Representation Method for Engineering Perspective

Gaku Ishii and Masatake Sakuma

Toshiba Corporation
Komukai-Toshiba-cho, Saiwai-ku, Kawasaki 212-8582, Japan
{gaku.ishii,masatake.sakuma}@toshiba.co.jp

Abstract. For most Japanese Companies, knowledge succession is important for retaining technical competitiveness in the context of the rapid change of human resources. While efficient and effective knowledge succession requires the support of an IT system, the requirements for the supporting system are severe. That is, the system not only must offer the knowledge users need, but also must represent how to apprehend and utilize the knowledge.This paper introduces a method of representing technical knowledge considered in the development process of a knowledge succession support system (IVYs). It focuses on the user interface representing the standard or situation-dependent perspective of technical knowledge that experts define.

Keywords: KM (knowledge management), knowledge succession, engineering-support system, web-based application, user interface.

1 Introduction

Japan is confronted by "the year 2007 problem," which was identified and named by Teiichi Ariga, a former director of CSK Holdings Corp. The year 2007 problem refers to the concern that the retirement of Japan's baby boomers, i.e., those born in the period 1947-1952, will cause serious problems for Japanese companies and industry. The primary concern is that the accumulated experience and know-how of the baby boomers will be lost. In particular, there is concern that there will be insufficient engineers to operate computer programs of corporate mission-critical systems, because those programs were developed mostly by baby boomers [1]. Fig.1 shows the demographics of Japan [2].

Subsequently, there was a growing realization in Japan that the year 2007 problem might have a much larger impact on various technical fields than originally anticipated [3]. Moreover, the current global recession is compelling many companies to execute structural reforms and the related downsizing of workforces, in addition to natural attrition, in exacerbating companies' concerns about the risk of losing knowledge.

In the circumstances, knowledge succession to maintain technical competitiveness has become a pressing issue. Increasingly, Japanese companies are constructing systems to support knowledge succession [4] [5]. Toshiba is one such company and this paper introduces its activities to ensure knowledge succession.

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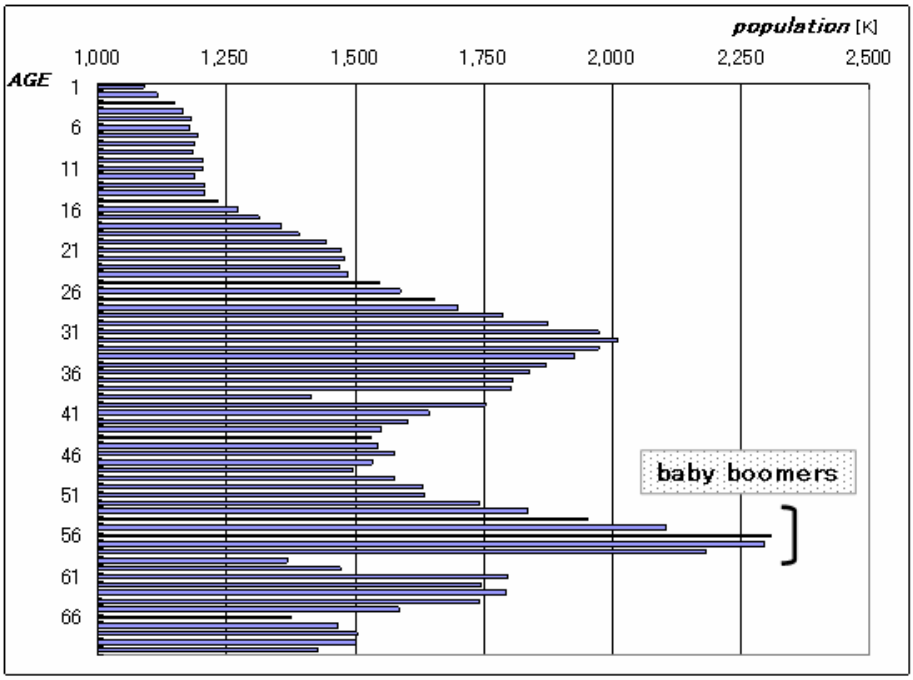

Fig. 1. Demographics of Japan, 2005

2 Knowledge Succession Support System: IVYs

IVYs (Intellectual Voyage System) is a web-based application designed by Toshiba that supports knowledge succession. IVYs has been used since April 2008 as an engineering-support system by a mechatronics engineering department consisting of about 60 engineers.

IVYs-knowledge, i.e., the knowledge registered in IVYs is mainly technical knowledge, such as technical standards and exemplary cases applied in the process of product design and development, and various functions making technical knowledge easy for engineers to use are implemented. IVYs-knowledge is mainly applied in engineering subprocesses, such as the design of size, form, and mechanism, or the selection of parts or materials.

We confirmed by interview that everyone in the department was aware of IVYs and used it for these subprocesses. On the other hand, science these subprocesses are not routine or part of daily work, engineers don't require or use IVYs-knowledge daily. Therefore, access frequency is not a reliable indication of the usefulness of IVYs. Although it has already been confirmed that IVYs has reduced the searching time for required technical knowledge by 80 to 90 %, it is important to establish a new method of evaluating the true value of IVYs.

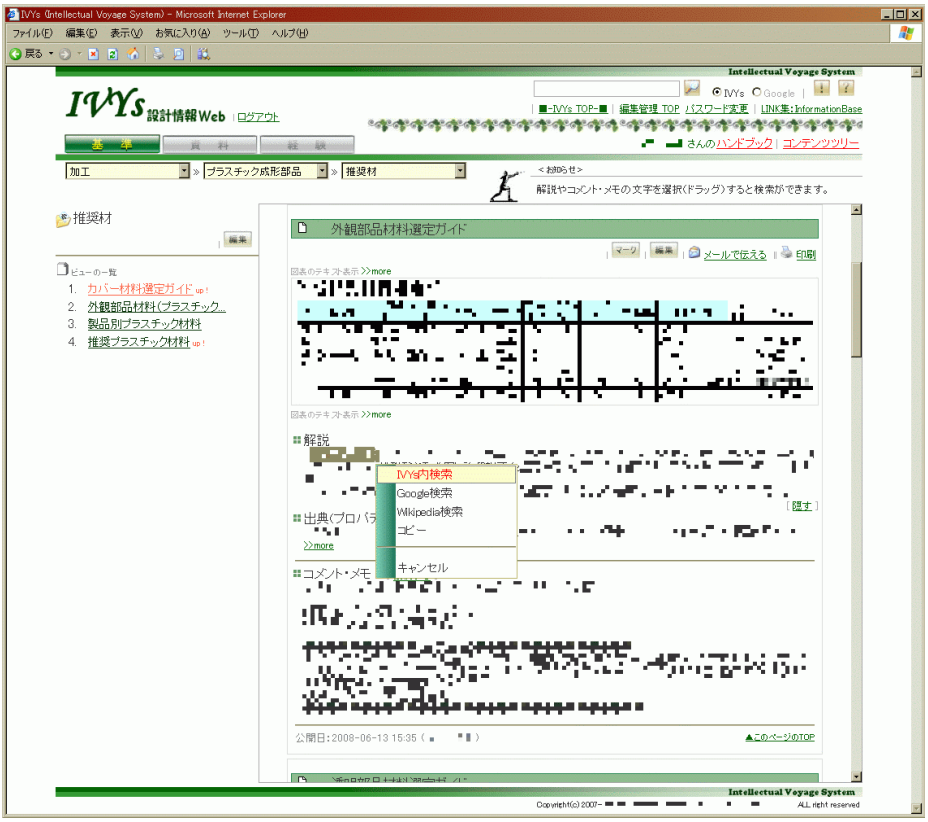

Fig. 2. IVYs (Intellectual Voyage System)

3 Requirements for Knowledge Succession in Engineering Fields

In order to practice knowledge succession in engineering fields, the support system not only must offer the knowledge engineers need, but must also represent the context of knowledge so that engineers can deepen their understanding of the knowledge. Since technology advances rapidly, engineers have to find the technical knowledge they require by themselves, i.e., engineers must have the capability to discover the field of required knowledge and its usage. An engineer with this capability can understand what query should be put to which system or whom, i.e., the engineer can generate the optimal inquiry for acquiring knowledge.

Therefore, for an engineer to strengthen this capability, the support system must represent technical knowledge, including its classification and usage scenarios, i.e., “the perspective of technical knowledge.” Through the experience of knowledge succession in the mechatronics engineering department, functions for representing and sharing the perspective are implemented in IVYs.

4 Functions of Representing and Sharing the Perspective

4.1 Representing the Standard Classification of Technical Knowledge

In order to represent the standard classification of technical knowledge, IVYs-knowledge is arranged in a classification tree according to the characteristics of the network structure that allows a child node to have two or more parent nodes. The classification tree in IVYs is expressed using three forms that support engineers understanding of the classification of technical knowledge. Fig.3 shows these two forms for representing the classification tree.

(1) The list box that is a standard component of HTML

(2) The contents tree illustrating the classification tree (IVYs original UI)

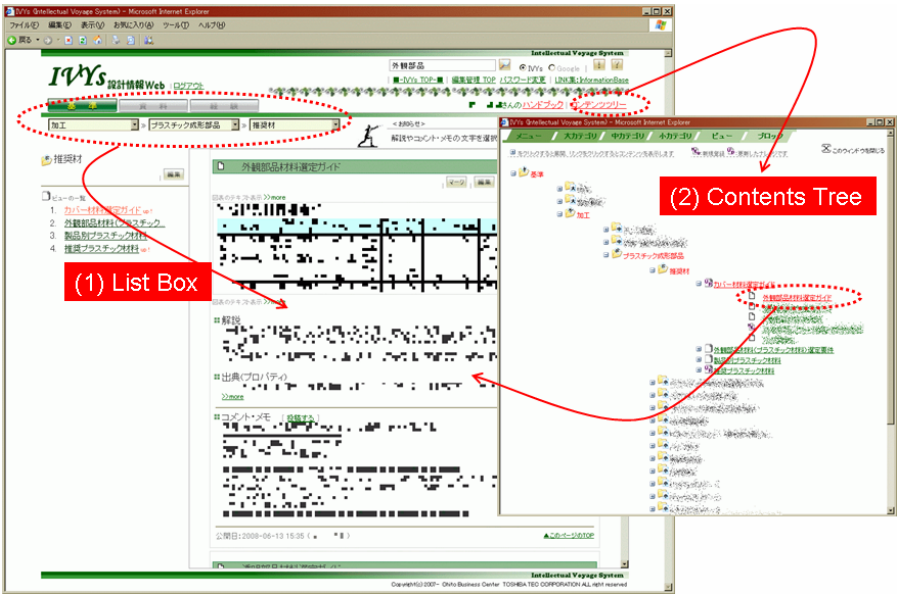

Fig. 3. HTML UI for representing the classification tree

Since most users are experienced in operation of the list box (1), it is an efficient interface for the user who understands the classification of technical knowledge. However, since the user cannot look at all choices of all classes at once, it is difficult for the user to trace a quick path by selecting the category to browse the knowledge.

Next, (2) has an advantage in that it is easier to look through the classification classes and categories of technical knowledge compared with (1). On the other hand, since the user may have to learn the operation of the application, beginner-oriented help and an intuitive user interface become more important.

In any event, since both (1) and (2) are premised on understanding the classification of technical knowledge, the situation for a user who does not understand the classification is akin to being lost in a maze. Therefore, IVYs' search function displays the "category chain" representing the classification to which the searched technical

knowledge belongs. The user can access searched technical knowledge from the hyperlink in the "category chain" (Fig.4), and this function servers as a refinement that makes the classification tree more familiar for the user.

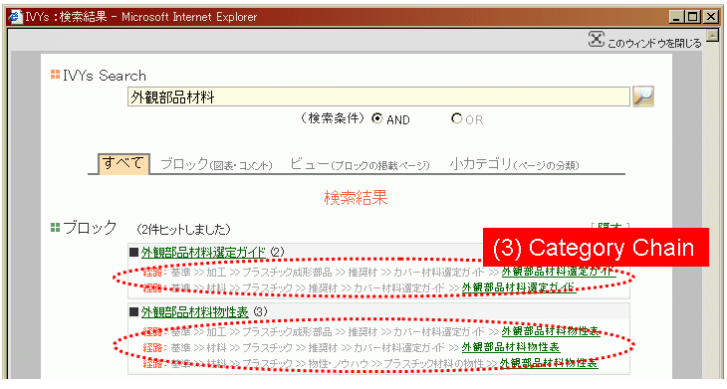

Fig. 4. Category Chain for representing the classification tree

4.2 Representing the Usage Scene of Technical Knowledge

IVYs' knowledge manager disassembles original engineering documentation into the minimum unit, called "BLOCK", which engineers can utilize, and registers them in IVYs as technical knowledge. Furthermore, the knowledge manager defines the required BLOCKs for every usage scenario as "VIEW" (Fig.5). VIEW equivalent to a page of a website is linked to the classification tree, and each VIEW represents a usage scenario of technical knowledge (Fig.6).

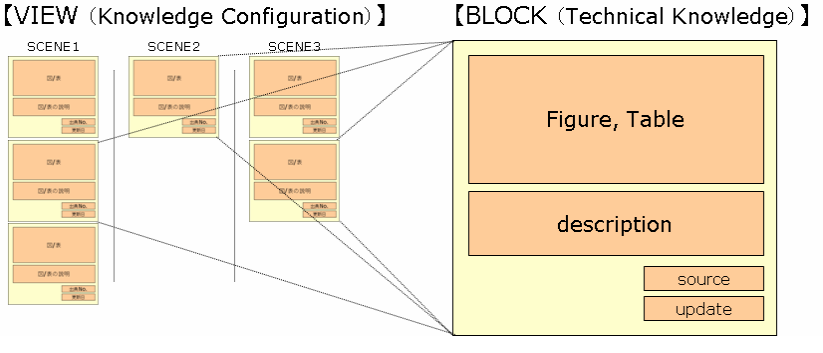

Fig. 5. IVYs' BLOCK & VIEW

A usage scenario is a certain scene in the engineering process such as "selecting a plastic component." Technical knowledge is needed for the consideration process of such selection. Therefore, in the case of the scenario "selection of a plastic component", technical knowledge required for the selection is constituted in accordance with the sequence of consideration, and shown to the user.

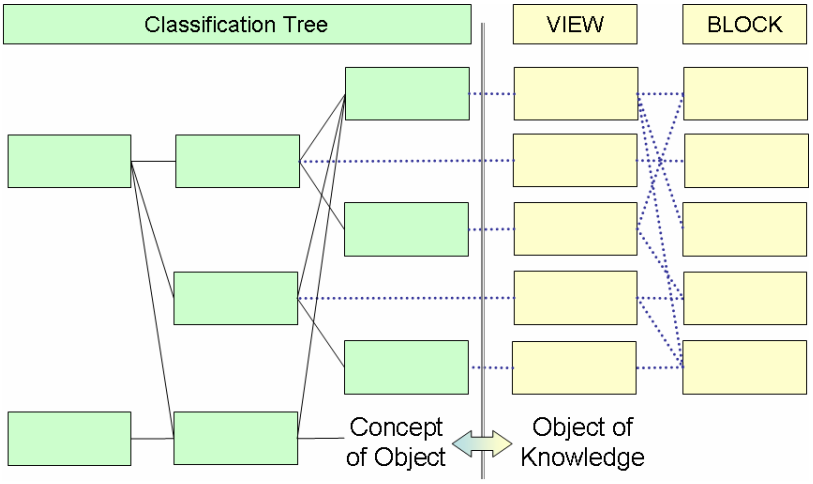

Fig. 6. Data Structure of IVYs

4.3 Representing and Sharing Situation-Dependent Perspective: Social Bookmarking

The usage scenarios of technical knowledge are defined in advance by the expert or the knowledge manager, and they can be considered to be the perspective represented by the expert that is valuable for inexperienced engineers. However, this is the standard

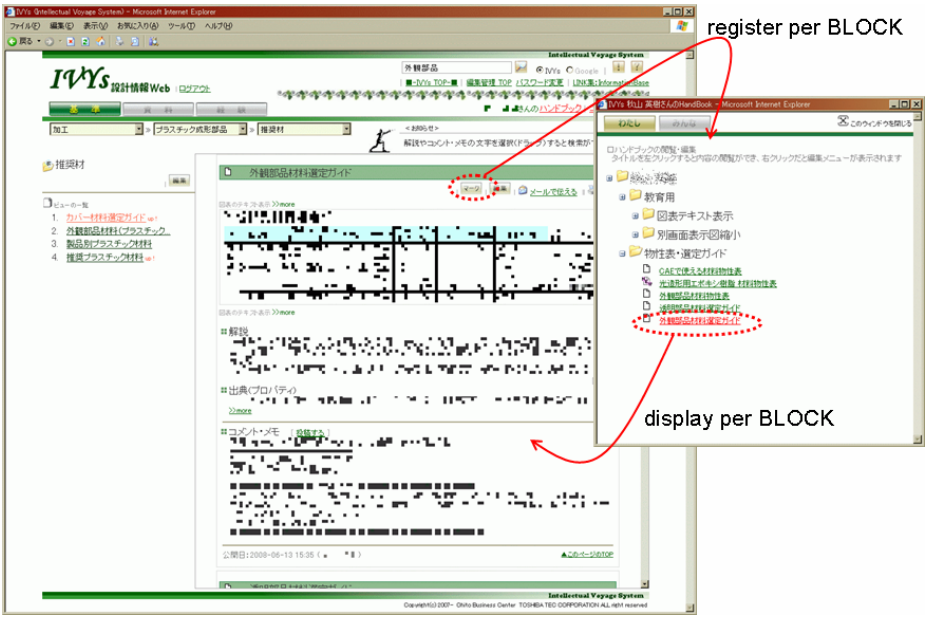

Fig. 7. IVYs HANDBOOK: Situation-dependent Classification Tree

perspective defined by the expert and it may not be applicable to actual engineering. Therefore, a function allowing each engineer to classify technical knowledge is also needed. Furthermore, in the actual engineering process, it is necessary to ensure that members of a project team have a good understanding of the technical knowledge that the project leader considers especially important, and, for that purpose, the members of the project team need a function enabling them to share the original classification.

This function named "HANDBOOK," which a form of Social Bookmarking, is intended to support succession of practical perspectives (Fig.7). The interface, which is the same as that of the contents tree explained above, can perform edit of an addition, deletion , display order change, etc. on a browser. In Addition, when maintaining social bookmarking on a company intranet, it is important to minimize the maintenance const. Therefore, the mechanism whereby the classification tree of each project is not neglected is implemented in HANDBOOK by setting up the display term.

5 Conclusion

At Toshiba, we are developing IVYs, a support system of knowledge succession, and are studying the method of representing "the perspective of technical knowledge" through the practice of IVYs.

It has already been confirmed that IVYs has reduced the searching time for required technical knowledge by 80 to 90 %. On the other hand, the impact of IVYs on knowledge succession will be evaluated from now on.

The ideal situation of knowledge succession in the engineering process is for the technical knowledge to be applied in engineering correctly. Therefore, the impact of knowledge succession should be evaluated on the basis of the observance rate of IVYs-knowledge in the engineering process. In this case, it is insufficient to evaluate the user's activity concerning the inspection of the knowledge on IVYs. It is necessary to evaluate the engineer's activity that applies IVYs-knowledge to engineering. For that purpose, a function enabling technical knowledge to be used in CAD (Computer Aided Design system) is required, and a mechanism connecting IVYs and CAD is currently under development. Analysis of the utilization of IVYs-knowledge on the extended mechanism is a subject for future work.

References

1. Yajima, N.: The 2007 problem of information system caused by the retirement of experts (April 2003) (in Japanese), `http://www.nikkeibp.co.jp/style/bizinno/conduct/article20030404.shtml`
2. Ministry of Internal Affairs and Communications, Population Census (in Japanese) (October 2005) World Wide Web, `http://www.stat.go.jp/data/kokusei/2005/kekkagai.htm` (retrieved 2/27/09)
3. Cabinet Office of Japan, The policy research report about participation in society by the elderly (in Japanese) (July 2005) World Wide Web, `http://www8.cao.go.jp/kourei/kenkyu/kenkyu.html` (retrieved 2/27/09)

4. Ishii, G., Nakayama, Y.: Method of utilizing the valuable knowledge of a company - integration of information lifecycle management and knowledge management. In: Papers presented at HCI International Conference 2005 [CD-ROM] (2005)
5. Ishii, G.: A Study of Knowledge Succession in Engineering Process Management. In: Papers presented at PICMET 2007 Conference [CD-ROM] (2007)
6. von Hippel, E.: "Sticky Information" and the locus of problem solving: Implications for innovation. Management Science 40(4), 429–439 (1994)
7. Szulanski, G.: Exploring Internal Stickiness: Impediments to the transfer of best practice within the firm. Strategic Management Journal 17, 27–43 (1996)
8. von Krogh, G., Ichijo, K., Nonaka, I.: Enabling Knowledge Creation: How to Unlock the Mystery of Tacit Knowledge and Release the Power of Innovation. Oxford University Press, New York (2000)