluating organizational capabilities. In ISO 9001, auditors check individual management system based on generic management system standards. Auditors faced with semantic problems because they must interpret the meaning of individual complex management system from the stand point of generic management system standards. To solve this semantic problem, audit support system has been developed using ontology editor. However the audit support system is not widespread, because the ontology editor is so complex. In ontology editor Protégé, too many functions for the ontology operations are provided. The main objective of this paper is to develop a new audit support plug-in system, which supports auditors who don't know about ontology concepts will be able to solve the semantic problems. In this paper, first we analyze complexity of conventional audit support system. Next, we construct plug-in system that is customized in audit by the use of Protégé plug-in function.

Keywords: ISO, audit support system, Ontology, plug-in, Protégé API

INTRODUCTION AND MOTIVATION

Auditing against Generic Management System requirements, like requirements of ISO 9001, is an established means for evaluating organizational capabilities. ISO 9000 family is a set of standards for Quality Management Systems (QMS). ISO9000 family includes ISO9000 (basic terminology), 9001 (QMS Requirements), 9004 (guidance for improving performance), and 19011 (audit guidance). To acquire the ISO9001 certification, organizations have to receive third party audits. Auditors check QMS of auditee (the party receiving audit) with ISO9001 requirements. However there are 2 problems. One problem is that Management system standards are too general to be applied effectively, because ISO9000 family is defined abstractly to apply varied sizes or types of organizations. Therefore it's not easy for auditors to understand the management system standards, and then audit conclusion may be changed. The other problem is "Lack of understanding QMS." Individual QMS is complex information system which has a lot of variation, so it's not easy for auditor to understand the auditee's QMS too. The main audit activity is to check auditee's QMS. Therefore it's necessary to understand and share auditee's QMS correctly between auditors and auditee.

Ontology is studied as a knowledge acquisition method in the artificial intelligence field in recent years. Ontology can systematically classifies everything that exists in the object world, define the relation of the vocabulary by property, and be able to describe meaning of the vocabulary and the relation. Using ISO9000 family ontologies, auditors can prevent misunderstanding. Gehrmann et al. (Gehrmann, 2005) constructed audit ontologies called AuditOWL using ontology editor Protégé. AuditOWL has ISO9000 ontology, ISO9001 ontology, ISO19011 ontology, and audit meta-ontology. Audit meta-

ontology is ontology in order to construct auditee's QMS ontology. Applying auditee's QMS to ontology, auditors can come to understand QMS correctly. ISO ontologies can enable interested parties to put abstract ISO concepts and requirements and to establish a wider ontological commitment, and can so contribute to more effective auditing by prevention of "interactive waste." Furthermore it's enabled auditors to audit consistently by cross-referring ISO ontologies and auditee's QMS ontology. Furthermore QMS ontology can share by using ontologies shareable over network, e.g. the Internet. AuditOWL supports auditors. However the auditors must understand ontological concepts for using AuditOWL. And Protégé has a lot of functions and complex interfaces. The problem is that the difficulty of Protégé's usage. The main objective of this paper is to enable auditors without ontology concepts to perform audit activities with AuditOWL system. Protégé provides plug-in function and a Java-based Application Programming Interface (API) for building knowledge-based tools and applications. We develop Audit Support Plug-in which supports "Auditing with AuditOWL" and improves AuditOWL's usability. In this paper, we explain "Auditing with AuditOWL" and the problems, and then we propose Audit Support Plug-in.

AUDIT ONTOLOGIES

The Problems about QMS Audit

ISO 9000 family is standards for quality management systems. ISO9000 family consists of 4 core standards, ISO9000 (fundamental and vocabulary), ISO9001 (Requirements), ISO9004 (Guidelines for performance improvements), and ISO19011 (Guidelines for Quality Management Systems Auditing). ISO9001 is the only standard for certification. The organization can provide continually the products or services of an excellent quality operating the certified QMS. Auditors audit organizational QMS comparing with ISO9001 requirements. In auditing, the following 2 problems are discussed (Gehrmann, 2008).

- terminology problem
- audit complexity problem

ISO 9000 family defined abstractly because ISO 9000 family was revised for applying varied types or sizes of organizations in 2000. As a result, it's not easy for auditors to understand the management system standards, and then audit conclusion may be changed. This difficulty called terminology problem. Auditors need to understand ISO 9000 family standards correctly. Lack of understanding of auditee's QMS is also audit problem. The varied sizes or types of QMS which constructed by auditee is complex information system. Therefore it's not easy for auditor to understand auditee's QMS too. Auditors may points out an irrelevant thing. Gerhmann (Gerhmann, 2008) calls this problem "audit complexity problem." Auditors and auditee should have common understanding about their QMS, and auditors should lead an accurate audit conclusion.

Currently computer assisted auditing techniques like web meetings, interactive web-based communications and remote electronic access to the documentation and/or processes are considered for enhancements of audit effectiveness and efficiency. These types of techniques are considered to increase the efficiency of audits in terms of time saving and cost reduction. However above-mentioned issues are not yet addressed.

Audit Support System Using Ontologies Called AuditOWL

Audit Support plug-in system by the use of ontology model

Ontology is studied as a knowledge acquisition method in the artificial intelligence field in recent years. Several definitions of ontologies are commonly used. T. Gruber (Gruber, 1993) defines ontologies as agreements between shared conceptualization. Ontology is used for the definition of the concepts and the relationship among concepts.

To solve the audit problems, Gehrmann et al. (Gehrmann, 2005) constructed audit ontologies called AuditOWL using ontology editor Protégé. AuditOWL has ISO9000 ontology, 9001 ontology, 19011 ontology and QMS meta-ontology. QMS meta-ontology is ontology to construct auditee's QMS ontology. Auditors construct auditee's QMS ontology using this QMS meta-ontology. Auditors and auditee can have the shared common understanding about the system concepts by defining the concept of QMS formally. And auditors can draw accurate and consistent conclusions from audits, by cross-referring QMS ontology and ISO9001 ontology.

The Problems of Conventional Audit Ssupport System

However the audit support system called AuditOWL is not widespread. There are the following 3 problems for AuditOWL.

Complex Protégé Interface

Protégé is a free, open source ontology modeling editor. Protégé can enhance the function using Protégé plug-in. On the other hands, Protégé has a lot of icons or tabs on the interface (Figure 1). So it's difficult for auditors to operate Protégé intuitively. The easy input interface is needed.

Necessity of QMS Ontology Construction

Using AuditOWL, auditors can draw accurate and consistent conclusions from audits by cross-referring QMS ontology with ISO9001 ontology. To draw accurate and consistent conclusions, auditors need construct QMS ontology. However all auditors do not necessarily have ontology knowledge. It is difficult for auditors who don't know ontology concepts to use this system. The device that doesn't need to require ontology concepts is necessary.

Complex Use

There is a "complex use" problem as a cause to which AuditOWL isn't widespread. Figure 2 shows the interface that appears when auditor checks requirements of management systems. For example, to check "Control of monitoring and measuring devices", the auditor need select "Product Realization" class from too many classes. And then auditor selects "Control of monitoring and measuring devices" instance from the right side. AuditOWL has 364 classes about audit. When auditors make some instances from specify class or give the slot values, user will be puzzled. Protégé has a search functions, but the beginner user doesn't know class name or property name. The structure to navigate input for beginner user is required.

Audit Support plug-in system by the use of ontology model
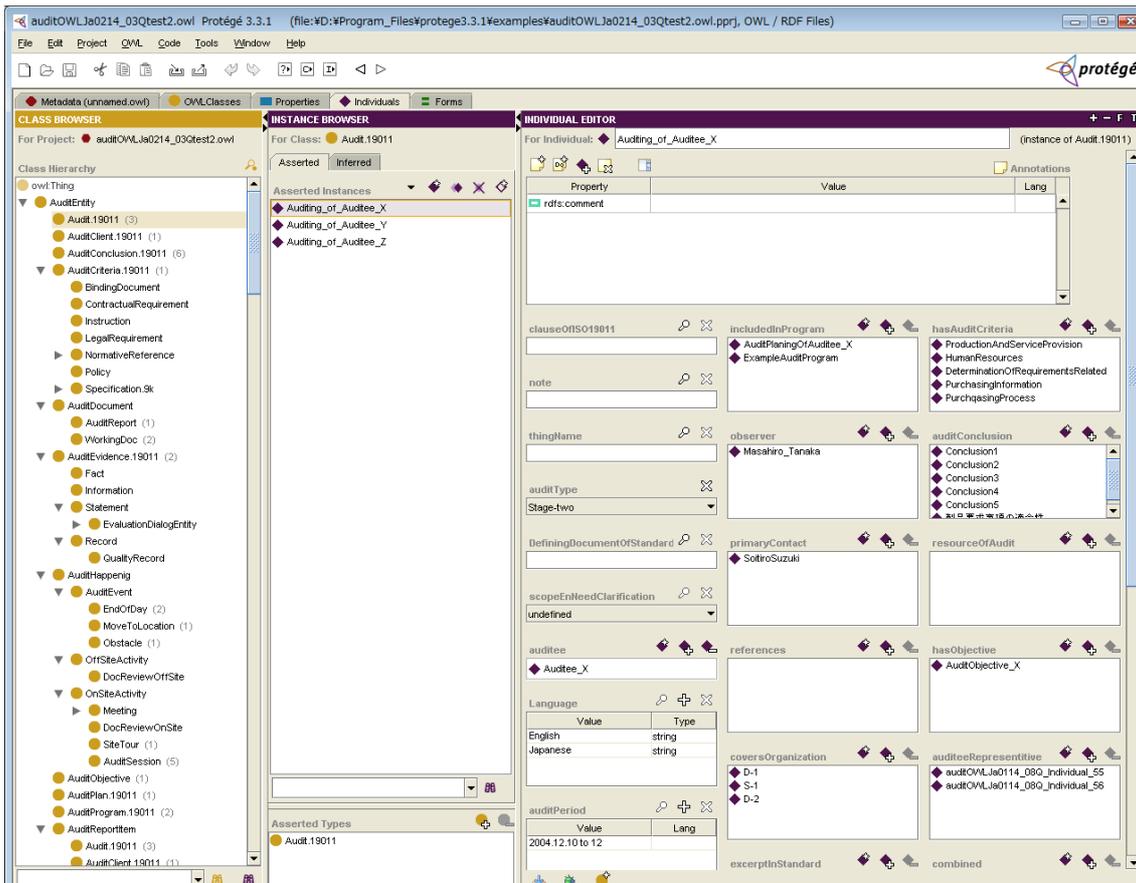
Figure 1. The Protégé Interface
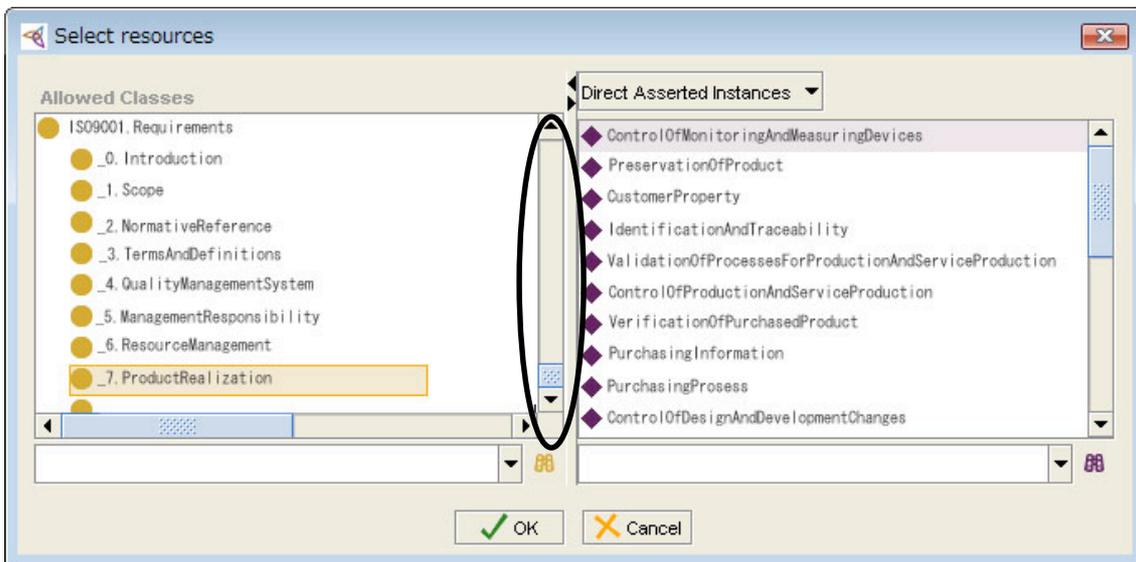
Figure 2. The Interface that Appears When Auditor Checks Requirements of Management Systems

We think that the following things may solve the 3 problems above.

- Easy interface to input
- Do not require the ontology concepts to auditors
- Navigating mechanism for input

Audit Support plug-in system by the use of ontology model

We try to improve audit support system and solve the 3 problems.

AUDIT SUPPORT PLUG-IN

As a method of solving the problems of AuditOWL, it's conceivable that "Teaching ontology concepts to auditors" or "Constructing a new application which auditors can use easily." However "Teaching Ontology to auditors" costs a lot of money and time. Or if we construct a new application, the effectiveness of AuditOWL is lost. Meanwhile ontology editor Protégé provides plug-in function. Plug-in can be used to change and extend the functions of Protégé. We construct the plug-in with the function demanded from AuditOWL. Then auditors can use AuditOWL easier with the efficient of AuditOWL.

Development of Audit Support Plug-in

We try to develop Audit Support Plug-in which solves the AuditOWL problems. This plug-in doesn't require considering ontology concepts to the users and settles the problems of AuditOWL.

Interface which is Specialized for Audit Activities

First, we design the interface which is specialized for the audit activities. We customize the interface so that auditors can input audit information in order (Figure 3). This interface supports to input audit information (like "audit objective", "covered department" etc. Thus the problem of complex Protégé interface is solved. However, in this state, auditors can't construct QMS ontology.

Figure 3. Interface which is Specialized for Audit Activity

Conversion from Input Information to QMS Ontology

We try to consider a method to construct QMS ontology from audit information. We should consider auditors who don't know about ontology concepts, so it is preferable to hide the ontology construction part from auditors. To hide the ontology construction part, we use Protégé API. The Protégé API is an open-source Java library. The API provides the classes and methods to load and save OWL (Web Ontology Language) files, to query and manipulate OWL data models, and to perform reasoning. For example "createInstance (*String, Class*)" method creates instance from a specific class. "setOwnSlotValues (*Frame, Slot, Collctions*)" method sets values to specific slot of specific frame. To create "audit objective" instance and set the slot values, AuditOWL needs first select "audit objective" class from lots of classes, second click the "create new instance" icon, and third input the audit information as an slot value. On the other hand, in a new way of using Protégé API, the user only input audit objective to the prepared text field. When the user clicks the OK button, the audit objective instance is automatically made. Auditors who don't know ontology concepts can construct QMS ontology. Thus the problem of necessity of QMS ontology construction is improved.

Navigation for Input

We should consider that auditors don't be puzzled when they input audit information. In ISO19011, the 7 steps of typical audit activity are shown (Figure 4). Auditors perform the audit activities following this audit steps.
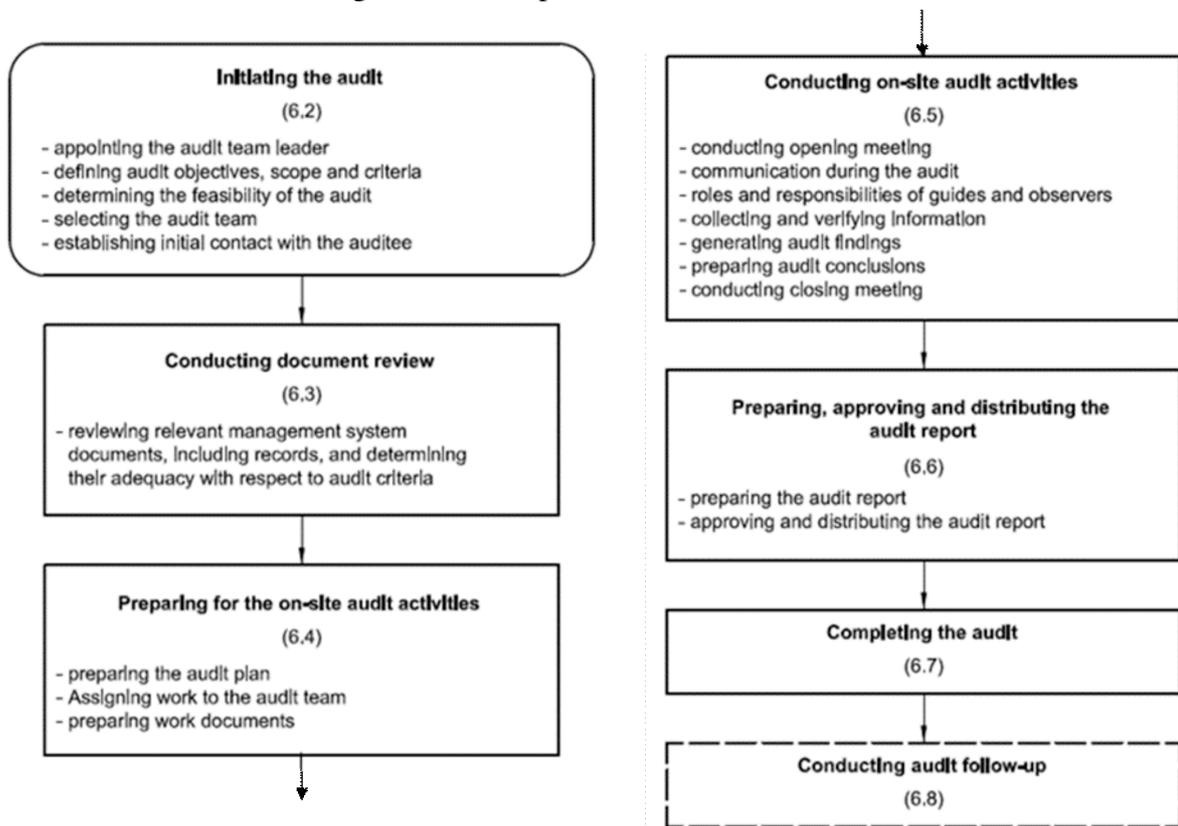

Figure 4. Overview of Typical Audit Activities

We re-customize the Audit Support Plug-in interface based on the typical audit steps. In the new interface, the 7 steps are arranged in order of audit steps at left side like menu bar (Figure 5). When the each button is clicked, each input form is displayed.
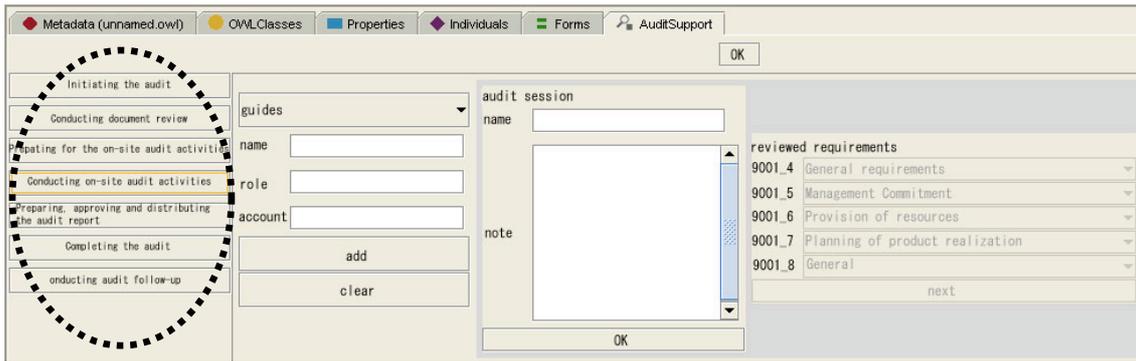
Figure 5. The Interface Based on Typical Audit Activities

Thus auditors are able to input audit information without being puzzled. The navigating mechanism was able to be done and the problem of complex use. The problems "complex Protégé interface", "necessity of QMS ontology construction", and "complex use" of a past system were solved by "Introduction of the plug-in", "Use of Protégé API", and "Design of the interface based on a typical audit activity"

Table 1. Problems and Resolves

Problem	Resolve	Use
Complex Protégé interface	Use Protégé Plug-in function and customize the Protégé interface which is specialized for audit activities	Protégé Plug-in
Necessity of QMS ontology construction	Construct QMS ontology automatically from audit information using Protégé API	Protégé API
Complex use	Re-customize based on typical audit activities and navigate the users.	Typical audit activities

Table 2. Comparative Table between **AuditOWL & AuditOWL with Audit Support Plug-in**

	AuditOWL	AuditOWL_AuditSupportPlugin
Auditor who knows about ontology	_ can use	_ can use
Auditor who doesn't know about ontology	_ can't use	_ can use
Interface	complex	Simple (only information about audit)
Manipulation	complex	Simple (only input information in the blank and click a button)

CONCLUSION

The number of organizations that want to take certification of ISO9001 has increased aiming at the quality improvement of the product and service._To take ISO9001 certification, the organizations construct original QMS, and receive the third party audit. It is said that auditors have terminology problem and audit complexity problem in the audit activities. To solve these problems, Gehrmann(Gehrmann, 2005) constructed audit ontologies, and propose audit support system called AuditOWL. AuditOWL helps auditors to understand ISO9000 family and auditee's QMS. And a consistent audit can be held by cross-referring auditee's QMS ontology with ISO9001 ontology. However, in order to use AuditOWL, auditors need ontological concepts and to construct auditee's QMS ontology. Moreover ontology editor Protégé has a lot of functions and complex interface, so it's not easy for auditors to use AuditOWL. We developed Audit Support Plug-in that is specialized for audit activities. This plug-in system provides simple interface and simple use, and be able to construct auditee's QMS ontology. To hide the ontology construction part, we use Protégé API. Auditors need to only input audit information to the prepared text field. Then they can construct auditee's QMS ontology without ontology concepts. Furthermore they can lead audit conclusion correctly by cross-referring QMS ontology with ISO 9001 ontology.

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