An Integrated Framework for Knowledge Audit and Capture

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ABSTRACT

In this paper, an integrated framework for knowledge audit and capture using the task analysis approach is presented. We first identify the types of knowledge that could be ascribed to tasks and analyze a task by breaking it down into subtasks and task elements. We then identify the skills and knowledge required to perform the tasks at this level. The framework is validated and tested on an expertise-based task, the findings of which are compiled as a knowledge-based document.

Keywords
Knowledge Management, Knowledge Audit, Knowledge Capture, Task Analysis.

1.0 INTRODUCTION

The problem of knowledge loss is an experience of all organizations, big and small, resulting from the loss of knowledge workers when they leave the organizations. However, most organizations do not find this problem compellingly urgent if failures of performance do not incur high costs to the business as new knowledge workers could be hired to replace the loss or they could provide other measures to avoid serious disruption of business activities. The problem becomes a matter of concern when the loss involves an expert, which may pose serious threats to the business. However, if recurring problems are not addressed, the costs of managing this problem could be astounding. As Soltan (1995) claims, 'knowledge mismanagement is costing a company far more than managing information systems.'

Earlier attempts of knowledge management (KM) have been corroborated by the deployment of intelligent systems in organizations. Today, such systems, which utilize the AI techniques are coupled with or embedded within information systems and equipped with advanced capabilities (Davenport et al., 2005; Fayyad et al., 1996). The current landscape of knowledge management is epitomized by business and predictive analytics. Companies that strive to improve their business performance using these data-intensive approaches are competing on optimization-based strategies (Kohavi et al., 2002).

In this paper, we present our contribution to KM in an aspect relating to the audit, capture, and reuse of expert knowledge. We propose an integrated framework that concurrently audit and capture knowledge using the task analysis approach.

In the next section, we review some of the related work in this research. Section 3.0 discusses the types of knowledge proposed by many researchers and describes our preferred types. In Section 4.0, we present our framework followed by Section 5.0, which describes the framework's validation process. Section 6.0 highlights the use of the framework's outcome and Section 7.0 concludes the paper.

2.0 RELATED WORK

The KM process embraces several tasks, which include knowledge creation, collection, organization, dissemination, and maintenance (Awad & Ghaziri, 2004). In this paper, we focus on a small but significant aspect of knowledge collection. The following subsections discuss some of the work that are relevant to our research.

2.1 Task Analysis

The task analysis approach to knowledge capture and audit is adapted from the study and analysis of tasks. The purpose of task analysis is to determine the nature of the task, the way in which it is performed, and the behaviors the knowledge worker must exhibit to accomplish the task (Youngman et al., 1986).

With task analysis, the types and degrees of knowledge, skills, and abilities the knowledge worker must posses can be determined (Freedman et al., 1982). Usually, the information are used to design training curricula to fulfill the training needs of knowledge workers. While the analysis of tasks carried out for training purposes requires the determination of skills, knowledge and attitudes to

a much greater detail, the task analysis conducted for knowledge capture and audit requires the auditor to determine only the skills and knowledge deficiencies.

2.2 Knowledge Audit

There is a consensus among researchers that knowledge audit is the process of identifying the core information and knowledge needs and uses in an organization. It identifies gaps, duplications, flows, and how they contribute to business goals (Thirumoorthy, 2003), (Yelden & Albers, 2004). It also investigates and analyses the current knowledge environment and culminates in a diagnostic and prognostic report on the current corporate 'knowledge health.' The audit is, thus, the first major stage in effective knowledge management and corporate knowledge valuation (Hylton, 2002).

The importance of knowledge audit is attested by the numerous techniques and methodologies for knowledge audit. Choy et al. (2004), for example, suggest a systematic approach to integrate various knowledge audit related techniques into pre-audit preparation, in-audit process and post-audit analysis. Lauer and Tanniru (2001) propose a methodology to understand the "gaps" in the needs of a knowledge worker. The methodology uses the "process change" research to help build a socio-technical environment critical for knowledge work. Thirumoorthy (2003) proposes a three-step procedure of knowledge audit, which identifies what knowledge currently exists in the targeted area, identifies what knowledge is missing in the targeted area, and provides recommendations to management regarding the status quo and possible improvements to the knowledge management activities in the targeted area.

2.3 Knowledge Capture

Knowledge capture or elicitation is a process by which an expert's thoughts and experiences are captured and documented (Awad & Ghaziri, 2004). Many knowledge capture techniques have been proposed by researchers. However, no one technique can claim superiority over the others. Each of these techniques such as on-site observation; brainstorming; protocol analysis; repertory grid; concept mapping; and nominal group technique is used to capture a particular type of knowledge (Awad & Ghaziri, 2004). Consequently, a knowledge engineer must be able to assess and select a suitable technique or a combination of techniques that ensure the total capture of knowledge from experts.

Kingston, Shadbolt and Tate (1996) establish a comprehensive knowledge engineering approach to knowledge-based systems design. The CommonKADS (Kingston et al., 1996) employs expertise and design models to support knowledge engineers in choosing knowledge representations and programming techniques. The models consist of a three-stage transformation process: application design, architectural design, and platform design. The approach enables useful documentation of system design process and encourage greater modularity and reusability of designs.

3.0 TYPES OF KNOWLEDGE

The knowledge management literature describe two general types of knowledge: tacit and explicit (Nonaka, 1994). Ryle (1969) suggests that knowledge can be classified as "knowing how" and "knowing that." Others label such knowledge as procedural and declarative knowledge respectively (Awad & Ghaziri, 2004), (Anderson, 1983). Velencei (2003) further details the tacit and explicit types into skills, intuitions and facts. Jorna (2001) prefers a semiotic perspective to knowledge types and considers three types of knowledge: tacit or perceptual knowledge, coded knowledge and theoretical knowledge.

Clearly, the various aspects of knowledge make it almost impossible to define specific types of knowledge. We base our framework on the tasks of knowledge workers, not just any tasks but specifically, expertise-based tasks. It does not consider the explicit knowledge assets of an organization, but focus primarily on an expert's tacit knowledge.

3.1 Development of Framework

To develop the framework, we use the task analysis technique while analyzing, identifying and classifying the skills and knowledge into several types. However, the classification is contextual in nature and is derived from the analysis of common organizational tasks. The knowledge types are classified as follows:

- motor skill (S),
- heuristic (H),
- procedural (P),
- fundamental (F).

Skill is defined as the ability, talent and craftiness of a knowledge worker to perform a manual task completely and thoroughly. Heuristic refers to the tricks of the trade, rules of thumb, hunches, intuitions, instincts or short cuts which evolve through constant exposure and prolonged experience in a specific task. In this context, cognitive skills are considered as a form of heuristic. We define procedural knowledge as the steps or procedure to perform a task. Knowledge acquired by knowledge workers through formal education and training is the fundamental

knowledge. This knowledge type varies in depth and complexity according to the qualifications and educational background of knowledge seekers. It is the enabling knowledge which serves as a foundation for knowledge seekers to acquire and utilize more advanced knowledge required for the performance of their jobs. The reasons for classifying the knowledge types in this manner are:

- these types of knowledge are difficult to manage and should be identified as separate entities,
- the knowledge types embedded within the head of each knowledge worker are unique to him and hence must be treated as such,
- it would make knowledge auditing more convenient,
- it would facilitate the alignment and integration of knowledge for the achievement of organizational goals.

4.0 THE INTEGRATED FRAMEWORK

The integrated framework identifies the skills and knowledge of a task. It analyzes the task further to identify the tools, procedures and references used. The outcome of this process is the *knowledge structure* of the task, which shows the skills and knowledge the task is made of. Figure 1 below shows a representation of our concept.

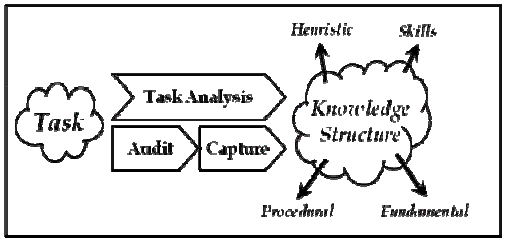

Figure 1: The Concept of K-Audit and Capture

The integrated framework consists of two composite processes of knowledge audit and capture. The audit process is characterized by the identification of the type of skills and knowledge, whether the task can be performed, the tools or instruments used and the references referred to. The organization and documentation of the information characterize the capture process. The processes of auditing and capturing the knowledge are conducted using the brainstorming technique with a subject matter expert (SME). The technique involves the following activities:

(a) Identify the tasks that contribute to the accomplishment of a job,
(b) Decompose each task into its components, that is, its subtasks,
(c) For each subtask, audit the skills and knowledge requirements and their types, the sources of references, and the instruments or tools to be used.

If it is possible to break down the subtask into its task elements, the skills and knowledge, their types, the sources of references, and the tools used could also be identified at this level. A task element is an elaboration of the subtask, which shows the detailed steps to accomplish the subtask. Figure 2 displays the integrated framework.

5.0 VALIDATION OF FRAMEWORK

To validate our framework, we apply it as a pilot project on the tasks associated with cable fault location for Tenaga Nasional Berhad (TNB) (Ahmad et al., 2010). We present excerpts of the project report in the following subsections

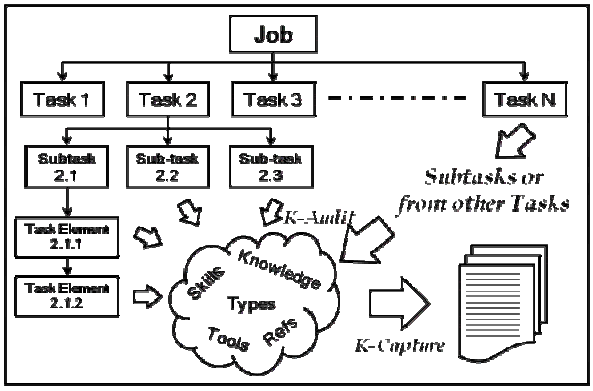

Figure 2: The Integrated Framework

5.1 Knowledge Audit and Capture

A brainstorming session was organized with an SME, which was conducted as follows:

1. The SME verbalized the sequence of steps (or subtasks) performed in each task.
2. For each subtask, a facilitator queried the SME the following:

   - describe the skills and knowledge applied,
   - identify the types of knowledge, whether the knowledge applied were skills (S), heuristics (H), procedural (P), and/or fundamental (F) know-ledge,
   - whether the subtask could be performed,
   - tools and/or instruments used,
   - references used and referred to.

   These queries characterize the knowledge auditing process for each subtask. In several instances, the SME narrated detailed activities performed for a subtask and provided further insights and finer points that were crucial to perform the task qualitatively.
3. Steps 1 and 2 were repeated for all the tasks of cable fault location.

We recorded the details of the findings in two audit forms: (a) AUDI (Task Descriptions) and (b) AUDII (Skills and Knowledge). These two documents represent the knowledge-based documents of Cable Fault Location (Ahmad et al., 2010).

5.2 Creation of Knowledge Structure

The knowledge structure of a task is created by compiling the skills a task performer needs to have and the knowledge he/she needs to know. These skills and knowledge types (i.e. S, H, P, and/or F) were identified while analyzing a subtask.

As an illustration, we show in Table 1, a portion of the sample of the knowledge structure of Subtask 2.1 and 2.2 extracted from Ahmad et al. (2010). The contents of **KNOWLEDGE ELEMENTS** and **TYPES** represent the knowledge structure of the **SUB-TASKS/TASK ELEMENTS** (Ref. No. 2.1).

The resulting knowledge structure of the task is the union of the knowledge structures of all its subtasks. Abstracting this concept further, the knowledge structure of cable fault location is the union of all the knowledge structures of its tasks. Figure 3 illustrates these abstractions.

The knowledge structure can then be used as a reference document for a Knowledge Enhancement Program (KEP).

6.0 KNOWLEDGE ENHANCEMENT PROGRAM

The KEP segments collections of each knowledge type (S, H, P, F) identified from the framework into specific training programs: Skills Training, Mentoring, On-the-Job Training or Formal Education. Figure 4 explains this concept.

A knowledge worker undergoes a KEP if there is a knowledge gap between his/her knowledge and the knowledge structure, i.e. the knowledge that are required by his/her job. Identifying this gap is just a matter of assessing his/her achievement in written and practical test sessions.

Table 1: A Sample of the Knowledge Structure

JOB: Cable Fault Location				
TASK REF. NO.: 2.0	**TASK:** Analysis of cable fault			
REF. NO.	**SUB-TASKS/TASK ELEMENTS**	**KNOWLEDGE ELEMENTS**	**TYPES**	**Can Perform?**
2.1	For RMU/OLU only, check test plugs of switch gear for proper sitting: (a) Use insulation tester to ensure proper sitting. → High readings indicate that the test plugs are not properly seated.	• Use Insulation Tester (P) • Judge proper sitting (H) • Basic Electrical Eng. (F)	P, H, F	Y
2.2	Connect the test cable of the instruments to the faulty cable terminal.	• Basic circuit theory (F)	F	Y

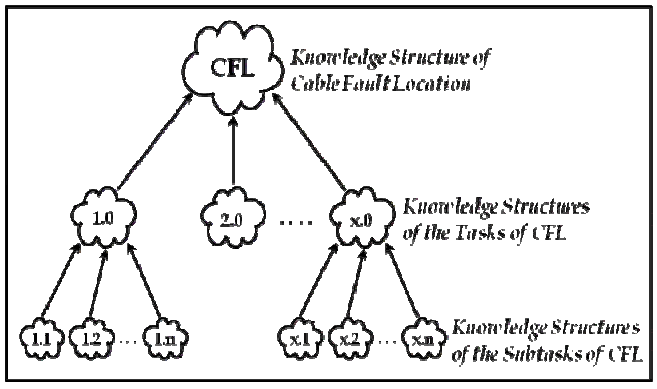

Figure 3: Abstractions of Knowledge Structures

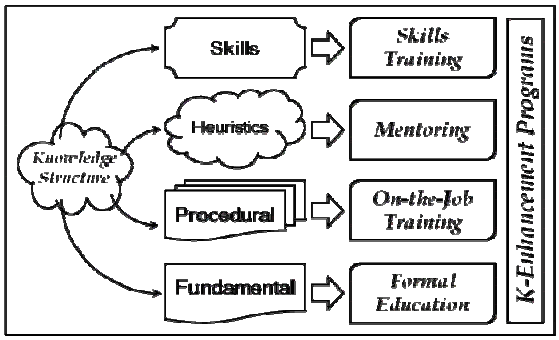

Figure 4: The K-Enhancement Program

The skills and knowledge gained out of this program enhance his/her understanding of the information in the knowledge-based documents and become the new found knowledge which he/she uses to perform his/her job.

7.0 CONCLUSIONS AND FURTHER WORK

The integrated framework presented here captures the steps of performing a task, the skills and knowledge used and their types, whether the task can be performed, the tools or instruments used and the references referred to. The framework offers a means to preserve and reuse the knowledge, which would otherwise be lost when experts depart.

At this initial stage, we represent the captured knowledge in natural language to assess the practicality and applicability of the framework in field trials, where both experts and non-experts use the documents in solving critical problems.

In our future work, we will develop a framework for documenting new knowledge, which are created or discovered in the field while experts solve non-recurring problems.

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