Method assembly approach towards the development of a reference method for knowledge auditing

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Abstract. Knowledge management was regarded as the discipline of the 21st century but it has yet to bear all of its fruits. The expectations are high but a number of barriers limit the effects of knowledge management initiatives. A serious problem is the lack of a comprehensive assessment to prepare the ground for the successful implementation of knowledge management initiatives. A promising solution to this problem is the area of knowledge audits. But the theory and the techniques behind it are not yet mature. The following paper is presenting the development of a comprehensive knowledge audit method that could serve as a standardized method for auditing knowledge. A design research approach was used to compare and integrate 13 different knowledge and information audit methods. The analysis of the existing methods was based on the notion of method engineering and the new method was applied and evaluated in a Dutch telecommunications company.

Keywords: Knowledge management, knowledge audit, method engineering, knowledge network analysis.

1 Introduction

Knowledge management and related strategy concepts are considered necessary components for organizations to thrive and maintain their competitive advantage [1], [2]. Consequently, both public and private sectors started implementing knowledge management initiatives. One survey shows that up to 72% of firms within Europe have some kind of a KM initiative underway [3]; this figure is even up to 80% according a global survey [4]. Still, knowledge management is not fully exploited and many KM initiatives fail [5]. An estimated 80 percent of KM projects, for example, have little or no impact on the organizations [6]. This resulted in a discussion on how to conduct KM initiatives and consequently several methods have been proposed [7]. However, different companies need different knowledge management solutions, and hence ad hoc or standard solutions are not a good option [8]. Therefore, investigating the unique environment and knowledge culture of an organization is a necessary step in a method for conducting KM initiatives. This step is also referred to as a

knowledge audit. According to Hylton [7], many of the mistakes that both earlier and more recent adopters of knowledge management originate from, is the serious oversight of not including the knowledge audit in their overall KM strategies and method for conducting their KM initiatives. Furthermore, we found that even though a knowledge audit can help to prepare the ground for implementing successful KM initiatives, the theory behind it is still rather abstract. This led to the question that dictated our research:

How should a reference method for auditing knowledge be formulated in order to prepare the ground for knowledge management initiatives?

This paper presents the results of developing a reference method for knowledge auditing and has been validated in a case study in a Dutch telecommunications company. It is based on existing knowledge audits, but it is more than just a combination of existing methods. Firstly, because the goal is to be more complete and detailed than existing methods. Hence, it is assumed to be more valuable for practitioners in the KM domain. Secondly, also new concepts are introduced that are not part of existing methods and are derived from knowledge strategy formulation and social network analysis. For these two reasons we also intend to refer to the developed knowledge audit method as a reference method for knowledge auditing.

In the next section, an introduction and literature review concerning the development of knowledge audit methods is presented. Next, the third section will present the research method(s) used to develop the new knowledge audit method. The fourth section presents the steps of assembling the method and finally conclusions and suggestions for future research are provided in the fifth section

2. Knowledge Audit

Section 2.1 provides a brief insight on the theory behind information and knowledge audit methods. Section 2.2 explains how an inventory of information audit methods was made and which criteria were used to include existing methods in this research.

2.1 Introduction to Information and Knowledge Auditing

Information audit as a term was first mentioned by Reynolds back in 1980 (as cited by [9]). Initially, an information audit was considered a process used in the user requirement phase of a management information system project where the ranking and the organizing of the information resources of the system was conducted. Later in the 1990s, information started to gain popularity as an integral strategic resource. As a result, “information audits extended the concept of auditing by evaluating an organization’s accounting and financial procedures to that of the organizations overall information system” [10]. The term was used to suggest a method for the identification, evaluation, and management of information resources in order to fully exploit the strategic importance of information [9]. Typical objectives of an information audit include identifying an organisation's information resources (1) and identifying an organisation's information requirements (2). Later, Buchanan and Gibb [9] added more objectives so that the audit would become a truly comprehensive and

integrated strategic approach. The most important objectives included: integrating IT investments with strategic business initiatives (1) and identifying information flows and processes (2).

Debenham and Clark [11] can be considered as proponents of the knowledge auditing theory and were among the first to introduce the term 'knowledge audit' in 1994. Knowledge auditing can be regarded as a successor of information auditing. Information audits mainly focused on codified or explicit knowledge, whereas, knowledge auditing also "tries to identify, evaluate and manage tacit knowledge along with explicit knowledge" [9]. Hence a knowledge audit can be defined as an assessment that "incorporates all the effective processes associated with the exploration (such as identify, evaluate, manage) of human knowledge (tacit and explicit) within a business unit or an organization" [32]. Such an audit is typically conducted before embarking on a KM initiative in order to make an inventory of current knowledge and knowledge processes in the organization and to assess if there is a gap between current situation and the desired situation that is required to achieve the business goals [32].

In the next section, the most commonly adopted methods for auditing knowledge are presented. As the similarities between information audits and knowledge audits are, not surprisingly, great. Both information audit and knowledge audit methods were regarded of equal importance for this research.

2.2 Inventory of existing Methods

The literature study was conducted using mainly the following sources: Citeseer, Google Scholar, Scirus, Picarta (national library database), and our university library. The main keywords for conducting the search on existing auditing methods were "knowledge audit", "information audit", "auditing knowledge" and "knowledge inventory". Not all methods that were found were included in our research. The following criteria have been used to select methods:

1. the methods should be available in scientific literature or another public source so that sufficient information is available
2. they should be methods that prescribe specific steps to follow
3. the methods should specifically engage on auditing information or knowledge

In total, thirteen methods have been found that satisfied these criteria: [9, 11-22]. In the remainder of this paper is explained how a new reference method for knowledge auditing has been derived from these methods using a method assembly approach.

3. Research method

3.1 Design research approach

A design research has been applied to develop the reference method for auditing knowledge [23], [24]. Although an entirely new method was not created, the research can be considered as design research as the new method is a combination of existing

methods, , i.e. method assembly, to which some new elements were added. The design research cycle suggested by [24] and by [25] dictated the research. In a nutshell the phases of our design research cycle include:

- Awareness of the problem – Failing KM initiatives/abstract knowledge auditing theory
- Suggestion – Comparison of existing methods to determine differences/ overlap
- Development – Creation of reference method based on the comparison
- Evaluation – Case study for validation of reference method
- Conclusion – Conclusion and further research

Method development in phase 2 and 3 is based on techniques from the Method Engineering domain [27-28]. The process that is applied in this research for method development is discussed in the next section.

3.2 Method development

Method engineering forms the theoretical background on how to develop (engineer) the new knowledge audit method. A method is defined as an "*approach to perform a systems development project, based on a specific way of thinking, consisting of directions and rules, structured in a systematic way in development activities with corresponding development products*" [27]. Although, it originally refers to IS development method it can also be applied to other methods. A meaningful part of a method is also called a method fragment [28]. Hence, a method can be decomposed in method fragments. Method engineering is defined by Brinkkemper [27] as *"the engineering discipline to design, construct and adapt methods, techniques and tools for the development of information systems"*. This can refer to the development of a completely new method or to the assembly of method fragments, originating from different existing methods, into a new method.

Table 1. Method development process

Step 1: Define steps/outline of new reference method for knowledge auditing
Step 2: Identify best methods for donating method fragments to the new reference method
Step 3: Select method fragments to be included in new reference method
Step 4: Assemble and describe new reference method for knowledge auditing

In this research, we developed a new reference method for knowledge auditing using the four steps described in table 1 and is based on Hong et al.'s comparison method [26]. The first step in the development method is to define an outline of the new reference method for knowledge auditing that outlines the main steps of the new reference method. Hong et al. also refer to this as the super method and defines it as the smallest common denominator of all activities covering all of the existing knowledge audit methods [26]. Hence, the super method is by definition more complete than each of the individual methods. In step 2, we choose a number of methods, out of the existing thirteen methods, as possible donators of method fragments to the new reference method. The method fragments that are actually donated are selected in step 3. This is done by first comparing the selected method

against the outline of the reference method, i.e. super method. Based on this comparison those method fragments are selected that best match one or more activities in the super method. Finally, in the fourth step the selected method fragments are assembled and the new reference method for knowledge auditing is described.
In order to be able to compare methods, we first described the existing methods in a standardized format using a meta-modeling technique called Process-Deliverable Diagram (PDD) [29]. A PDD is the integration of two separate diagrams, the meta-process diagram (process view) and the meta-deliverable diagram (deliverable view). The meta-process diagram is based on a UML activity diagram and the deliverable view is based on a UML class diagram [29]. An example of a PDD is shown in figure 1. Finally, we also completely described the new reference method for knowledge auditing using the PDD technique.

4. Development of the new knowledge audit method

This section describes the development of the new reference method for knowledge auditing according the four steps as described in the previous section.

4.1 Defining the outline for the new reference method (step1)

To find the list of activities that constitute the super method, all existing knowledge audit methods have been analyzed in detail by creating meta-process diagrams using the PDD technique from [29][1]. In creating the PDD's, we tried to stay as close as possible to the original terminology as was used by the author(s). Afterwards, the PDD's were compared and it was found that there was much difference in the labeling of activities and deliverables and also in the level of detail that was used to describe a method. In identifying the super method, it was decided to go through the identification in a top down manner, i.e. from high level to a lower, more detailed level. The result of the high level comparison is the distinction of eight main activities for the outline of the new reference method, i.e. super method:

- Prepare audit: in this stage the initial meetings with the management take place, the scope and the objectives of the audit are defined and the environment of the targeted area is investigated
- Promote audit's benefits: the benefits of the audit are discussed with top management and employees are invited to take part in the process
- Investigate targeted area: the identification of the business processes and the stakeholders involved takes part in this stage
- Collect data: collecting data through interviews and/or surveys is facilitated here.
- Analyze data: the data are processed and the end products are graphs depicting knowledge flows, the knowledge inventory and others.

[1] Due to space limitations it is not possible to show all PDD in this paper. A report containing all PDD's is submitted separately for PAKM 2008 (in the final version we will include a link were the document can be downloaded).

- Evaluate data: the identification of problems and bottlenecks starts along with suggestions to overcome these difficulties
- Conclude audit: the main product is the audit report and the action plan
- Re-auditing: the suggestion that the audit should be continuous is observed in most of the methods and it was included as the last activity of the supermethod

In the next step, each of these activities was decomposed into further sub-activities in accordance with the steps of the analyzed methods and the end result was a complete list of activities and sub-activities of the super method (see columns 1 and 2 in table 2) that covered the ground of all the methods.

4.2 Identification of best methods for donating method fragments (step 2)

To determine which method would be the best 'donator' of a method fragment to the new reference method, we first compared each existing method with the super method to find differences and similarities. This is done by creating a comparison table as shown in Table 2. All notations and the way of structuring the comparison table have been adopted from [26].

Table 2. Comparison of reference method with existing audit methods

Activity	Sub-activity	Orna	Henczel	Burnett	Perez-Soltero	Cheung
1. Preliminary	1.1 Organization brief			=1.1	=1.1	=1.1
	1.2 Observe targeted area	=1.1	>1.1	><1.2	=1.2	=1.2, 2.1
	1.3 Set objectives of audit	>2.1	=1.1			
	1.4 Set scope of audit		=1.2			=1.2
2. Promote audit	2.1 Ensure management support	=2.1	=1.5			
	2.2 Foster collaboration with employees	=2.2	=1.4	=2.1		
3. In depth investigation	3.1 Identify business processes		>2.1		=1.3	
	3.2 Identify key actors				=4.1	>2.2
	3.3 Identify knowledge requirements	=1.2				
	3.4 Identify knowledge processes			=1.3	><2.1	
4. Collect data	4.1 Meet key actors				=4.2	
	4.2 Conduct survey/interviews	=5	>< 2	=4.1	=4.3	=2.2
5. Analyze data	5.1 Build knowledge inventory	>4.1,4.4	>< 3.2	><5.1	=5.1	=2.3

	5.2 Build knowledge map	>4.3	=3.3	><5.1	=5.2,5.3	=2.4
	5.3 Execute Social network analysis					>2.5
	5.4 Execute Gap Analysis	><5.1				
6. Evaluate data	6.1 Identify bottlenecks and gaps		=4.1	><5.1	>6.1	>3.1
	6.2 Prioritize problems		=4.2			
	6.3 Suggest solutions	=6.1	=4.3	=6.3	=6.1	=3.1
	6.4 Rank solutions		=4.4	=7.1		
	6.5 Develop action plan	=6.3	=4.5	=6.3+7.2		>3.3
7. Conclude audit	7.1 Write audit report	=6.1	=5.1	><6.2	=6.1	=3.1
	7.2 Present results	=6.3	=5.2			
	7.3 Get approval of action plan	=7.1	=6	=8		>3.3
8. Re-audit		=7.3	=7		=6.2	=4

The first two left columns of the comparison table display the activities of the super method. The remaining columns show how well the existing knowledge audit methods match with the super method. If a cell in the comparison table is blank, this means that the activity on that row is not present in the method of the corresponding column. In any other case, there are three notations describing the relationship between the super method and the other methods that should be taken into account when looking at the table.

- An "=" symbol indicates that a similar activity to the one of the super method is available in the method of the corresponding column
- An "<" or an ">" symbol indicates that the activity of the method of the corresponding column does more or less than the activity of the super method, respectively
- An "><" symbol indicates that a part of the activity of the method of the corresponding column overlaps a part of the activity of the super method and the other parts of both activities do not overlap

Due to space limitations table 2 does not show the complete comparison table, i.e. only five out of thirteen methods are displayed. However, it does shows that there are distinct differences in the activities that each method supports. Furthermore, there is no single method that covers all the activities of the super method; the best match is Henczel's method that covers 18 of the 25 activities of the super method.

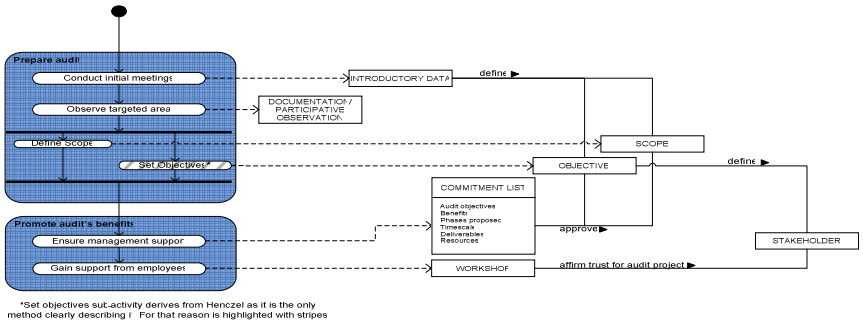

Fig. 1. Part of the knowledge audit method

4.3 Selection of method fragments and assembly of the new reference method (step 3 and 4)

Based on the comparison table (table 2), a corresponding method fragment is selected that best matches a particular activity or set of activities in the super method, i.e. outline of the new reference method. In those cases, where there were two or more method fragments to choose from, the criteria for selecting a particular method fragment was the amount of information provided for the deliverables of the method. As already stated, there was a lack of terminology and information on the deliverables of activities in the existing methods. Thus, method fragments that provided a substantial amount of information on the deliverable of an activity and/or providing templates and details on supporting techniques were selected against other similar method fragments with less information. A small part (containing the first two activities) of the method that was developed is shown in figure 1. The left part is the meta-process model, which shows the processes/activities, and the right part is the meta-deliverable model, which shows the deliverables of the respective processes/activities. Due to space limitations it is not possible to describe the complete reference method for knowledge auditing here as it covers many pages. A link to the document containing the complete description of the reference method is provided in footnote 1.

5. Validation of the new knowledge audit method

The iterative approach for applying the reference knowledge audit method made it possible to test and refine the method during the case study.

5.1 Case study organization

The case study organization is a Dutch Information and Communication Technology company, Getronics PinkRoccade. Getronics PinkRoccade works globally in 105

countries and employs 23,000 people worldwide. The case study was conducted in the Business Unit of Consulting (BUCO) in the Netherlands, which is specialized in offering solutions to a broad spectrum concerning IT-management. The target group within this business unit consisted of 58 consultants that are predominantly working on client's sites which are located within the Netherlands. The projects carried out are primarily on areas such as project management, and service and performance management. In the past, the business unit had attempted several times to implement a successful knowledge management system. The organization tried both extremes; either focusing on the people and the transfer of the so called tacit knowledge or focusing on the computer based technology and mainly the storage of and access to the so called explicit knowledge. Managing knowledge became even harder after the acquisition of PinkRoccade. This becomes more obvious within the business unit under investigation as most of the employees there come from PinkRoccade. Systems that were successful within PinkRoccade where shut down but there were no systems to properly replace them.
This history of failed implementations makes BUCO an interesting case to see if the knowledge audit can be used to prepare the ground for a new knowledge management initiative.

5.2 Evaluation of the reference knowledge audit method

The case study at BUCO was conducted to evaluate the newly developed knowledge audit method. It was conducted by the main author of this paper and took approximately two months to complete. Besides the author, the manager of the BUCO unit was involved who acted as the main sponsor of the project. Also the consultants of the BUCO unit were involved. First of all, the consultants had to provide input for the questionnaire and interviews that are part of the reference knowledge audit method. Secondly, the consultants provided feedback on the usefulness and completeness of the method were appropriate. Progress of the knowledge audit was regularly reported in department meetings once per week. During the execution of the knowledge audit the researcher could evaluate the method himself. This resulted in two big changes to the method. The first problem that was encountered concerned the identification of knowledge that supports the business processes (3.1 - 3.3 in the reference method). The method fragments that were included were not descriptive enough to provide guidance to identify the required knowledge. To improve this part of the reference method, parts of the Knowledge Strategy Process by Van der Spek et al. were adopted [30]. It especially concerned the part that describes how knowledge areas can be identified within an organization. The second problem that was encountered concerned the construction and analysis of the knowledge map. A knowledge map provides an overview of who shares knowledge with who, i.e. shows the knowledge flows through the company (step 5.2, 5.3 and 6.1). The method fragment that was selected provided some instructions for executing a social network analysis. However, the analysis part in this method was rather straight forward. Therefore, this part was replaced by the Knowledge Network Analysis technique, which provides more elaborate guidelines of bottlenecks in knowledge networks [31].

Besides the evaluation by the researcher, the revised reference method, including the change as described above, was also evaluated by 5 other persons. First of all, the clarity of the activities and deliverables of the reference method were evaluated. A consultant from BUCO, with expertise in the knowledge management area, approved the final version of the method by stating that the steps were clear and the expected results should satisfy the goals of the project. The method was also explained thoroughly to two consultants of BUCO. Their feedback was positive as they could comprehend all of the steps depicted in the process deliverable diagrams of the knowledge audit method and they verified the importance of the deliverables.

The second evaluation criteria concerned the usefulness and effectiveness as a knowledge audit tool. The three consultants that were mentioned above also evaluated the reference method on this aspect. Their most valuable feedback was that there was no need of expert knowledge in the area of auditing to carry out the method. They stated that the only prerequisites were some experience in the field of knowledge management and a capability to execute network analysis. Because the consultants did not have any auditing experience we also asked two practitioners of auditing knowledge (outside Getronics) to review the new knowledge audit method in terms of its potential usefulness and effectiveness. Their judgment was based on the method development report that was send to them by email. The remarks were very positive regarding the applicability and the completeness of the method. One practitioner had some doubts regarding its consistency but after further explanation regarding the relations between the gap analysis and the network analysis he reacted positively. Both of them were intrigued by the application of the Knowledge Strategy Process and agreed that it was a valuable contribution to the knowledge audit method enhancing its applicability and adjustability.

Besides evaluation of the reference method, application of the method also prepared the ground for a new KM initiative at BUCO. Awareness within the organization has been increased and the identified problems were recognized by management and the consultants of BUCO. The formulated suggestions are taken as recommendations for the new knowledge management initiative that is now on its way.

6. Conclusions and Further Research

In this research we used a design research approach in which we compared thirteen knowledge and information audits methods. Based on the comparison of the methods we selected five methods as potential donators to the reference method for knowledge auditing that we intended to develop. From the selected methods we used fragments to create a reference method that is more comprehensive then any of the methods assessed. The method was applied and evaluated with success in a consulting business unit, the objectives stated in the start of the project were met. Suggestions provided in the knowledge audit report can be implemented in the new knowledge management initiative to ensure its success. Instead of just implementing a promising new knowledge management system without preparation, the knowledge audit helps the organization to identify problems that should be taken into consideration. For

example, the identification of knowledge gaps should engage the top management to assure the support for the cultivation of this missing knowledge either by hiring an external expert or integrating some system that supports it. The knowledge audit method should be considered as a necessary step before the implementation of any new knowledge management initiative, in order to define exactly what needs to be implemented.

One limitation of this research was the limited time which resulted in analyzing five of the thirteen methods in more detail. Of course, the five selected methods covered the whole spectrum of activities and were the most elaborated ones, but in the future it might be worthwhile to also study the other methods. What is more, it is possible to include in the analysis, methods that focus on only one activity of the supermethod or even a sub-activity resulting in a much more extensive background that could resulted in a refined knowledge audit method.

Secondly, the knowledge audit method should be tested in different kind of companies to assess its adaptability, consistency and applicability in all possible circumstances. In case that some difficulties emerge it should be updated to improve its applicability if it is to be considered a standardized method.

Thirdly, it is possible to decompose further the activities and sub-activities of the knowledge audit method in order to have a lower-level view. Finally, as knowledge management is evolving the new knowledge audit method should be updated to keep its consistency and applicability. New techniques and methods are developed and if proven sound and relevant they should be considered for to be integrated with the method. It should be noted that a knowledge audit does not guarantee the success of a knowledge management initiative but its purpose is to improve its chances of success.

Acknowledgments.
We would like to thank Ankie Eeken (former Getronics PinkRoccade) for her support and valuable contribution for initiating this research. Special thanks to Anne-Marie Soppe (Getronics PinkRoccade) for her forbearance and support throughout the duration of the project.

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