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Performing a Knowledge Audit Within a South African Chemical Manufacturer:
A Case Study

Daniel Hechter, University of Pretoria, South Africa
Hanlie Smuts, University of Pretoria, South Africa*
https://orcid.org/0000-0001-7120-7787

ABSTRACT

Despite the increased efforts of organisations to implement knowledge management (KM) initiatives, many fail. Performing a knowledge audit before embarking on KM activities increases the probability of success. In this interpretive case study, the authors applied a modified version of the knowledge audit methodology developed by Perez-Soltero et al. to a South African (SA) veterinary medicine, fine chemical, and pharmaceutical manufacturer. The authors engaged members of the organisation in focus group sessions and individual interviews to identify knowledge assets related to core processes within the organisation. They used the data from the focus groups and individual interviews to identify and articulate many of the knowledge assets at the core of the organisation's current success. In addition, the process of conducting a knowledge audit and making the steps explicit while adjusting for context, may inform researchers and practitioners in terms of knowledge audit approach.

KEYWORDS

Case Study, Knowledge Assets, Knowledge Audit, Knowledge Audit Process, Knowledge Map

INTRODUCTION

In recent decades, the forces of globalisation and rapid technological innovation have given rise to a knowledge-based economy (Hadad, 2017). As the foundation of industrialised economies shifted from physical resources to intellectual assets, knowledge became the new competitive advantage for organisations (Omotayo, 2015). Executives recognise that the knowledge possessed by their employees is the most important strategic resource in their organisations, but concede that the way to manage this resource remains unclear (Evans et al., 2015). While knowledge is increasingly viewed as an asset or commodity, it is still radically different from traditional commodities due to paradoxical attributes. For example, knowledge is not depleted when used or lost when transferred (Dalkir, 2013). Furthermore, knowledge is plentiful, but the ability to use it is scarce and much of an organisation's valuable knowledge walks out the door at the end of the day (Dalkir, 2013; Liebowitz & Beckman, 2020).

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*Corresponding Author

The field of KM has garnered substantial interest since it came to prominence in the mid-1990s (Chaffey & Wood, 2005) and the significance of KM is no longer limited to knowledge-intensive organisations in high-tech industries (Cormican et al., 2021). According to Harvey et al. (2021), the physical products and services an organisation provides are only the tangible results of the knowledge contained within the organisation's intangible assets. Consequently, a more deliberate and systematised approach to developing and sharing an organisation's knowledge is needed (Dalkir, 2013; Nakash & Bouhnik, 2021).

Despite the increasing efforts of organisations to implement KM initiatives, many fail to achieve the desired results. Scholars cite poorly scoped KM initiatives, unclear objectives, poor communication among stakeholders and lack of measurable benefits definition as pitfalls (Firestone & McElroy, 2012). Lee et al. (2021) argued that the pitfalls can be minimised or entirely avoided by performing a knowledge audit before KM implementation.

Chaffey and Wood (2005) define a knowledge audit as "a systematic process of identifying knowledge assets and their relationship across an organisation." (p. 233) Knowledge audits therefore help organisations determine what knowledge they currently have, how they utilise knowledge, and what knowledge they will need in the future (Yue, 2012). Perez-Soltero et al. (2007) noted that many reputable consulting enterprises own proprietary knowledge audit methodologies. However, there is an apparent lack of knowledge audit methodologies in the scientific literature. Despite the lack of published accounts that precisely detail how to execute a standard KM audit, it is possible to extract sufficient insight from existing literature to develop a basis for the creation of a customised KM audit methodology for a specific enterprise (Cormican et al., 2021; Malekolkalami & Sharif, 2022).

This study aimed to perform a knowledge audit within a South African veterinary medicine, fine chemical, and pharmaceutical manufacturer. The knowledge audit aimed to identify and map some of the vital knowledge assets that contribute to the organisation's success focusing on the question: "How can a knowledge audit be executed in a South African veterinary medicine, fine chemical, and pharmaceutical manufacturer?" The objectives and scope of the study were two-fold. First, the knowledge audit would provide a solid foundation should the organisation choose to develop and implement a formal KM strategy in the future. Second, a knowledge audit methodology, based on the work of Perez-Soltero et al. (2007), would be adapted to the unique context of the organisation.

The rest of the paper is structured as follows: Section 2 provides an overview of KM and KM audit-related literature, Section 3 details the theoretical framework and Section 4 presents the research approach and data collection. Section 5 presents the results and Section 6 includes a discussion. Section 7 concludes the paper.

LITERATURE OVERVIEW

Data, Information, and Knowledge

Data refers to "raw images, numbers, words, sounds, etc., which result from observation or measurement" whereas "raw" implies that the data have no inherent structure (Hislop, 2005, p. 16). A set of data by itself does not stipulate its own relevance or importance. According to Nonaka and Takeuchi (1995), information "provides a new point of view for interpreting events or objects, which makes visible previously invisible meanings or sheds light on unexpected connections." (p. 57) Thus, one creates information by interpreting the meaning of data within a specific context. Armbrust et al. (2021) stated that knowledge "is the value added to information by people who have the experience and acumen to understand its real potential." The definitions above support the conventional view that a hierarchical structure exists between data, information, and knowledge (Oltmann et al., 2021).

Polanyi (1966) first distinguished between two kinds of knowledge that are now widely accepted: tacit and explicit knowledge. Explicit knowledge consists of knowledge captured in a tangible form or concrete media. In contrast, tacit knowledge is more difficult to put into words, text, or drawings

(Dalkir, 2013). Tacit knowledge is rooted in personal experience and linked to individual beliefs, perspectives, and value systems (Dalkir, 2013; Evans et al., 2015; Nonaka & Takeuchi, 1995). Most practitioners and professionals agree that KM recognises that both tacit and explicit knowledge add value to the organisation (Dalkir, 2013). Adding value to an organisation means increasing its ability to achieve its business objectives; KM in this context consists of activities for leveraging the organisation's knowledge assets to the same end. Hajric (2018:24) has elegantly captured many authors' ideas by defining KM as "the systematic management of an organisation's knowledge assets for the purpose of creating value and meeting tactical and strategic requirements."

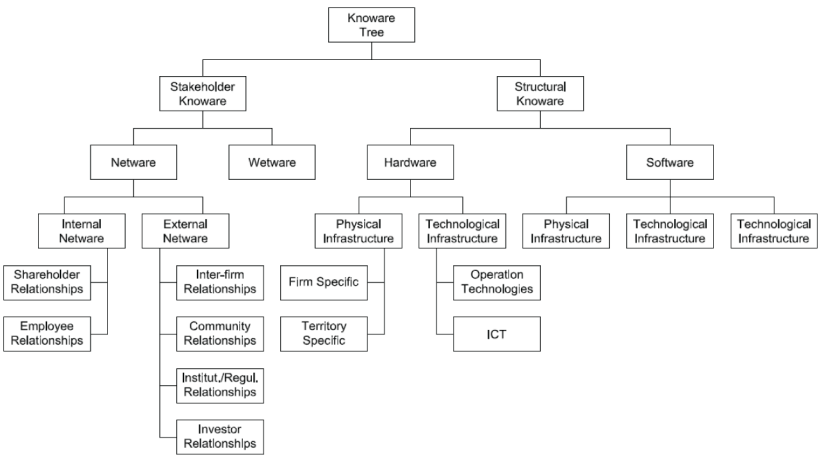
Knowledge Assets and Intellectual Capital

Knowledge assets are the inputs and outputs of the organisational knowledge creation process. These assets are of far greater value to an organisation than any tangible assets, such as natural resources, factories, equipment, and land (Nonaka & Takeuchi, 1995; Smuts et al., 2012). For an organisation to manage its knowledge, it must identify and manage its knowledge assets (Asiaei & Bontis, 2019). The gap between an organisation's reported value and its actual market value is partly due to the challenge of measuring the true value of intangible assets using traditional accounting practices, primarily developed to accommodate tangible assets (Buallay, 2017; Öner et al., 2021). The concept of intellectual capital (IC) was the first step to a less abstract understanding of the value of knowledge assets and Bayraktaroglu et al. (2019) defined IC as "the sum of all knowledge a firm is able to use in the process of conducting businesses to create value for the company."

Sveiby (1997) developed the intangible asset monitor to measure and report crucial IC performance indicators. Building on the work of Sveiby and other authors, Schiuma and Marr (2001) developed the knowledge assets map to provide managers with a more extensive framework of organisational knowledge (Ayinde et al., 2021). Schiuma et al. (2008) refined the knowledge assets map to create the knoware tree model for identifying and classifying organisational knowledge assets. Figure 1 shows the knoware tree model with its various categories and sub-components (Schiuma et al., 2008). The terms "knoware" and knowledge are applied interchangeably. The knoware tree model distinguishes primarily between stakeholder knowledge and structural knowledge.

Stakeholder knowledge includes netware (knowledge assets related to relationships) and wetware (knowledge assets related to human resources). Hardware, included under structural knowledge,

Figure 1. The categories and sub-components of the Knoware Tree (*Note*: Adapted from "The knoware tree and the regional intellectual capital index: An assessment within Italy," by G. Schiuma, A. Lerro, and D. Carlucci, 2008, *Journal of Intellectual Capital*, *9*(2), p. XXX (https://doi.org/10.1108/14691930810870346))



relates to physical infrastructures embodying critical knowledge. Also under structural knowledge, software includes intangible infrastructures representing critical knowledge.

Every organisation is a system of interdependent knowledge elements or assets. Knowledge asset identification allows an organisation to define the portfolio of knowledge assets that lie at the root of its ability to create and capture value (Schiuma, 2009). While KM efforts should aim to improve all knowledge domains within an organisation, limited time and resources often require managers to focus their attention on developing those knowledge assets that would result in the most value creation. For this reason, knowledge assets value drivers must be identified.

Schiuma (2009) developed the knowledge asset value chain (Figure 2) to show the causal relationships that link knowledge assets to an organisation's key strategic value propositions. Once an organisation identifies its knowledge assets and key strategic value propositions, managers can use a top-down approach to determine which knowledge assets are the vital drivers of organisational value creation. Improving these knowledge assets should be the focus of KM initiatives.

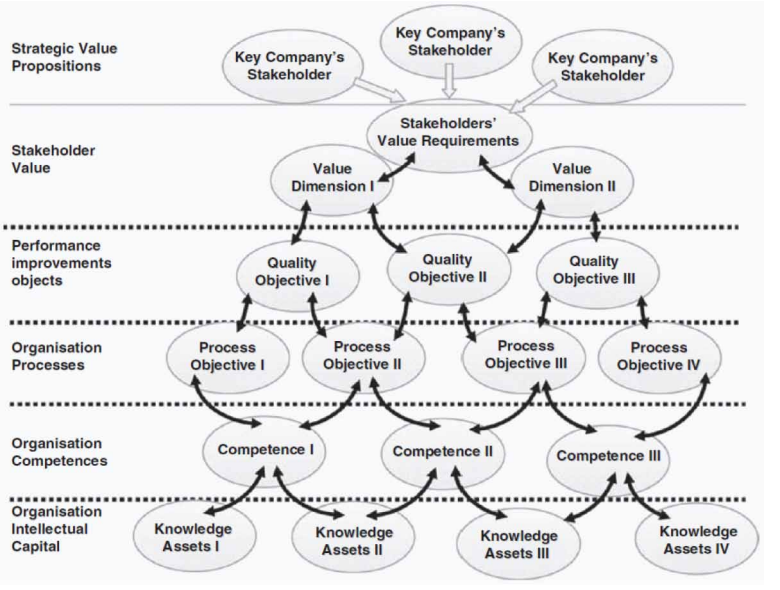
Knowledge Audit

Several authors recommend performing a knowledge audit before implementing any KM system or program (Dattero et al., 2007; Liebowitz et al., 2000; Malekolkalami & Sharif, 2022; Wang & Xiao, 2009). Chaffey and Wood (2005) define a knowledge audit as "a systematic process of identifying knowledge assets and their relationship across an organisation." (p. 233) Perez-Soltero et al. (2007) developed a knowledge audit methodology that focuses on an organisation's core processes.

The knowledge auditing methodology focusing on core processes consists of ten stages (Perez-Soltero et al., 2007):

- Stage 1: Acquire organisational strategic information
- Stage 2: Identify organisation's core processes
- Stage 3: Prioritise and select organisation's core processes
- Stage 4: Identify key people

Figure 2. The knowledge assets value chain (Note: Adapted from "The managerial foundations of knowledge assets dynamics," by G. Schiuma, 2009, Knowledge Management Research & Practice, 7(4), p. XXX. (https://doi.org/10.1057/kmrp.2009.21))



- Stage 5: Meeting with key people
- Stage 6: Obtaining knowledge inventory
- Stage 7: Analysing knowledge flow
- Stage 8: Knowledge mapping
- Stage 9: Knowledge audit reporting
- Stage 10: Continuous knowledge re-auditing

We modified the knowledge audit methodology developed by Perez-Soltero et al. (2007) to fit the objectives and scope of this study. The implication of the objectives and scope of this study was that, since the organisation did not have a formal KM strategy in place, the knowledge audit would be executed once to illustrate its benefit to the management of the organisation. Therefore, Stage 10 (continuous knowledge re-auditing) was not a stage that could be executed as part of the study. Furthermore, Stage 1 (acquire organisational strategic information) called for access to confidential strategic information that the management of the organisation was not prepared to share in detail during the time of the study. By excluding these stages, our study had to accommodate an adapted stage execution of the methodology developed by Perez-Soltero et al. (2007) detailed in the next section.

CONCEPTUAL MODEL

The modified model used key stakeholders to identify core processes based on the knowledge assets value chain developed by Schiuma (2009) instead of strategic information like the organisation's mission, vision, and objectives. Unlike strategic information, like vision and mission, the concept of stakeholders is much less ambiguous, with concrete criteria like those proposed by (Benn et al., 2016).

A researcher or organisation new to knowledge audits would benefit from a more concrete and systematised approach to knowledge asset identification. In addition to the above, the original publication by Perez-Soltero et al. (2007) did not describe the exact process of knowledge mapping or an example of how the final knowledge map should look. We applied a well-detailed method for mapping knowledge assets in the knoware tree model developed by Schiuma et al. (2008), which was also incorporated into the modified knowledge audit model. The final modified knowledge audit model consisted of seven stages.

Stage 1: Identify Key Stakeholders

A stakeholder is any individual, group, or party interested in the organisation and the outcomes of its actions (Benn et al., 2016). We reviewed the organisation's documentation to compile a list of stakeholders. While not exhaustive, the generated list contained the most critical stakeholders, as they featured prominently in organisational documents such as customer and employee registers. The organisation's board of directors selected key stakeholders from the list during a focus group session.

Stage 2: Identify Key Stakeholder Value Requirements

Following the identification of key stakeholders, the next step required considering the organisation's unique value to each stakeholder to compile a list of key stakeholder value requirements. Stakeholder value requirements are the value propositions that an organisation offers to its stakeholders. The organisation's board of directors identified stakeholder requirements related to each key stakeholder during a focus group session.

Stage 3: Identify Core Processes

The organisation's board of directors identified core processes related to each key stakeholder value requirement during a focus group session. Core processes were identified by linking them to key stakeholders via the knowledge asset value chain (Schiuma, 2009).

Stage 4: Identify Key People

After compiling a list of core processes, the key people involved in those processes needed to be identified. The organisation's board of directors identified key people involved in each of the core processes during focus group sessions.

Stage 5: Meeting with Key People

The key people involved in the organisation's core processes were informed of the study and its context. It was essential to explain to each individual that their participation was in no way mandatory, and should they decline, there would be no negative consequences or ill will toward them now or in the future.

Stage 6: Create an Inventory of Core Knowledge Assets

During this crucial stage, the existing knowledge assets within the organisation relating to the core processes selected earlier were identified and captured. We engaged each key person in an individual interview to identify their unique knowledge assets related to the core processes.

Stage 7: Map Core Knowledge Assets

A visual representation of the organisation's knowledge was constructed from the knowledge assets identified during the previous stage. The knowhere tree model developed by Schiuma et al. (2008) served as a framework for the knowledge map.

RESEARCH DESIGN AND METHODOLOGY

To achieve the objective of this study, we followed an interpretive, case study approach. Harrison et al. (2017) stated that "the fundamental goal of case study research is to conduct an in-depth analysis of an issue, within its context to understand the issue from the perspective of participants." As this study focused on a specific organisation, the approach developed by Yin (2018), which emphasises data collection through interviews and observations, served as the guiding methodology.

Textual Data

Stage 1 of the knowledge audit required us to compile a list of all the organisation's stakeholders. Fortunately, we had access to high-quality textual data from the organisation, including employee lists, supplier lists, customer lists, order histories, and financial performance data.

Where information was readily or exclusively accessible to a member of the organisation, we contacted them personally to request access.

Focus Group Discussions

To complete Stage 1 to Stage 4 of the knowledge audit, we engaged the organisation's board of directors in two focus group discussions. The focus group discussions were not recorded due to the confidential nature of the subject material, and note-taking was the primary method of data collection.

Individual Interviews

Stage 6 of the knowledge audit methodology required us to identify the knowledge assets related to the organisation's core processes by engaging key people in individual interviews. The individual interviews were semi-structured based on a set of predetermined questions. As with the focus group discussions, the individual interviews were not recorded due to the confidential nature of the subject material, and note-taking was the primary method of data collection.

Data Analysis

The data collected during the individual interviews consisted of sentence fragments containing details and descriptions related to a particular core process. After each interview, we organised and interpreted the data using the inductive approach to content analysis. The approach involves creating categories and abstractions from a set of data (Lindgren et al., 2020). We used the definition of knowledge assets derived in Section 2 to search for unique data that matched the description of knowledge assets.

The result was a list of unique knowledge assets. We then went through the original data set line by line to match every sentence fragment to only one of the unique knowledge assets identified. Whenever a fragment containing a detail or description matched a knowledge asset, it was removed from the data set for future iterations. We repeated this process until every fragment in the data set matched only one unique knowledge asset.

Due to the uniqueness of each knowledge asset, we did not observe any overlap when matching sentence fragments to knowledge assets. Some fragments contained information unrelated to any knowledge assets and were subsequently discarded from the data set. Finally, we used the fragments of information grouped into each knowledge asset to create coherent written descriptions of each knowledge asset.

FINDINGS

Stage 1: Identify Key Stakeholders

This section of the study and stage of the knowledge audit focused on identifying the primary stakeholders of the organisation. Primary stakeholders include shareholders, employees, customers, suppliers, governments, and communities (Benn et al., 2016).

Shareholders and Employees

We decided not to include shareholders and employees in the list of stakeholders. Selection of the final list of key stakeholders would lie with organisation board members. We believed that asking shareholder board members to explicitly weigh their needs and contributions in the presence of an employee would put them in a situation where it is impossible to answer without bias, conscious or otherwise.

Customers

The managing director supplied a list of the organisation's customers along with financial data. We found that six customers accounted for 90% of revenue and 89.4% of the organisation's gross profit during the latest financial year. The organisation's board selected four of those six customers as key stakeholders.

Suppliers

The managing director provided a list of the organisation's suppliers for the 2021 fiscal year (1 March 2020–28 February 2021). To avoid conflicts of interest, suppliers owned entirely or in part by board members were removed from the list. The organisation's directors identified 23 suppliers as key stakeholders.

Governments and Communities

As with shareholders and employees, we decided not to include any governments or communities in the list of stakeholders. While governments and communities are undoubtedly critical to the success of any organisation, we did not want to place the directors in a position where they must explicitly state which governments and communities they consider more or less critical to the success of the organisation.

Key Stakeholders

We combined the lists of key customers and suppliers into a single list containing 27 key stakeholders.

Stage 2: Identify Key Stakeholder Value Requirements

During the same focus group discussion as Stage 1, once the key stakeholders were selected by consensus, the directors considered the organisation's value propositions to each key stakeholder. After some discussion, stakeholders were split into the categories listed in Table 1.

The reason was that the most significant differences in value requirements would be between stakeholders that fall into these categories, and stakeholders within each category would have very similar or identical value requirements. The directors identified the following key stakeholder value requirements by consensus:

- Competitively priced products
- Reliability of supply
- High product quality
- High standard quality assurance system
- Order flexibility
- High standard sustainability management
- Ease of communication
- Approved raw material
- Well-defined product quality specifications
- Well-defined quality assurance and product quality requirements
- Large order volumes
- Accurate order forecasting
- Timely payments
- Loyalty and shared history

This concluded the first focus group session, which lasted approximately 90 minutes.

Stage 3: Identify Core Processes

The second focus group began with the directors reviewing the list of 14 key stakeholder value requirements identified during the previous session. We tasked the group with identifying the core processes contributing most to the organisation's ability to meet each value requirement. During the process, a participant would suggest and describe a core process related to one or more key stakeholder value requirements. The group then discussed the core process and decided by consensus whether or not to include it. The group repeated this process until no more suggestions were generated and identified the following core processes by consensus:

Core Process 1: Raw Material Procurement

The raw material procurement process starts when the production department requests raw materials from logistics. Once a request is received, the logistics clerk will check current stock levels. The

Table 1. Stakeholder categories

Stakeholder Category	Description
Local Customers	Customers based or operating predominantly in Southern Africa.
Multinational Customers	Customers based or operating in multiple countries, including or excluding South Africa.
Raw Material and Packaging Suppliers	Suppliers of raw materials and packaging materials based or operating either exclusively in South Africa or multiple countries.
Service Providers	Service providers based or operating either exclusively in South Africa or multiple countries.

logistics clerk will notify the logistics manager of any shortages so the required stock can be acquired. All raw materials that arrive on the premises are inspected and placed in a "quarantine" area for temporary storage. The logistics clerk then arranges for a quality control analyst to sample and test each raw material. Materials that pass analytical testing are moved from the quarantine area to the "released" area, ready for use by the production team.

Core Process 2: Production Planning

The production output of the organisation is primarily constrained by the physical limitations of its manufacturing equipment. Such equipment systems take months or years to design and install. Consequently, the organisation cannot react to sudden surges in demand by increasing its production capacity through additional labour, like some service industries. The operations director is ultimately responsible for balancing customer requirements with the limitations of production equipment by creating and managing a detailed production schedule. With each new order, the operations director must incorporate it into the existing production schedule. The production planning process includes all the activities related to creating and managing this schedule.

Core Process 3: Equipment Maintenance

The success of the organisation depends heavily on the performance of its various production equipment systems. Consequently, the maintenance activities related to these equipment systems are of primary importance. The equipment maintenance process includes the physical maintenance operations and the planning and scheduling of preventative maintenance activities.

Core Process 4: Quality Management

The primary quality management functions within the organisation are quality assurance and quality control. Quality assurance ensures that all organisational processes and activities are performed according to a certain standard, and quality control focuses on verifying the quality and consistency of manufactured products.

Core Process Exclusions

After some deliberation, the group decided that the scope of this study would only allow detailed consideration of two of the four identified core processes. Consequently, the remainder of the second focus group and the study focused only on raw material procurement and production planning.

Stage 4: Identify Key People

To conclude the second focus group session, we tasked the group with identifying all personnel in the organisation who play a key role in raw material procurement and production planning. A participant would suggest a potential key person involved in raw material procurement or production planning, and the group would decide by consensus if that person indeed plays a critical role. The process was repeated until no more suggestions were generated, and six key people were identified. Table 2 lists the key people identified and shows which core process each person relates to.

Stage 5: Meeting with Key People

Once the key people involved in the organisation's core processes were identified, we recruited them individually via face-to-face invitations at their offices in April 2021.

All key people agreed to participate as interviewees, and each individual signed an informed consent form before their interview.

Table 2. Key people linked to core processes

Key Person	RMP	PP
Logistics Manager	X	X
Managing Director	X	
Logistics Clerk	X	
Quality Control Manager	X	
Quality Control Analyst	X	
Operations Director		X

Note: RMP = raw material procurement; PP = production planning

Stage 6: Create an Inventory of Core Knowledge Assets

We engaged the six key people identified in Stage 5 in individual semi-structured interviews to create an inventory of the organisation's core knowledge assets related to raw material procurement and production management. We interviewed five participants individually in the organisation's board room during May of 2021. Due to complications related to COVID-19, one participant was interviewed in August of 2021.

Seventeen unique knowledge assets were identified from the data collected during the individual interviews. We then matched each sentence fragment from the original data set to only one of the 17 unique knowledge assets identified. Due to the uniqueness of each knowledge asset, we did not observe any overlap when matching sentence fragments to knowledge assets. Some fragments contained information unrelated to any knowledge assets and were subsequently discarded from the data set.

Finally, we used the fragments of information grouped with each knowledge asset to create coherent written descriptions of each knowledge asset. Below are the descriptions of each knowledge asset generated, organised by the relevant process and key person.

Relationships with Raw Material Suppliers (Logistics Manager)

The logistics manager is the first point of contact between the organisation and its raw material suppliers. Knowledge is embedded in the relationships that develop over time between the logistics manager and each supplier relating to their unique operations, requirements and constraints.

Raw Material Supplier Selection (Logistics Manager)

While the organisation aims to build and maintain long-term relationships with trusted suppliers, unforeseen global developments can make a long-time supplier suddenly unavailable, sometimes indefinitely. In such cases, the logistics manager is responsible for finding a reliable alternative supplier.

Raw Material Importation and Transportation (Logistics Manager)

The logistics manager has critical knowledge of the various logistic and legal requirements and constraints related to importing and transporting raw materials to South Africa to produce animal medicines.

Product Applications and Chemistry (Managing Director)

The managing director holds a post-graduate degree in chemistry, providing a fundamental understanding of the chemical properties of raw materials and final products and the manufacturing processes by which raw materials are converted to final products.

Analytical Test Method Selection (Managing Director)

Before a raw material can be used for production, it must be tested and shown to conform to certain quality specifications which the client typically defines. The managing director is responsible for drawing up a laboratory test form (LTF) for each new raw material that specifies the analytical tests required.

Raw Material Inspection (Logistics Clerk)

The logistics clerk is responsible for inspecting all raw materials that arrive on the premises. This involves checking the condition of the raw material packaging and the integrity of the packaging seal. The logistics clerk must use their judgment to accept the raw materials or escalate any concerns to the logistics manager.

Raw Material Control (Logistics Clerk)

The logistics clerk arranges with the quality control manager for an analyst to sample the raw material and perform tests according to the LTF. If the raw material passes all testing, each container is labelled as "released" and moved into the raw material store for use by the production team. The logistics clerk is responsible for tracking all raw materials' status and reporting any discrepancies to the logistics manager or quality assurance manager.

Raw Material Sample Management (Quality Control Manager)

The quality control manager ensures that all incoming raw materials are tested quickly and correctly. A representative sample is taken from each raw material container by a quality control analyst. The excess material from each sample is kept as a reference sample in a dedicated storage area for one year after the expiry date. Each reference sample serves as a record of the raw material and can be analysed in the event of a final product quality deviation. The quality control manager maintains a record of traceability of all samples and ensures that they are accessible to regulatory authorities at reasonable times. Finally, the quality control manager ensures that all expired reference samples are destroyed.

Raw Material Sampling Technique (Quality Control Analyst)

Raw material sampling involves collecting and measuring exact quantities of solid and liquid materials from containers of various shapes and sizes. The quality control analysts perform the physical task of sampling each raw material. While the various steps are described in standard operating procedures, sampling raw materials is a skill learned and refined through repetition.

Analytical Testing Equipment Operation (Quality Control Analyst)

Once collected, raw material samples are tested according to an LTF. The LTF indicates the required tests and the acceptable test result ranges that the raw material must conform to. The quality control analysts are responsible for performing tests and documenting the results on the LTF. This requires knowledge of the operation of various analytical testing equipment and good laboratory practice.

Analytical Test Result Interpretation (Quality Control Analyst)

In addition to the knowledge required to perform analytical testing, quality control analysts must interpret the test results correctly. In the event of a test failure, how the result deviates from the expected value provides insight into the nature of the failure. Quality control analysts must know the factors that impact test results to interpret a deviation and rule out causes other than material defects.

Relationships with Staff (Logistics Manager)

Knowledge is embedded in the relationships that develop over time between the logistics manager and the logistics and production staff.

Relationships with Customers (Logistics Manager)

The logistics manager is the first point of contact between the organisation and its customers. Like supplier relationships, knowledge is embedded in the relationships that develop over time between the logistics manager and each customer. These relationships are critical in cases where the logistics manager must manage customer expectations.

Raw Material and Packaging Management (Logistics Manager)

Where the logistics clerk manages the daily tracking of raw materials and packaging, it is ultimately the logistic manager's responsibility to ensure that all raw materials and packaging are available for production when needed.

Global Market Opportunity Analysis (Logistics Manager)

The cost of raw materials is the single most crucial factor impacting the profitability of the organisation. Due to shifting supply and demand, global raw material prices constantly change, making optimal profitability a moving target. The logistics manager monitors global market conditions closely to look for opportunities to increase profitability by purchasing raw materials at favourable prices.

Production Processes and Equipment (Operations Director)

The organisation has a finite production capacity that must be managed carefully to balance the needs of its many customers. Products supplied by the organisation are made in batches, and most of the production equipment is not dedicated to a single product. There are also several possible product combinations, mainly where the final product includes unique packaging and labels supplied by the customer. The operations director is ultimately responsible for ensuring that all products are made on time and to customers' exact specifications. To us, this represented two different but complementary knowledge bases. The first is knowledge of the processes and equipment involved in the production, which tells one how to make each product. To achieve this, the operations director requires and has built up substantial knowledge related to:

- The general chemical and thermodynamic mechanisms that underly each production process (e.g. chemical reactions, pH and phase changes). The operations director holds a bachelor's degree in chemistry.
- The general working principle of each piece of equipment used during the production processes (e.g. heat exchangers, batch reactors and piston fillers).

The second knowledge base is related to the logistics and timing of production, which tells one when to make each product. This knowledge asset is discussed in the following section.

Production Schedule Management (Operations Director)

Each product combination consists of linear steps with either a fixed or variable duration. For example, the time it takes for operators to load raw materials into a reactor manually will vary from day to day. However, the critical reaction step always has a fixed duration. Consequently, there is a substantial difference between the expected manufacturing duration "on paper" and the duration in reality. By overseeing the production of thousands of product batches over the years, the operations director has developed a good sense of the average production time for each product combination. This knowledge allows the operations director to ensure that orders are manufactured and delivered on time by effectively scheduling and planning production activities.

Stage 7: Map Core Knowledge Assets

A visual representation of the organisation's knowledge was constructed from the knowledge assets identified during the previous stage. The knowhere tree model developed by Schiuma et al. (2008) served as a framework for the knowledge asset map (Figure 3).

DISCUSSION

Summary of Focus Group Sessions

The identification of key people concluded the second of two focus group sessions. We considered it worthwhile to integrate all the data from the focus group sessions into a single visual representation (Figure 4). Figure 4 shows the flow of the data collection process from Stage 1 to Stage 4. Each stage generated a list of output data that served as inputs for the following stage. We also considered Figure 4 a valuable strategic tool for the organisation by itself. At a glance, one sees the specific ways the organisation provides value to its customers and suppliers and the processes and people involved. In addition, it shows the specific interdependencies between the various stakeholders, value requirements, core processes and people.

Knowledge Audit Implementation

We consider the knowledge audit a success within the narrow boundaries defined by the conceptual model. We were able to identify and articulate many of the knowledge assets at the core of the organisation's current success. In its current form, the knowledge asset map will provide a sufficient foundation for the organisation's future KM efforts.

Methodology and Confidentiality Limitations

Due to time and resource constraints, a modified version of the knowledge audit methodology proposed by Perez-Soltero et al. (2007) was used. The focus on stakeholders allowed us to identify many critical knowledge assets in a short time but categorically excluded some knowledge assets. Considering the knowhere tree model (Figure 5), the focus on stakeholders limited the audit to netware and wetware knowledge assets. The boxes crossed out in Figure 5 indicate all the sub-categories of knowledge under hardware and software that were overlooked as a result.

In addition to structural limitations resulting from the methodological approach, the audit's outcome was narrowed further by confidentiality constraints.

It provided privileged access to critical organisation documentation but excluded knowledge asset categories to avoid conflicts of interest. The boxes crossed out in Figure 6 indicate all the sub-categories of knowledge that were overlooked as a result of both the methodological and confidentiality constraints. In addition to those shown in Figure 6, they included:

- Shareholder relationships
- Community relationships
- Institutional or regulatory relationships
- Investor relationships

While much can be learned about implementing knowledge audits from this study, we now believe private and for-profit organisations are not ideal subjects for advancing the knowledge audit literature. The fact that knowledge is the new competitive advantage for organisations may partly explain the lack of publicly available knowledge audit methodologies observed by Perez-Soltero et al. (2007).

Figure 3. Key knowledge asset map

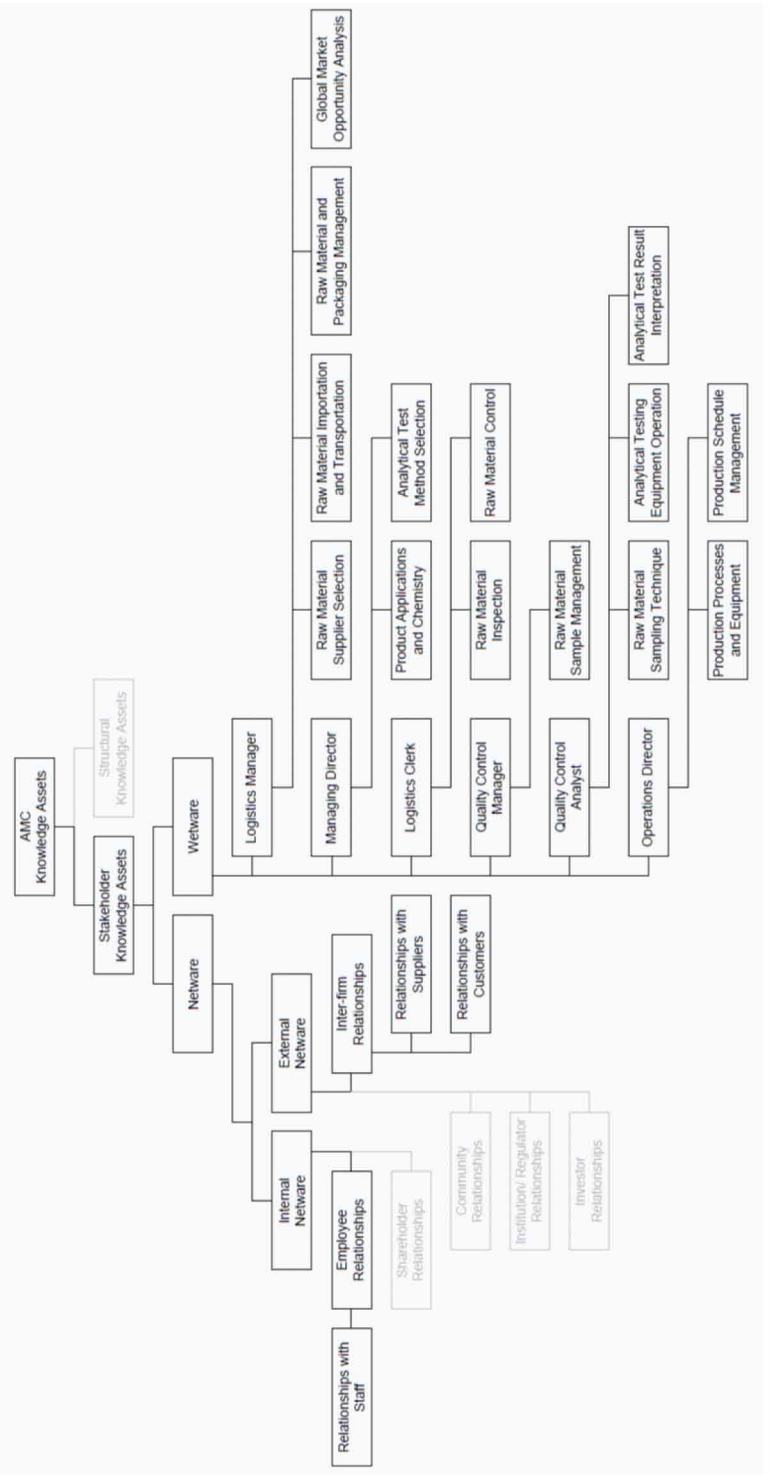
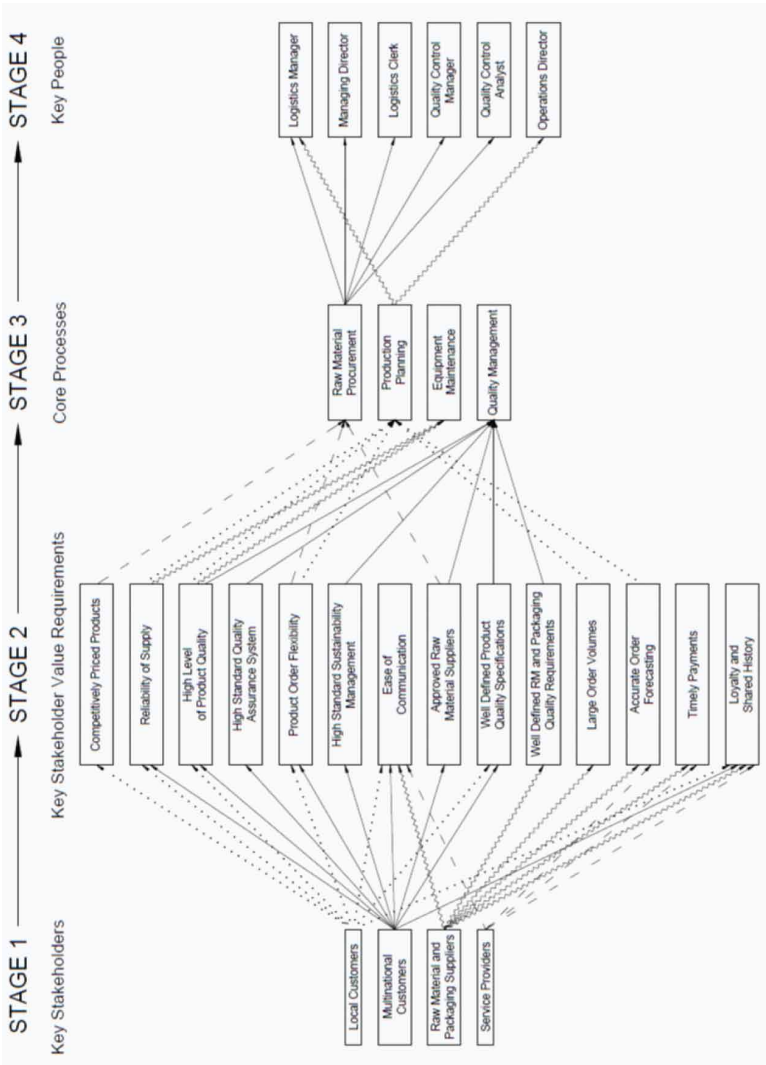


Figure 4. Summary of Data collected from stage 1 to stage 4



An organisation that grants full access to its knowledge for testing in the public domain risks severe damage to its competitive edge. Scientific researchers are thus limited in the number of organisations available as case study subjects. Consulting enterprises have the advantage of maintaining client confidentiality, providing more opportunities to test and refine their proprietary knowledge audit methodologies on real-world organisations. As an alternative, researchers may consider non-profit organisations as future case study subjects.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study served as an example of a knowledge audit applied to a real-world organisation. In total, 17 of the organisation's key knowledge assets were identified and mapped. While the study was successful within its narrow boundaries, its results were limited by several contributing factors. Due

Figure 5. Methodological knowledge asset category exclusions

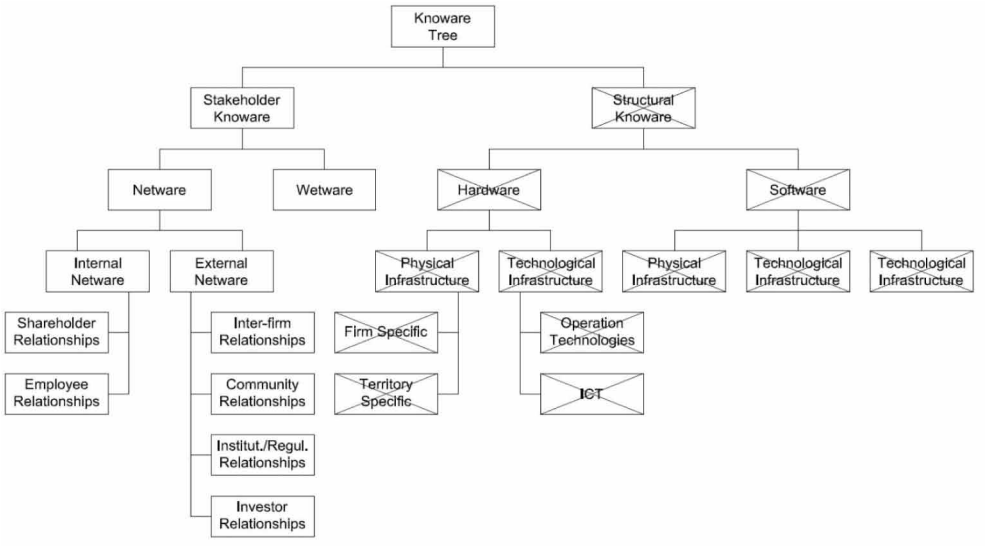
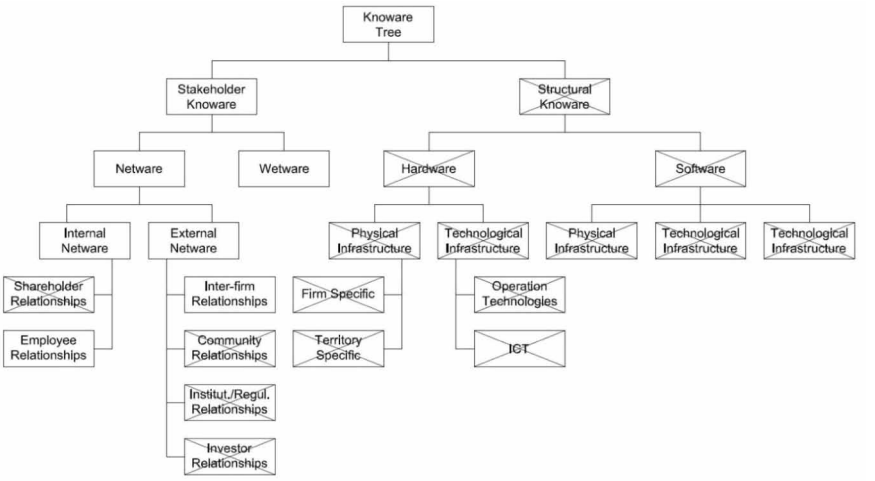


Figure 6. Cumulative knowledge asset category exclusions



to time and resource constraints, a modified version of the knowledge audit methodology proposed by Perez-Soltero et al. (2007) was used. The focus on stakeholders allowed us to identify many critical knowledge assets in a short time but categorically excluded structural knowledge assets.

Furthermore, the choice of a privately owned for-profit organisation as the case study subject imposed confidentiality constraints, further excluding categories of knowledge assets. While much can be learned about implementing knowledge audits from this study, we now believe private and for-profit organisations are not ideal subjects for advancing the knowledge audit literature. The fact that knowledge is the new competitive advantage for organisations may partly explain the lack of publicly available knowledge audit methodologies observed by Perez-Soltero et al. (2007).

One can generate many theoretical models, but to know what works requires real-world testing and refinement. An organisation that grants full access to its knowledge for testing in the public domain risks severe damage to its competitive edge. Scientific researchers are thus limited in the number of organisations available as case study subjects. Consulting enterprises have the advantage of maintaining client confidentiality, providing more opportunities to test and refine their proprietary knowledge audit methodologies on real-world organisations. As an alternative, researchers may consider non-profit organisations as future case study subjects.

Recommendations

We propose the following alternative approaches to the stakeholder-focused knowledge audit methodology for future studies of this nature.

Physical Infrastructure Audit

A focus on human resource knowledge overlooks the knowledge embedded in the physical infrastructure of an organisation. As an alternative to key stakeholders, one could begin the audit with a list of the organisation's physical assets. If time and resources are limited, management can indicate the most critical physical assets to receive primary focus. Similar to the key stakeholder approach, physical assets can be linked to core organisational processes. We believe that this approach should yield more hardware-related knowledge assets.

Intellectual Property and Patent Audit

Similar to the physical infrastructure audit, but starting with a list of the organisation's intellectual property and registered patents. Management can help to narrow the list down to optimise the use of time and resources. We believe that this approach should yield more software-related knowledge assets.

Mixed-Method Approach

Using a combination of the methods above should yield the most comprehensive knowledge asset map. Of course, the suggested approaches are not exhaustive, and many other equally valid approaches are possible. We believe that the quality of the final knowledge asset map correlates strongly with the availability of human resources allocated to the knowledge audit process.

Context of the Organisation

One can generate many theoretical models, but to know what works requires testing and refinement through real-world application. An organisation that grants full access to its knowledge for testing in the public domain, may risk severe damage to its competitive edge. Scientific researchers are thus limited in the number of organisations available as case study subjects. Consulting enterprises have the advantage of maintaining client confidentiality, providing more opportunities to test and refine their proprietary knowledge audit methodologies on real-world organisations. As an alternative, researchers may consider non-profit organisations as future case study subjects.

Directions for Future Research

In this study, a modified version of the knowledge audit methodology developed by (Perez-Soltero et al., 2007) was successfully applied to South African veterinary medicine, fine chemical, and pharmaceutical manufacturer. The end product was a knowledge asset map based on the Knoware Tree Model (Schiuma et al., 2008). However, due to methodological and confidentiality constraints, the knowledge assets identified were limited to a few sub-categories of the Knoware Tree Model. This study served as an example of a knowledge audit applied to a real-world organisation. While the case study was successful within its narrow boundaries, its results were limited by several contributing

factors. Due to time and resource constraints, a modified version of the knowledge audit methodology proposed by Perez-Soltero et al. (2007) was used. The focus on stakeholders allowed us to identify many critical knowledge assets in a short time but categorically excluded structural knowledge assets. Furthermore, the choice of a privately owned for-profit organisation as the case study subject imposed confidentiality constraints, further excluding categories of knowledge assets.

Further research can build on this work by applying the model to a similar organisation, with the inclusion of a physical infrastructure and intellectual property audit for identifying other core processes. The knowledge assets identified from the additional core processes should provide further insight into the knowledge used by similar organisations. In addition, further research could involve applying the modified knowledge audit methodology to an entirely different kind of organisation. As the proposed revised methodology was defined based on the real-world problem of sharing confidential, strategic information, our proposed methodology may also benefit organisations in the same situation, and this application may be tested.

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Daniel Hechter is a process engineer specialising in designing, installing and commissioning GMP compliant manufacturing facilities for human and animal health active pharmaceutical ingredients (APIs). His current focus is working with teams of professionals from organisations and national government departments to establish an API manufacturing industry in South Africa. The goal is to create an industry that allows South Africa to compete on the international market and to secure access to life-saving medicine for individuals in South Africa and Africa.

Hanlie Smuts is an Associate Professor in the Department of Informatics at the University of Pretoria, South Africa. During her more than 30 years tenure in large corporates in industry, she aimed to deliver consistent customer relevance across all digital touch points, to empower customers through convenient and effective self-service, and to drive growth through personalised digital offerings. Through a deeper understanding of the digital and adjacent ecosystems, as well as data and insight, she championed transformation to digital and the need for collaboration in this context. Hanlie currently focuses on research in IS and the Organisation with particular emphasis on digital transformation, disruptive technologies, big data management and knowledge management. Hanlie has published several papers and book chapters in her field of study.