Measurement of the Valuation of Knowledge in Organizations: A Review Analysis

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Abstract: The purpose of this paper is to address the question of how to measure the value of knowledge in an organization. The study shows how to identify the attributes used to measure this value and identify the relationships between these attributes. As a first step, researchers chose selected 203 studies for review. Then those studies were analyzed through content and contextual analysis. It has been shown that it is possible to identify identical attributes across theoretical works and case studies that are aimed to assess the value of an investment in knowledge. The attributes can be defined and hierarchically structured. The paper provides the basis for establishing a broadly applicable methodology for assessing the value of the investment in knowledge and, consequently, improving the possibilities to determine its effectiveness.

Keywords: added value; content analysis; contextual analysis; intangible assets; investment; knowledge; knowledge management

1. Introduction

Currently, knowledge is considered an essential source of competitive advantage for companies. From this viewpoint, knowledge is understood as an asset [1–3]. Thus, a task for managerial decision-making is the issue of expressing the costs of receiving knowledge and the benefits that arise from said knowledge. Cost planning and calculation are usually not difficult; standard accounting methods can be used for this purpose. The main problem is how to express the benefits directly or indirectly connected to obtained knowledge. To our best knowledge, there is no general scheme for how to classify the benefits of knowledge; however, many contributors, articles, and other studies deal with these issues [4,5].

We want to fill a gap, which consists in a need for a standardized system of measures and criteria to support management in streamlining the whole decision-making process. The goal of such a system would be to measure the real value of an organization and its knowledge. To know the real value of organizations would help management teams to qualitatively evaluate attributes of knowledge value and make decisions about the organization itself. To achieve this, organizations would need to focus on the value of the knowledge held by their key employees, key departments, and other parts of the organization [6]. Ultimately, this will help to prevent the loss of knowledge from the organization.

This paper is explicitly targeted at the knowledge management field, which encompasses the management of organizations and the whole process of management decision-making in organizations [7,8]. This field is closely connected with the human resources domain (in particular, intellectual capital and knowledge value creation) [9], although there is still a gap between these fields. Our approach, based on a framework used by authors from other scientific disciplines, consisted of an in-depth analysis of textual materials, mainly from scientific journals [10]. Henritius et al. used a similar
approach in their study focused on the connection between students’ emotions and virtual learning. Their study, focused on textual materials from scientific journals, showed that the most common concept related to their research question (RQ) was “satisfaction”. Another study, by Palvalin et al. [11], investigated a novel tool used to measure knowledge-related work performance—the SmartWoW [12]. Palvalin et al. also provided validation and improvement of this study and their SmartWoW tool. Their study focused on applying the NewWoW approach and technologies, and adapted their approach for use in one organization. The whole idea is to “work smarter, not harder”. For authors to develop work practices via the NewWoW mode, it is necessary to have an analytical management tool to assess the status of an organization’s current work practices and to demonstrate the impacts of development initiatives.

Based on the above, we posed the following research question.

RQ: What are the most common attributes used in the literature for the valuation of knowledge in organizations?

We posed the following sub-RQs:

1. What concepts have been used to research knowledge value and measurement of that value?
2. What methods have been applied in research on knowledge value and its measurement?
3. Which key theoretical contributors feature prominently in research on knowledge value?
4. What were the findings of the reviewed studies?

We focused on identifying measures of value creation for organizations, intending to provide valuable metrics. Based on the preliminary data analysis from the text mining study, we introduced the content and contextual analysis of the study materials, with the final query of groups of attributes.

The paper is divided as follows. Following this brief introduction, we present the Materials and Methods section, which addresses how the data were collected and analyzed and how the findings were gathered. The third section provides a discussion of the results and the practical implications of measuring the value of knowledge in an organizational environment. The final section provides the conclusions drawn from the presented study and suggestions for future research.

2. Materials and Methods

This study follows up on the research of Mudrychová et al. [13], and it expands the research, as we provide here the complete review of materials used, where the study as mentioned later presented a part of the whole research. Research materials and documents were extracted from indexed scientific databases worldwide, including Scopus, ISI Web of Knowledge, ProQuest, and ScienceDirect. The primary phrases and queries used in the materials searched were as follows: (“measurement of investments”, or “measuring of investments”, or “investment”) and (“knowledge”, or “intangible assets”, or “intellectual capital”, or “knowledge discovery”, or “knowledge management”, or “knowledge mining”, or “knowledge-based system”). The materials searched were chosen according to predefined keywords and were published in the period from 1990 to 2018 [9,14].

Primarily, we pre-selected 796 original peer-reviewed documents. All studied documents were published in English, consisted of 10 to 20 pages, and some went beyond the mentioned concepts related to knowledge. The textual materials selection was based on articles from dozens of international journals/conferences or similar international relevant organizations for research into eight fundamental concepts. The journals were chosen to reflect different research areas with the same set of searched concepts and contexts related to the value of knowledge [14].

The following criteria were used to define the studies to be included in the review:

- An empirical study;
- A focus on knowledge management, knowledge value creation, and organizational value, employee value, and others;
- Research materials and documents available from a well-known international scientific database (Scopus, ISI Web of Knowledge, ProQuest, or ScienceDirect) prior to the year 2018.
Studies were related not only to economics and business but also to other disciplines, and fields, and different types of organization. The final output of their analysis included 203 documents, which had to be classified, accessible, and suitable for use [14].

After the process above, we proceeded with the contextual and content analysis through the program Tovek Tools [15]. There we had to properly set up the set of queries for Query Editor and Harvester (see the below chapter “Contextual analysis and Content analysis”). This article presents attributes which are described from a sophisticated point of view and presented as a part of an extensive, complex system of groups of attributes that can be used to measure the value of knowledge.

2.1. Contextual Analysis

Contextual analysis is the primary analysis of a text. Such analysis helps researchers to go through a text within the context of its history and cultural setting. It also provides access to its textuality; i.e., the characteristic qualities of that text [16]. This method is qualitative, although some variations incorporate quantitative methods. The results are quantitative, and they are usually visualized to better understand the results and the analysis in general.

The primary purpose of contextual analysis is to identify selected words and stems chosen by users. All documents that contain those words and stems are then indexed in the software. Contextual analysis is used to describe specific contexts and to illustrate the overarching context of the items searched, and for predefined topics [13,17].

2.2. Content Analysis

Content analysis is used to make replications and valid inferences while users interpret and code textual materials. If a systematic evaluation of texts is made, then the qualitative data can be converted into quantitative data. This method can be qualitative or quantitative, but the quantitative method is used more widely. However, a researcher has to remove much of the subjectivity from summaries (reviews do not represent a content analysis, but rather an evaluation) and simplify the detection of trends. The analyzed content can be in any form. Content is converted into words or stems many times in a text [18].

Content analysis allows the content structure of a text to be described and explained to ordinary users. As Pilar et al. [19] described in their previous study, systematic, objective, and quantitative methods are used for content analysis. The main objective is related to identification using statistical methods of critical terms in a group of materials and documents, and their frequency and development over time. The resulting outputs are annotations, abstracts, sets of descriptive keywords, and subject topics. A similar approach is being used for the content analysis of social networks [20].

Moreover, users can see not only those connections but also the specific surroundings around chosen keywords and documents where the words appear. Such connections are sometimes used even for contextual analysis. In such cases, connections between topics and content are searched [13].

The main program used in this study was Tovek Tools software, version 7.4. In this study, text documents were indexed. The software applied searches in all documents and provided features that allow the content and contextual analysis. The first feature used for contextual analysis allows users to sort all documents and materials by selected topics. This program includes two features: Query Editor and Harvester. The Query Editor feature was used to create more complex queries, and those queries were presented in a tree/hierarchical structure. We created topics, formulated the problem accurately, and determined the importance of the weight of each part of the query and which had the most substantial influence on the final results. The Harvester feature was used for the content analysis of all selected materials and documents, as it is quite suitable for orientation in huge texts containing unknown data. All methods used by the two features mentioned above combine statistical methods and linguistic analysis. The search can be set up for two or more words which occur close to each other in examined documents. It can also reveal essential keywords and relationships between them, the surroundings of selected words, and the documents in which they occur [13,15].
We provide here also an example of a Query editor query and Harvester analysis (see below Figures 1–3).

Figure 1. Query editor and an example query.

Source: Authors’ work (prepared and exported from Tovek Tools program).

Figure 2. Query editor (different type of query) and an example query.

Source: Authors’ work (prepared and exported from Tovek Tools program).

Figure 3. Content analysis diagram (from Harvester).

This query above means that stems (a root of a specific word) are searched with the importance 80 for knowledge and also in the same time for stems with the importance 50 for measurement. The prefix “many” stresses the importance of specified stems.

3. Results

We summarized results from analyses in graphs and tables which are shown in this chapter. We sorted all studies by concepts (field of studies), and provided how many studies were included in each concept. The number of review topics from selected journals and how many articles contained each concept were as follows:

- economics, business, and management: 73;
- information technologies, mathematics, and technological studies: 50;
- environmental technologies, sustainable technologies, and engineering: 24;
- social and behavioral techniques, psychology, and cognitive techniques: 23;
- medicine and medical technologies: 19;
- biology, physics, and chemistry: 8;
- education: 4;
- food and health care: 2.

The topics and their distribution are also presented in Figure 4 below.

![Pie chart showing topic distribution]

**Figure 4.** The topic of research studies with the count of journals of those research studies.

Most of the articles were focused on economics, business, and management, and they were frequently presented in journals focused on financial investment, management decisions, and organizational value, among other topics. Most of those journals had relatively high impact factors in their respective fields.

For example, the *Journal of Business Research* had a 2017 impact factor of 2.509; its CiteScore for the same year was 3.31, its SCImago Journal Rank (SJR) in 2017 was 1.260, and its h-index was 144. Several studies were also selected from the *International Journal of Project Management*. That journal had an impact factor in 2017 of 4.328, and its CiteScore for the same year was 5.06, its SJR was 1.463, and its h-index was 110. Another interesting journal from which a few studies were selected was *Expert Systems with Applications*. This journal had a 2017 impact factor of 3.768, and in the same year its CiteScore was 5.22, its SJR in 2017 was 1.371, and its h-index was 145. SCImago has a good base of information on how to search for journals and inspired how to sort our journals and gain a picture of the context of the articles.

We also investigated the count of articles by year and topic. The most frequent year was 2015 and other years were less frequent, particularly 2010–2014, 2016–2018, and 2005. The most frequent topics were, as mentioned above, economics, business, and management, and information technologies, mathematics, and technological studies. Figure 5 presents the past seven years of studies.
As the last step of our analysis, we wished to identify groups of attributes that could cover our scope of research and be applied to organizations to measure the value of knowledge inside the organization. We identified five groups of attributes, each containing specific attributes: knowledge management capability, knowledge sourcing, knowledge collection/exploitation, knowledge contribution, and seeking and innovation. Each group contained three or four variables. The first variable of the “knowledge contribution” group was presented in our previous study [13].

Research methods used in articles could be grouped into three types: quantitative, qualitative, and mixed research. These types could be divided into sub-categories to clarify the methods used. The quantitative research was divided into experimental and nonexperimental methods, and the qualitative research was divided into biography, phenomenology, case study, grounded theory, and historical methods. In the case of mixed research, there existed a mixed method and mixed model; i.e., the combination of qualitative and quantitative research methods.

The below mind-map (Figure 6) was based and created on stems and phrases from selected articles. The most frequent word was “knowledge”, after which there were other words such as “data”, “analysis”, “hypothesis”, “system”, or “method”. We included in the mind-map below a frequency of each attribute, and also a percentage appearance in peer-reviewed studies. In peer-reviewed studies selected for this review study, a group of attributes’ knowledge sourcing (103) was the most commonly
used, followed by a group of attributes’ knowledge collection and exploitation (75). We included also a Table 1 below which shows the frequency and percentage of appearance across groups of attributes.

Figure 6. Mind-map of groups of attributes and their attributes (including frequency and percentage of each attribute’s appearance in peer-reviewed studies).

Table 1. Group of attributes, frequency, and percentage of peer-reviewed studies in which each attribute appears.

| Group of Attributes                      | f  | % of Studies (n = 203) |
|-----------------------------------------|----|------------------------|
| Knowledge sourcing                      | 103| 50.74                  |
| Knowledge collection and exploitation   | 75 | 36.95                  |
| Knowledge management capability         | 68 | 33.50                  |
| Knowledge contribution and seeking      | 54 | 26.60                  |
| Innovation                              | 38 | 18.72                  |

Source: Authors’ work.

The research question which we posed was:

RQ: What are the most common attributes used in the literature for the valuation of knowledge in organizations?

There exist groups of attributes that can be used to measure knowledge and for the valuation of knowledge in organizations, independently of the methods and approaches applied in particular
studies. We identified these groups as follows: “knowledge management capability”, “innovation”, “knowledge sourcing”, “knowledge collection/exploitation”, “knowledge contribution”, and “seeking”.

We posed the following research sub-RQs:

1. What concepts have been used to research knowledge value and measurement of that value?

We identified eight topics related to knowledge value and its measurement. The most frequent were economics, business and management, and information technologies, mathematics, and technological studies.

2. What methods have been applied in research on knowledge value and its measurement?

There are several methods that can be used if an organization wants to value its knowledge. One method which could be used is the investment in knowledge. This can be applied if there are projects and more complex activities where investments are carefully controlled and can be divided into activities. Those activities can be valued through the costs spent on such activities.

3. Which key theoretical contributors feature prominently in research on knowledge value?

Although the terms “knowledge” and “knowledge management” were being used previously, in the US, the terms were reputedly first coined by Karl Wiig in 1986 [21]. Between the years 1980 and 1990, knowledge focus became more significant, especially in companies such as management consulting companies, advisory companies and, in general, companies focused on services. In Sweden, 1991, an insurance company appointed the first Director of Intellectual Capital, a new position in the business world. In 1995, Leonard-Barton [22] successfully deployed knowledge focus in one company; that company was called Chaparral Steel. Boisot [23] highlighted one digital company and its focus as a significant milestone in the development of its expert system; the company was called Digital Equipment Corporation (DEC), and the expert system was XCON [24].

In 2001, McDermott and O’Dell showed the focus of the late 1990s when authors started to focus more on knowledge transfer itself, and the barriers between people, cultures, countries, and others [25].

Lin, in 2008, expanded previous models such as the case model of DeLone and McLean [26,27], moving the research area in a new direction. Authors began to focus on the virtual environment, digital and information technologies, and other fields. Another essential focus, first discussed by McDermott et al. [25], is contemporary culture differences. Culture is an ever-changing environment globally, which was the focus of an exciting study by Madžar [28]. The last person studied, whom we consider may even be the most important in the field, is Peter Massingham. His recent work, such as from the year 2018, is focused on, for example, knowledge loss in organizations or development of a suitable knowledge management framework in non-profit organizations [29].

All information mentioned above was used as an input for Table 2 where all key theoretical contributors are mentioned. Their references and citations in reviewed articles are listed too.

4. What were the findings of the reviewed studies?

Our review showed that the most common strategy for knowledge measurement was via attributes of employee performance, satisfaction, and motivation. More than 60% of the articles examined the application of any measurement of knowledge, its transfer, or the improvement of knowledge. Many of the studies used graphic design, sometimes in combination with another research design. A mix of qualitative and quantitative methods was used.
Table 2. Key theoretical contributors, their references and citations in the articles reviewed.

| Key Theoretical Contributors | No. of Articles That Referred to the Contributor in Total | No. of Works by Contributor Cited in the Reviewed Articles | The Main Research Object Concerning the Group of Attributes |
|------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|
| Massingham, P., Massingham, R. and Pomering, A. | 90 | 55 | Innovative concepts/Innovation in knowledge, knowledge management, knowledge collection and exploitation, knowledge contribution and seeking |
| Boisot, M.H. | 57 | 65 | Knowledge sourcing, knowledge collection/exploitation |
| Lin, H.F. | 35 | 36 | Knowledge collection/exploitation |
| McDermott, R. and O’Dell, D. | 28 | 23 | Knowledge contribution and seeking |
| Wiig, K. | 25 | 3 | Knowledge management capability and its usage |
| Leonard-Barton, D. | 17 | 14 | Innovative concepts/Innovation in knowledge, knowledge management |
| Madzar, D. | 15 | 1 | Knowledge contribution and seeking |
| Beckman, T. | 13 | 10 | Knowledge management capability |
| DeLone, W.H. and McLean, E.R. | 10 | 15 | Innovative concepts/Innovation in knowledge, knowledge management, knowledge collection and exploitation |

Source: Authors’ work.

4. Discussion

There were differences between the current study and, for example, the study of Henritius et al. [10]. The present review contained 91 articles published between 2002 and 2017, while [10] focused only on four international journals. In the current study, we provided a review of 203 articles from the years 1970 to 2018. The main set of articles was from 1991 to 2018. We did not limit the range of international journals and conferences wherein the articles were published. We believe that knowledge value measurement can be relevant across all contemporary fields, and should be measured in all of those fields.

We argue that the meaningful importance of the value of knowledge does not relate only to the process of transfer of knowledge, as argued in the study of Tsai et al. [30]. Their study established methods for the transfer of company values from traditional physical assets to intangible knowledge; on this point, we support their conclusions. The goal of our paper was to understand how organizations can measure and evaluate the value of knowledge. Authors such as Jong-Min et al. [19] have tried to use text mining to build an unstructured data set with a preselected couple of words for a specific organization (Apple company). The importance of understanding crucial documents and keywords from those documents in organizations was made evident in their study, and it is clear for us too. However, our research produced groups of attributes, which are more flexible and applicable to a high number of documents.

Our results were also partly in line with a study by Lee et al. [31] called “Examining the impacts of organizational and top management support of knowledge sharing on the success of software process improvement.” However, we focused more on upper-management support of knowledge sharing across a range of organizations and their processes, not only in SPI (software process improvement). From our point of view, we believe that support of upper management influences an organization’s success. It is widely agreed that the improvement of information technologies and their application can affect knowledge sharing and transfer [32].

Tsai et al. [33] looked into the process of transfer of knowledge and its importance, similarly to this study. He looked more closely into the discipline of machine learning, which is connected to the new technologies used in recent studies.
This research also explored an approach of contextual analysis of knowledge based on a literature review (literature study). Contextual analysis has become especially critical in recent years; e.g., for knowledge management oriented information systems and other more sophisticated information systems, as well as for other kinds of change and development in most organizations. This analysis had another specification, namely the clarification of the performative function of knowledge and its relation to actions and communication. This kind of understanding is, among other things, necessary for the development of knowledge-oriented systems and the contextual analysis of knowledge (how knowledge is situated in the contexts of organizations) [34].

However, there is still an issue with contextual analysis; contextual analysis stops at the level of words or stems without looking into the contextual relationships between them in more depth and provides a less contextual understanding of the text than semantic analysis. It could be said that semantics applies to the study of the meaning of terms both in and out of context. In contextual analysis, one considers the overall significance of the words that appear in a structured document or piece of text, which are taken together to be applied based on how these terms are used together [35,36].

As the last step, we also looked into studies which are classified more in the usage of social media in the process of knowledge transfer. There is a tendency for some of those studies to be more connected to business and organizational environment, such as the study of Khan et al. [37], which was inspired to use a diffusion of innovation theory to determine the relationship between transformational leadership and employee innovation. This was done through the mediation of organisational learning and knowledge sharing. We believe we are partially in line with their results. Khan et al. [37] proved that transformational leadership has a positive impact on the learning process and knowledge transfer between employees. They also followed studies such as those by Gil de Zúñiga et al. [38] and Avery et al. [39]. The former focused more on their research about the usage of social media, its knowledge, and the knowledge-seeking process concerning people’s behaviors. Further, it looked at the prediction of their social capital and participatory political behavior, and tracked how they seek information through social network sites. We believe that it is possible to measure, by some of our attributes, leaders’ knowledge transfer to their employees. In addition, we believe that it can help organizations to measure how their employees spend time on social network sites during their work time and how they behave based on tracked information on such a network.

5. Conclusions

There is no general framework on how to measure knowledge in organizations. This is an issue when comparing not only companies but also profit and non-profit organizations. It is also a problem when examining differences between cultures and countries, which can be of interest not only between organizations but also inside organizations, as many of them have offices around the world. This research is a part of a complex research project of the authors that is a follow-up of the research of the whole research team. We were focused in this study on providing the first part of the whole concept—groups of attributes. A study with users has already happened, in which we focused on using eye-tracking technologies. At this moment, we are working on the methodology of defining attributes and their implementation in daily practice in cooperation with a big public company (30,000 employees). The planned certification authority for the methodology is the Ministry of Labour and Social Affairs.

We identified key topics via a literature review and selected groups of attributes that can be used to measure the RQ and sub-RQ value of knowledge. We began by examining current research possibilities and directions in measuring the value of knowledge. We focused on an analysis of literature using a tool that supported contextual and content analysis for a better understanding of connections among topics, contexts, and contents. In general, the identified proxy for managing and measuring the value of knowledge in organizations is strategic alignment. The sub-answer to our research question is that we identified from the literature five groups of key attributes, as described graphically in Figure 3. We concluded that these attributes could be used to study any organization. However, we did not
accurately describe in this paper all identified attributes, nor did we provide their description and relevant equations, as the present paper is only a summary of a more extensive study and analysis.

Limitations and Future Research

As the journals studied limited this study, and the authors selected them, it is difficult to prove that the selected set of attributes was complete. However, there was no significant aspect of the evaluation that could not be captured by the selected set of attributes. A more significant number of sources could have been explored to confirm the theoretical saturation of the research sample, but the completeness of the sample set would have remained unconfirmed. Another limiting factor in this research is the rapid development in the area under review. As the literature review showed, dozens of relevant studies are published each year on this subject. The information presented in this article was valid at the time of writing. Although it is unlikely that the nature of the attributes will change in the immediate future, other attributes may need to be added to the set based on future developments in the area.

A future study could be directed at a case study of a corporate company that is focused on new technologies and how they measure the value of knowledge. Specifically, we would like to analyze textual materials that were processed and produced by machines. As already mentioned in the introduction, we used a qualitative approach in this study, and we would like to continue our research using quantitative methods in the future.

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