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*Original Research*

# A Process-Oriented Approach to Knowledge Audit in Project-Based Organizations: A Qualitative Study

**Fatemeh Navidi**
Ph. D. in knowledge and information science, Kharazmi University, Tehran, Iran
Head of Public Relations Department of Iranian Space Research Center, Tehran, Iran
Corresponding Author: f.navidi@isrc.ac.ir
ORCID iD: https://orcid.org/0000-0002-3157-9460

**Mohammad Hassanzadeh**
Professor, Department of Knowledge and Information Science, Tarbiat Modares University, Tehran, Iran
hasanzadeh@modares.ac.ir
ORCID iD: https://orcid.org/0000-00026175-0855

**Ali Zolghadr Shojai**
Master of Industrial Engineering, Amirkabir University of Technology, Tehran, Iran
ali.zolghadr@aut.ac.ir
ORCID iD: https://orcid.org/0000-0001-7322-699X

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## Abstract

Knowledge audit can be considered the first step of knowledge management; thus, taking a process-oriented approach to knowledge audit in project-based organizations would help enrich the content related to the treasures of knowledge. In this research, the identification of components associated with knowledge audit and the design of the knowledge audit process in project-based organizations are performed based on the priorities and characteristics of such organizations. **This** study can be categorized as applied research. It has been carried out through a qualitative approach by employing documentary, exploratory, and thematic analysis techniques. The knowledge audit process is designed after the components of the knowledge audit have been identified. The semi-structured interview, a qualitative data collection strategy, was used throughout this research study. 13 experts involved with knowledge management in project-based organizations participated in the case study. Knowledge audit can be performed in 3 phases: the pre-audit phase, the audit phase; and, the post-audit phase. The pre-audit phase includes exploring organizational goals, vision, and mission, identifying the key processes and projects, organizing the knowledge audit team, developing the knowledge audit strategy, determining the assessment checklist and weighting the items, and designing the assessment system. In the audit phase, key projects are identified, and the assessment is carried out regarding the effective components of knowledge audit in project-based organizations. The post-audit phase incorporates developing the knowledge audit strategy, re-auditing; and, performing constant revisions. All the models and methodologies that deal with knowledge audit consider first-level processes; thus, they are too general and cannot guide how to undertake knowledge audit activities in different types of organizations practically. The distinguishing aspect of this paper is its focus on the key projects carried out in project-based organizations and preparing the assessment checklist based on the weighted components of knowledge audit determined for the requirements and priorities of such organizations.

**Keywords**: Knowledge audit; Components of knowledge audit; Knowledge audit process;

Implementation mechanism of knowledge audit; Project-based organizations

## Introduction and problem definition

The world economy has become dominated by paradigms that emphasize the effective utilization of intangible assets (such as information and knowledge resources) more than before. In this context, the knowledge economy, which uses knowledge to create goods and services, serves as the main anchoring point. Therefore, knowledge is a means to create innovative products and services which must be protected against external leakage. All the organizations need to first develop a comprehensive understanding of their current condition and situation before initiating any activities related to knowledge management. Only under these circumstances can a suitable strategy be established to reflect organizational needs for knowledge better. Peszynski, Cooper & Molla (2008)) claimed that one of the crucial elements for the success of knowledge strategy is the complete understanding of the major business processes and the environment encompassing organizational knowledge. This can be achieved through knowledge audit implementation and assessing the environment that affects the current knowledge. Rahman and Sharriff (2009) believed that organizational knowledge assessment would help establish a knowledge strategy that reflects organizational requirements.

Knowledge audit increases the capabilities of knowledge management and leads to the monitoring of knowledge management effectiveness. Other advantages of knowledge audit include assisting organizations with clear identification of the knowledge that is needed to attain major organizational goals, providing solid evidence of the domain of knowledge managed effectively, detecting potential improvement areas, identifying knowledge packs that have not been utilized, pointing out knowledge gaps in organizations, building the knowledge map and providing the communication flow network along with the required information needed to effectively develop knowledge management initiatives based on the specific knowledge needs and the current condition and situation of the organizations under study.

A knowledge audit can have multiple purposes, but the most common is to provide tangible evidence of what knowledge an organization need, where that knowledge is, how it is being used, what problems and difficulties exist, and what improvements can be made (Serrat, 2017). According to this explanation, many researchers consider knowledge audit to be the first step of knowledge management and; also one of the influencing factors on knowledge management (Leibowitz, 2000; Leibowitz et al., 2005; Henczel, 2011; Tiwana, 2000; Choy, Lee & Cheung, 2004). Furthermore, experts have emphasized that a comprehensive knowledge audit is essential to successfully implementing knowledge management. However, Bright (2019) emphasized that Knowledge Audit is an essential primary ingredient for many organizations setting out to define a knowledge management program.

It can be inferred from the literature review that some researchers indicate knowledge audit could generally include four components: (a) knowledge needs analysis, (b) knowledge inventory analysis, (c) knowledge flow analysis; and (d) knowledge map creation (Perez-Soltero, Barcelo-Valenzuela, Sanchez-Schmitz, Martin-Rubio, Palma-Mendez & Vanti, 2007; Sharma & Chowdhury, 2007; Serrat, 2009; Ganasan & Dominic, 2011; Kumar, 2013, Serrat, 2017). Since these components are the general components of knowledge audit and, on the other hand, different organizations might deal with various types of knowledge and perform various business processes, it is necessary to focus on unique characteristics, requirements, and infrastructures associated with each organization when it comes to the identification of

influencing factors on knowledge management; and, the design of knowledge audit processes and its implementation mechanism.

Project-based organizations are no exception. These organizations benefit from optimal organizational structures that enable them to merge the knowledge obtained from inside and outside the organization and provide new products and services. This type of organization can usually undertake various projects with different natures simultaneously. Managing the projects could pose a significant challenge as they become more diverse and exhibit different scopes. Therefore, project-based organizations face a growing need to manage the knowledge generated during projects and share such knowledge among different projects.

Consequently, major characteristics of project-based organizations, which makes it essential to consider their needs and requirements, can be outlined as follows: (a) to undertake projects simultaneously, (b) to deal with projects as temporary activities, (c) to incorporate part-time employees into processes and activities, (d) to assign project team members to new projects, (e) to be confronted by the need to transform experiences obtained from undertaking projects into knowledge, (f) to deal with the highly diverse knowledge domains originating from projects; and, (g) to face the fact that the obtained knowledge must be used and shared with other projects. Based on the requirements and priorities of project-based organizations, this study aims to identify the components of knowledge audit and propose a knowledge audit process to ensure the successful implementation of a knowledge audit.

## Methodology

Following a qualitative approach, this study was conducted as developmental-applied research incorporating documentary, exploratory, and thematic analysis techniques. The documentary study was used to extract the components of a knowledge audit. Since the obtained components of the knowledge audit were not enough, an exploratory study was conducted using a semi-structured interview technique to determine more components related to knowledge audit concerning the requirements and characteristics of project-based organizations.

The statistical sample included 13 knowledge management experts with Masters and Ph.D. degrees in Knowledge and Information Science, Management, and Industrial Engineering. Table 1 provides demographic information of the interviewees.

Table 1

*Demographic information of the interviewees*

| Characteristics | | Number of cases |
|---|---|---|
| Education | PhD | 8 |
| | MSc | 5 |
| Major | Knowledge and Information Science | 6 |
| | industrial engineering | 2 |
| | Management | 5 |
| Gender | Female | 5 |
| | Male | 8 |

In this study, a semi-structured interview was carried out to identify all components of knowledge audit and find answers to basic research questions. Several questions were prepared before the interview, and other questions were asked to make the given responses more transparent. The predetermined questions were intended as a discussion guide and were

supplemented with more specific questions posed by the interviewer during the interview. All the interviews were recorded and then carefully transcribed.

The predetermined questions were addressed to 3 experts with a Ph.D. degree in Knowledge and Information Science to assess the face validity of the interview questions. This, resulted in the revision of the predetermined questions. Furthermore, because some new questions can come to the interviewer's mind during interview sessions, it was decided to use the repeated interviews method to ask all the interviewees similar questions, improving the validity of the research findings. All the new questions raised during an interview session were also addressed to other interviewees throughout the interview sessions held afterward. The interviews were transcribed and returned to the respondents to investigate the interview findings and confirm their validity. They were asked to comment on the accuracy of the data and viewpoints exchanged.

The qualitative data analysis was performed employing the thematic analysis technique. This technique is a coding methodology whereby patterns, similarities, and themes emerge from the data and is a widely used method for quantitative, qualitative data analysis. A "theme" represents essential information on the given data and research questions; and, to some extent, demonstrates the meaning of the patterns identified in the data. This methodology considers the discovered patterns from given responses, repetitive keywords, comparison of different items, exploration of important issues, and identification of relationships. A theme is a pattern identified in the information that at minimum describes and organizes the possible observations and at maximum interprets different aspects of the phenomenon (Abedi Jafari, Taslimi, Faghihi & Sheikhzade, 2011). Thus, a theme is a repetitive and diverse feature in the text which researcher believes it represents specific understanding and experience about research questions.

There are several ways to perform thematic analysis techniques, each of which follows a particular process. In this study, the process associated with the thematic analysis technique includes three stages: (1) analyzing and describing the given responses to search and identify the themes, (2) interpreting the given responses to define and name the codes and analyze the themes; and, (3) merging and reintegrating the themes and patterns emerging from the data to prepare a report(s) and establish a link between the research questions and results obtained from the analysis. Generally, it can be said that the process of thematic analysis begins as the researcher tries to discover patterns of meaning and themes in the data. Moreover, the process comes to an end upon completing the report(s) that contain identified patterns and themes in the data along with their content and meanings. It must be noted that all the process stages require interpretation and analysis (ibid).

### Basic research questions

The basic research questions associated with this study are as follows: (a) what are the phases of the knowledge audit process in project-based organizations? (b) How can each phase of the knowledge audit process be accomplished in project-based organizations? (c) What are the components that must be considered while performing knowledge audit?

## Research findings

The first basic research question revolves around the phases of the knowledge audit process in project-based organizations. To determine the knowledge audit process and the steps

associated with it in project-based organizations, 18 models and methodologies related to knowledge audit were identified and explored (Debenham & Clark, 1994; Tiwana, 2000; Fraunhofer, 2000 (in Mertins, Heisig, Finke & ulbrich, 2003); Hylton, 2003; Libowitz, 2005; Perez- Soltero et al., 2007; Lee, Shek & Cheung, 2007; Cheung, Li, Shek, Lee & Tsang, 2007; Wu & Li, 2008; Dow et al., 2008; Wang & Xiao, 2009; Gourova, Atanassova & Todorova, 2009; Suo, Wang & Zhang, 2009; Jafari & Payani, 2013; Drus, Shariff & Othman, 2017). Common steps and processes were extracted from the models. In addition, the knowledge audit process was also discussed with knowledge management experts in some semi-structured interviews since all the investigated models provided general steps and processes of knowledge audit and did not take specific needs, priorities, and characteristics associated with different types of organizations into consideration while scrutinizing the components of a knowledge audit. Table 2 gives the different steps of standard processes of knowledge audit that the experts mentioned. As it can be seen in Table 2, the proposed processes include important steps such as (a) identifying the key organizational projects, (b) extracting and weighting the knowledge audit indicators; and, (c) determining the assessment checklist used for weighting purposes.

Table 2

*Common processes of knowledge audit in project-based organizations mentioned by the experts*

| | Step 1 | Step 2 | Step 3 | Step 4 | Step 5 | Step 6 | Step 7 |
|---|---|---|---|---|---|---|---|
| Process 1 | Developing the strategy for a knowledge audit | Determining the assessment checklist | Weighting the items in the assessment checklist | Developing the assessment system | Identifying the key projects | Implementing the assessment activity | Performing constant revisions/ re-auditing |
| Process 2 | Selecting the strategic goals | Identifying the functional needs | Selecting the specialized fields of key organizational activities | Comparing the current knowledge inventory with knowledge needs | Defining the knowledge management strategies | | |
| Process 3 | Organizing the knowledge audit team | Identifying the knowledge needs, knowledge flow, and knowledge inventory of the organization | Designing the project(s) based on the identified knowledge gaps and future trends | Providing the organizational knowledge map in accordance with the results of projects | | | |
| Process 4 | Studying the structure and activities of the organization | Studying the organizational processes | Extracting the knowledge audit indicators and preparing the operational plan | Evaluating the effectiveness of the operational plan | | | |

| | Step 1 | Step 2 | Step 3 | Step 4 | Step 5 | Step 6 | Step 7 |
|---|---|---|---|---|---|---|---|
| Process 5 | Studying the strategic documents and vision of the organization | Identifying the key projects | Identifying the key knowledge areas | Estimating the risks associated with strategic knowledge areas and losing key staff members | | | |
| Process 6 | Determining the knowledge audit indicators | Weighting the knowledge audit indicators | | | | | |

Considering the steps and processes discussed in the literature (general knowledge audit processes) and common aspects of the processes provided by the experts, Figure 1 illustrates the knowledge audit process in project-based organizations.

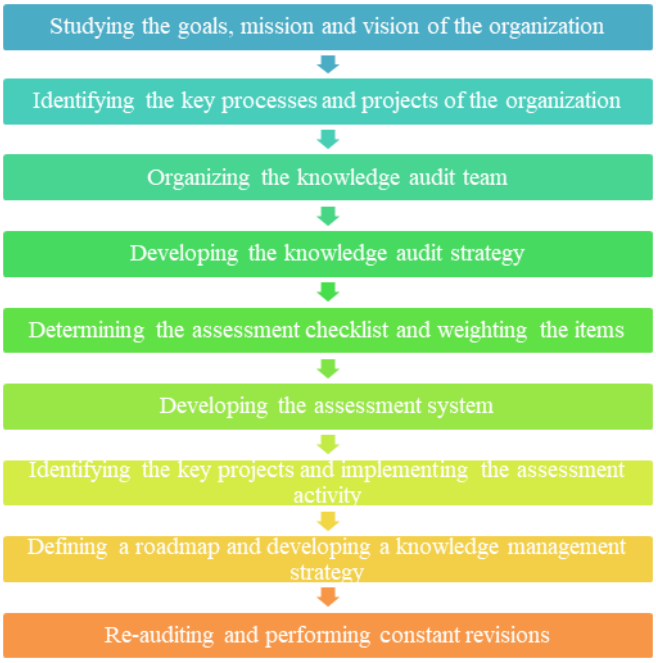


*Figure 1*: The knowledge audit process in project-based organizations

The distinctive features of our proposed knowledge audit process can be summarized as follows: (a) focusing on identifying key organizational projects and (b) preparing the assessment checklist based on the weighted components of knowledge audit determined concerning the requirements and priorities of project-based organizations.

The steps associated with this knowledge audit process can be grouped into 3 phases that are constantly and repetitively carried out: the pre-audit phase, the audit phase; and, the post-audit phase. The pre-audit phase includes exploring organizational goals, vision, and mission, identifying the key processes and projects, organizing the knowledge audit team, developing the knowledge audit strategy, determining the assessment checklist and weighting the items, and designing the assessment system. In the audit phase, key projects are identified, and the

assessment is carried out. The post-audit phase incorporates defining a roadmap, developing a strategy for knowledge management, and making a plan for re-auditing and performing constant revisions.

The second basic research question tries to obtain information on how each phase of the knowledge audit process is accomplished in project-based organizations. Table 3 outlines different phases of the knowledge audit process and the implementation mechanisms and tools associated with each phase and process extracted from literature reviews and interviews with experts.

Table 3

*Implementation mechanisms and tools associated with knowledge audit process in project-based organizations*

<table>
<tr><th>phase</th><th>Process</th><th>Implementation mechanism</th><th>Tools</th></tr>
<tr><td rowspan="4">Pre- audit</td><td>Studying the goals, mission, and vision of the organization</td><td rowspan="2">Performing the background study and data collection by investigating the strategic documents, organizational chart(s), business processes, websites, and other upstream documents of the organization</td><td rowspan="4">Observation, questionnaire, and interview with key senior managers and experts of the organization</td></tr>
<tr><td>Identifying the key processes and projects of the organization</td></tr>
<tr><td>Organizing the knowledge audit team</td><td rowspan="2">Focusing on the knowledge management department and a team of key experts of the organization</td></tr>
<tr><td>Developing the knowledge audit strategy</td></tr>
<tr><td>Determining the assessment checklist and developing the assessment system</td><td>Considering the identified components and weighted items</td></tr>
<tr><td>Audit</td><td>Identifying the key projects and implementing the assessment activity</td><td>Exploring the upstream and strategic documents, conducting interviews with key senior managers and experts, delivering assessment through the knowledge audit team</td><td>Components and the assessment checklist determined in the pre-audit phase (questionnaire and interview)</td></tr>
</table>

| phase | Process | Implementation mechanism | Tools |
|---|---|---|---|
| Post- audit | Developing the roadmap and strategy for knowledge management | Analyzing the data and findings obtained from previous phases of knowledge audit deeply and developing the roadmap for knowledge management | Analyzing methods and software such as Meta-Matrix Analysis, Social Network Analysis (SNA), Analytic Hierarchy Process (AHP), and Fuzzy Comprehensive Evaluation (FCE) |
| | Re-auditing and performing constant revisions | *When to perform auditing/ re-auditing procedures:* during project execution stage, after project closure stage, before adding new knowledge to the organizational knowledge base, after adding new knowledge to the organizational knowledge base; and, at intermittent time intervals | All the tools mentioned previously |

Throughout the pre-audit phase, the organizational goals, mission, and vision are explored, and key processes and projects are identified. The knowledge management team in the organization accomplishes these objectives by performing the background study and data collection employing strategic documents, organizational chart(s), business processes, websites, and other upstream documents of the organization. Standard tools for this type of work include observation, questionnaires, and interviews with key senior managers and experts of the organization.

The knowledge management department and a team of experts from the organization usually play a crucial role in developing the knowledge audit strategy and organizing the knowledge audit team. Considering the codes given by the thematic analysis technique, the knowledge audit team might include employees inside and outside the organization. Moreover, team members of research projects, project managers, the knowledge manager in the organization, academic researchers from universities; and, managers in the organization can be a part of the knowledge audit team. The knowledge audit team is responsible for preparing the assessment checklist and developing the assessment system based on the identified components and weighted items. In the audit phase, the key projects are identified according to the upstream and strategic documents and interviews with key senior managers and experts.

Furthermore, the knowledge audit team assesses questionnaires and interviews. The identified components and the assessment checklist from the pre-audit phase serve as the backbone for this assessment. On the other hand, the assessment must provide a range of different analyses, such as knowledge need analysis, knowledge inventory analysis, knowledge flow analysis, knowledge application analysis; and, knowledge valuation analysis. In the post-audit phase, the data and findings from previous phases of the knowledge audit process are deeply analyzed, and the roadmap for knowledge management is developed. This phase of the


*Figure 2*: The time periods at which knowledge audit is performed in project-based organizations

knowledge audit process requires tools, including analyzing methods and software such as Meta-Matrix Analysis (Dattero, Galop & Quan, 2007), Social Network Analysis (Gorouva, 2009), Analytic Hierarchy Process (Suo et al., 2008); and Fuzzy Comprehensive Evaluation (Suo et al., 2008). It must be noted that knowledge audit is a repetitive process and must be carried out iteratively at different timeframes. In project-based organizations, knowledge audit needs to be performed at intermittent time intervals and different periods (during project execution stage, after project closure stage, before adding new knowledge to the organizational knowledge base, after adding new knowledge to the organizational knowledge base) concerning the interviews with experts and codes obtained from thematic analysis technique. Figure 2 depicts the periods at which knowledge audit is performed in project-based organizations.

The third basic research question aims to identify the components that must be considered while performing knowledge audits in project-based organizations. In this research, documentary and exploratory studies were conducted to determine the components of a knowledge audit. A thorough search over the domain of interest (i.e., knowledge audit) was carried out using keywords such as “components of knowledge audit”, “knowledge audit elements,”; and “knowledge audit factors,” which retrieved no relevant results to fulfill the documentary study. Afterward, a nearly comprehensive study of pertinent texts in 60 references, including books, dissertations, research papers; and, online electronic files from 1999 to 2017. According to this study, knowledge audit is usually comprised of four components: (a) knowledge need analysis, (b) knowledge inventory analysis, (c) knowledge flow analysis; and (d) knowledge map design (Perez- Soltero et al., 2007; Sharma & Chowdhury, 2007; Serrat, 2009; Ganasan & Dominic, 2011; Kumar, 2013; Serrat, 2017). Knowledge need analysis tries to accurately identify the knowledge that already exists in the organization (what is already known) and the knowledge that might be needed to achieve future objectives and goals (what should be known). This analysis can help organizations develop and plan ensuing strategies.

Knowledge inventory analysis aims to identify and locate the explicit knowledge assets and resources (library resources and documented knowledge) and the organization's tacit knowledge assets and resources (owners of potential knowledge). The obtained results from these two analyses can be compared to each other to discover knowledge gaps and the repetitive and redundant knowledge areas. Knowledge flow analysis explains how employees find the knowledge they need and share the knowledge they possess. Based on this notion, knowledge flow analysis seeks explicit and tacit knowledge and evaluates the employees (how they contemplate knowledge use and knowledge sharing), processes (business processes, organizational policies, daily procedures; and, best practices); and, systems (information technology system, information accessibility, content management, applicability; and, practical use) (Chowdhury, 2006)

A knowledge map is a visual representation of the knowledge that exists in the organization, and it provides knowledge resources, knowledge flows; and, knowledge limitations. There are two common approaches when it comes to the development of a knowledge map: (a) determining knowledge resources and knowledge assets to identify the knowledge that exists in the organization and its location; and (b) incorporating knowledge flows into the knowledge map, which enables users to understand how knowledge circulates from one place to another when needed (Fai, Chin, Fu & Bun, 2005). A knowledge audit is a process that tends to optimize and utilize organizational knowledge inventory. Each component of knowledge audit comes into focus based on where the organization currently stands and where it wants to see itself (Seratt, 2009). Therefore, an exploratory study was carried out through semi-structured interviews with experts to modify and supplement the components of knowledge audit according to the requirements and characteristics of project-based organizations.

The findings of this exploratory study suggest that knowledge map design, although emphasized by the literature, cannot be considered one of the components of knowledge audit in project-based organizations. The reason for this could be that the knowledge map represents knowledge sharing, knowledge resources, and their location in the organization; thus, it is expressed by knowledge inventory analysis and knowledge flow analysis to some extent. Other findings of this research endeavor have been obtained from the interviews. They shed light on knowledge valuation analysis and knowledge application analysis as the components of a knowledge audit. It is inevitable to take the assessment and valuation of the generated documents (both in terms of structure and content) into consideration during projects' life cycle, considering the utmost importance of knowledge documentation in a project-based organization. It is necessary to utilize the existing knowledge of the project-based organization to reduce the incurred costs, lower the risks, save time; and, prevent performing the same tasks repeatedly. Therefore, knowledge application analysis can help determine to what extent the existing knowledge in the organization is applicable for the intended purposes.

Consequently, it can be said that knowledge needs analysis, knowledge inventory analysis, knowledge valuation analysis, knowledge flow analysis; and, knowledge application analysis establish the components of knowledge audit in project-based organizations, as shown by Figure 3.

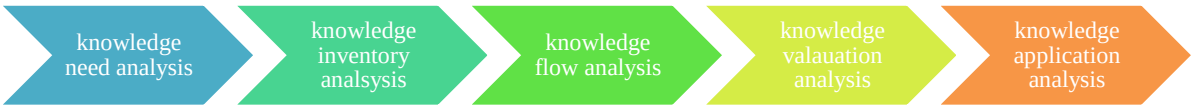


*Figure 3*: The components of knowledge audit in project-based organizations

The obtained results from the documentary study and the codes given by thematic analysis technique applied on interviews carried out with the experts indicate that the components of knowledge audit include 54 sub-components that are explained as follows:

Figure 4 shows 8 sub-components that influence knowledge need analysis. These sub-components are namely strategic documents, selected strategies, business processes, environment knowledge, competitor knowledge, stakeholders' knowledge, market knowledge, and strategy.

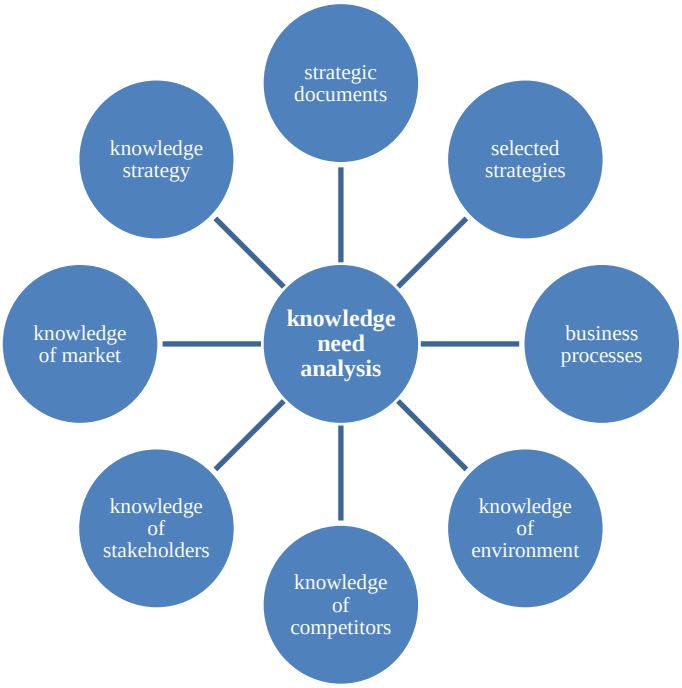


*Figure 4*: The sub-components that have influence on knowledge need analysis

The influencing factors on knowledge inventory analysis include 13 sub-components, such as owners of potential knowledge, producers of actual knowledge, the documented knowledge, knowledge resources, purpose, relevance, and quality of knowledge resources, location of knowledge resources, classification and accessibility of knowledge resources, frequency of using knowledge resources and reasons behind it, a profile of experts' knowledge, human resource management system, human resource development plan, a profile of knowledge owned by former employees; and, human resource succession plan. Knowledge inventory analysis is performed to identify and locate the explicit knowledge assets and resources (library resources and the documented knowledge) and the organization's tacit knowledge assets and resources (owners of potential knowledge). Figure 5 illustrates the identified influencing sub-components on knowledge inventory analysis.


*Figure 5*: The influencing sub-components on knowledge inventory analysis

Knowledge valuation aims to measure and evaluate the documents generated throughout projects' lifecycle phases, in terms of five criteria: (a) structure of the knowledge package, (b) content of the knowledge package, (c) nature of the knowledge package, (d) priority of the knowledge package; and, (e) rate of usage of the knowledge package. Overall, these criteria include 20 sub-components. The structure of the knowledge package includes compliance with the writing templates. When it comes to the content of the knowledge package, several sub-components such as quality, accuracy, relevance, being up-to-date, applicability, reliability; and, being evidence-based are considered. Novelty, being strategic, economic efficiency, impacts imposed on health, safety, and environment can be deemed the sub-components of the nature of the knowledge package. Priority of the knowledge package gives rise to various sub-components such as missions and strategic plans of the organization, current, and future organizational processes, ability to solve organizational problems, potential to fill the knowledge gaps, is a key knowledge area, priority and weight of each project. The sub-components associated with the rate of usage of the knowledge package are the purpose of use and frequency of use. Figure 6 provides an overview of the influencing factors on knowledge valuation analysis.

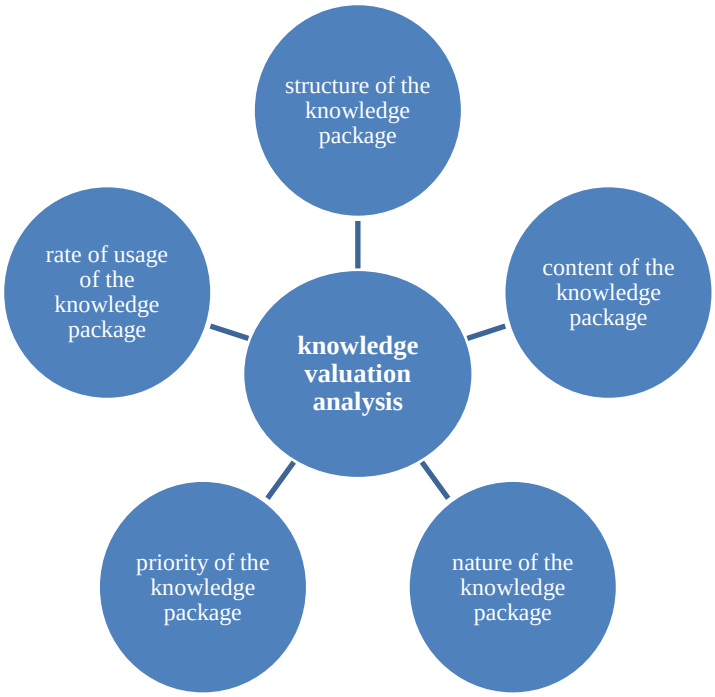


*Figure 6*: The influencing factors on knowledge valuation analysis

Knowledge flow analysis explores how knowledge is shared within an organization and how the interactions are conducted. The influencing factors on knowledge flow analysis include 7 sub-components: proper arrangement of knowledge flow, fluidity of knowledge flow, obstacles and noises affecting knowledge flow, facilitators of knowledge flow, volume of knowledge flow, timeliness, stability of knowledge flow. Figure 7 depicts the influencing factors on knowledge flow analysis.

*Figure 7*: The influencing factors on knowledge flow analysis

Knowledge application analysis aims to investigate the implementation of knowledge in an organization. Six sub-components influence knowledge application analysis: cost-benefit, rate of usage, rate of observation, rate of citation, download rate; and, comment rate. The influencing factors on knowledge application analysis can be seen in Figure 8.


*Figure 8*: The influencing factors on knowledge application analysis

As can be inferred from what was stated above, knowledge audit in project-based organizations generally includes five components, three of which have been obtained from the documentary study (Perez- Soltero et al., 2007; Sharma & Chowdhury, 2007; Serrat, 2009; Ganasan & Dominic, 2011; Kumar, 2013). These three components are knowledge need analysis, knowledge inventory analysis; and, knowledge flow analysis. The remaining two components (knowledge valuation analysis and knowledge application analysis) have been identified based on the findings given by the thematic analysis technique applied in interviews. Figure 9 illustrates 54 sub-components that have been determined.


*Figure 9*: The components of knowledge audit in project-based organizations and their sub-

## Discussion

Although a wide variety of approaches, methodologies, and processes have been proposed for knowledge audit with different details and coverage levels, there is no globally-accepted procedure for knowledge audit due to specific characteristics and requirements associated with each type of organization. Furthermore, all these approaches have been designed based on the components of knowledge audit, such as obtaining knowledge inventory, mapping knowledge networks and flows, and mapping knowledge resources. The appropriate approach is chosen concerning the business requirements and contextual objectives. Moreover, the phases and processes of the investigated models were carefully explored, and the findings indicate that those phases and processes are too general. Most of these phases and processes focus on four

typical components that are: (a) knowledge need analysis (Wang & Xiao, 2009; Suo, et al. 2009), (b) knowledge inventory analysis (Debenham & Clark, 1994; Tiwana, 2000; Fraunhofer, 2000; Hylton, 2004; Fai et al., 2005; Perez- Soltero et al., 2007; Lee, et al. , 2007; Wu & Li, 2008; Dow et al., 2008; Wang & Xiao, 2009; Gourova, et al. 2009; Suo, et al. 2009; Jafari & Payani, 2013), (c) knowledge flow analysis (Perez- Soltero et al., 2007; Cheung et al., 2007); and, (d) knowledge map creation (Debenham & Clark, 1994; Hylton, 2004; Fai et al., 2005; Perez- Soltero et al., 2007; Cheung et al., 2007; Dow et al., 2008).

The research results provided by Drus and Sharrif (2011) are in line with the findings of this study. They analyzed and compared ten knowledge audit models based on their life cycle and concluded that most of the knowledge audit models are too general and lack the necessary details associated with knowledge audit activities and processes. Based on the literature review and identified research gaps; and, in addition to outlining the phases and processes, the present research effort focused on providing a qualitative model for knowledge audit considering the characteristics and requirements of project-based organizations and implementation mechanism and tools associated with the knowledge audit process. Considering the codes given by thematic analysis technique applied on interviews carried out with the experts (See Table 3) and the literature review, the knowledge audit process in project-based organizations can be summarized as follows (See Figure 1): (a) studying the goals, mission, and vision of the organization, (b) identifying the key processes and projects of the organization, (c) organizing the knowledge audit team, (d) developing the knowledge audit strategy, (e) determining the assessment checklist and weighting the items, (f) developing the assessment system, (g) identifying the key projects and implementing the assessment activity, (h) developing the roadmap and strategy for knowledge management; and, (i) re-auditing and performing constant revisions.

Overall, it can be said that the steps associated with the proposed knowledge audit process in project-based organizations share common elements with what has been mentioned in the theoretical literature: (a) studying the goals, mission and vision (Perez- Soltero et al., 2007; Jafari & Payani, 2013), (b) identifying the processes (Perez- Soltero et al., 2007; Lee, et al., 2007), (c) organizing the knowledge audit team (Tiwana, 2000; Fraunhofer, 2000; Wu & Li, 2008; Dow et al., 2008; Wang & Xiao, 2009; Gourova, et al. 2009; Suo, et al. 2009), (d) developing a strategy or defining a methodology for knowledge audit (Tiwana, 2000; Gourova, et al. 2009), (e) developing the roadmap and strategy for knowledge management (Tiwana, 2000; Fraunhofer, 2000; Libowitz, 2005; Li, Cheung & Shek, 2007; Cheung et al., 2007; Wang & Xiao, 2009; Suo, et al. 2009); and, (f) re-auditing and performing constant revisions (Cheung et al., 2007; Wu & Li, 2008; Dow et al., 2008; Ganasan & Dominic, 2011; Wang & Xiao, 2009; Gourova, et al. 2009; Fai et al., 2005; Perez- Soltero et al., 2007).

The distinctive feature of the proposed knowledge audit process in project-based organizations is the necessity to focus on the key projects of the organization and determine the assessment checklist based on the weighted components of knowledge audit specified for the requirements and priorities of project-based organizations. Consequently, we identified 5 components and 54 sub-components that influence knowledge audit in project-based organizations and can serve as the basis for the audit phase in project-based organizations. It can be stated that the pre-audit phase includes exploring organizational goals, vision, and mission, and identifying the key processes and projects, considering the literature review and the knowledge audit process designed based on the interviews carried out with the experts. To

accomplish these tasks, we need to perform the background study and data collection by investigating the strategic documents, organizational chart(s), business processes, websites, and other upstream documents of the organization. Observation, questionnaires, and interviews with key senior managers and experts of the organization could be the tools used to carry out the implementation mechanism.

The knowledge management department and a team of key experts of the organization could join forces to organize the knowledge audit team, develop the knowledge audit strategy, determine the assessment checklist and weight the items; and, develop the assessment system. The knowledge audit team might include employees inside and outside the organization. Moreover, team members of research projects, project managers, the knowledge manager in the organization, academic researchers from universities; and, managers in the organization can be a part of the knowledge audit team. Throughout the audit phase, the key projects can also be identified by conducting interviews with key senior managers and experts; and exploring the upstream and strategic documents. The assessment activity needs to be implemented by the knowledge audit team described above. This assessment is performed based on the components and assessment checklist developed in the pre-audit phase. The assessment activity is done through questionnaires and interviews. It must include knowledge need analysis, knowledge inventory analysis, knowledge flow analysis, knowledge application analysis; and, knowledge valuation analysis as the components of knowledge audit in project-based organizations.

In the post-audit phase, the data and findings obtained from previous phases of knowledge audit must be deeply analyzed to develop the roadmap and strategy for knowledge management. Analyzing methods and software such as Meta-Matrix Analysis, Social Network Analysis (SNA), Analytic Hierarchy Process (AHP); and, Fuzzy Comprehensive Evaluation (FCE) are some of the tools that can be used in this phase. As can be seen in the theoretical literature, Dattero et al. (2007) used Meta-Matrix Analysis to evaluate the results from knowledge audit while Gourova et al. (2009) employed Balanced Scorecard (BSC) and Social Network Analysis (SNA) to perform the analysis of the obtained results. Moreover, Wang & Xiao (2009) analyzed the detailed content and research framework of a knowledge management audit, from the view of operation flow based on a cognition summary of knowledge management audit using Analytic Hierarchy Process (AHP) and Fuzzy Comprehensive Evaluation (FCE).

## Conclusion

It is essential to mention that knowledge audit needs to be performed based on the requirements and priorities of such organizations and components/ sub-components weighted concerning them in project-based organizations. Furthermore, knowledge audit is a repetitive process and must be carried out iteratively at different timeframes. It must be performed at intermittent time intervals and different periods (during project execution stage, after project closure stage, before adding new knowledge to the organizational knowledge base, after adding new knowledge to the organizational knowledge base). Future studies need to focus on developing a mechanism for implementing the knowledge valuation and application of the important knowledge packages in other similar projects, considering the significant importance of knowledge valuation analysis and application analysis as the components of knowledge audit in project-based organizations,. Moreover, It is highly recommended that the practical efficiency of the proposed knowledge audit process, implementation mechanism; and, tools be evaluated in real-world settings.

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