

ORGANIZING KNOWLEDGE VISUALISATION IN EMERGENCY: A COMPARATIVE ANALYSIS OF EUROPEAN UNIVERSITIES

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ABSTRACT

This study aims to analyse and understand the use of Knowledge Visualisation (KV) in universities. Specifically, we want to understand how KV can support decision-making in universities and which KV formats are used in emergency management. This study uses a dual methodological approach: qualitative and exploratory. The collection of data and information is based on the analysis of two case studies, semi-structured interviews and observed participation. To understand the role of KV during the emergency, the two European countries most affected by the COVID-19 pandemic crisis (Italy and Spain) have been identified. Two teams of researchers (one Italian and one Spanish) carried out interviews with the universities' communication managers. The results of this research offer food for thought for the academic debate on knowledge management in universities through a comparative analysis between two countries—Italy and Spain.

The results highlight the flexibility of Knowledge Visualization formats and their ability to support decision-making in the emergency phase.

This study is not without limitations. The results focus only on the role of Knowledge Visualization in the decision-making process during an emergency phase. Further insights are needed to understand the impact of KV in no-emergency phase. In addition, to understand its real impacts, it is necessary to explore how people in organisations act regarding KV by building sufficient awareness and also acquiring more knowledge, which we hope can be the next step of the investigation.

Keywords: Knowledge Visualisation, Emergency, University, Decision-making; Comparative Case studies, Knowledge Management.

1. INTRODUCTION

Knowledge Visualisation (KV) is a research area that is increasingly gaining attention because it examines the use of visual representations to improve knowledge management at all levels; including

personal, inter-personal, team, organisational, inter-organisational and social levels. Many scholars have highlighted the importance of using diagrams, graphs, schemes, mind maps and social graphs captured in real-time (Berinato, 2016; Miah et al., 2017). Visual representations of information and knowledge have been indicated as a dimension of modern knowledge management to support decision-making process (Miah et al., 2017). Organisations worldwide have had to face the pandemic, but KV could be a format that supports the decision-maker in emergency management. In this context, the decision-maker can use KV formats (images, maps, etc.) to transform data and information into accessible forms of representations to extract new knowledge and information. This study fills this gap in the literature by offering an overview on the use of KV in universities during an COVID-19 emergency. Based on these premises, this research starts with an analysis of the literature on the subject of KV and its formats. It then focuses on the empirical analysis of a case study on the University of Jaén (Spain) and the "Magna-Græcia" University of Catanzaro (Italy) as organisations that have been deeply impacted by the coronavirus.

This study investigates KV—through a qualitative and exploratory approach—with the help of two research questions.

RQ1: How does KV support emergency management in universities?

RQ2: What KV formats are used to support decision-making and knowledge management?

The remainder of this paper is structured as follows. Section 2 provides a theoretical framework on KV and issues in the decision-making process during an emergency. Section 3 proposes a detailed description of the methodology. Section 4 presents the findings and conclusions that are then discussed in section 5, in which the study's limitations and recommended future research are also identified.

2. THEORETICAL FRAMEWORK

2.1 Knowledge Visualisation Perspective

The field of Knowledge Visualisation focuses on creating and transferring knowledge through visualisation (Eppler and Burkhard, 2004; Meyer, 2010; Yan et.al., 2011). Eppler and Burkhard (2004) presented a widely accepted definition of KV, stating that it *"is defined as a field that examines the use of visual representations to improve the creation and transfer of knowledge between at least two people. Knowledge visualization thus designates all graphic means that can be used to construct and convey complex insights"*.

KV tends to improve the transfer and creation of knowledge between people by providing them with the means to express what they know. Consequently, KV tends to increase knowledge-intensive communication between individuals; for example, by relating new insights to concepts already understood (Eppler and Burkhard, 2004). Eppler and and Burkhard (2007) proposed a revised

definition of KV as "*the subject that studies how to improve complex knowledge creation and transmission between two or more applying visual representation*" (p.18). The primary goal of KV is to support knowledge creation and sharing processes. Burkhard (2005) compared Knowledge Management (KM) and KV and concluded that KV is classified as a component of KM, mainly because knowledge transfer is a key process in knowledge-intensive organisations. Burkhard

2.1.1 Knowledge Visualisation Format

According to Eppler and Bresciani (2013), KV refers to all graphic means that can be used to develop or mediate experiences, methods or skills. KV encourages the creation and transfer of knowledge by providing users with an extended range of formats to express and share what they know. The transfer of visual knowledge is complex and challenging as the recipient's background cannot be distinguished. Visual formats need to be specific, but to become knowledge, information must be processed, meaningful and integrated into the user's mental knowledge structure. KV formats may include a sketch, diagram, map, images, physical model and interactive visualisation (Meyer, 2010). Starting with early symbols, visualisation formats have been designed to improve and enhance knowledge sharing and overcome limitations of time and space (Katuscakova et al., 2019).

For the actual creation and transfer of knowledge through visualisation, Burkhard (2005) stated that at least five perspectives should be considered. The framework distinguishes six types of knowledge: declarative knowledge (knowing what), procedural knowledge (knowing how), experiential knowledge (knowing why), knowledge about people (knowing who), location-based knowledge (knowing where) and knowledge based on legislation or values (know-what-if). With the help of the function, it is possible to differentiate between different aims for the use of KV, including knowledge sharing through visual means, knowledge creation, learning from visual representations, visual coding of experiences in the past for future users or knowledge mapping (Eppler and Burkhard, 2004; Elouni et al., 2016). The target group perspective, on the other hand, underlines the fact that knowledge visualisation must satisfy the preferences of primary and potential target groups. Their background needs to be taken into consideration, in addition to their expectations when choosing a display format. The situation perspective view emphasises that the use of visualisation depends on the physical or virtual environment and the number of people interacting to manage knowledge.

Finally, the format perspective view outlines the view formats into seven main groups that use media prerequisites as a ranking criterion.

2.2 Knowledge Visualisation in the decision-making process

For all organizations, the decision-making process is one of the most important activities. It is a process involving choices, and this process generally consists of several steps: identifying problems, generating alternatives, evaluating alternatives, choosing an alternative, implementing the decision,

and evaluating decision effectiveness (Schoenfeld, 2011). The KV formats help decision-makers to see patterns in data that are more difficult to detect through rational methods, improving decisions (Lurie and Mason, 2007). According to Lurie and Mason (2007), the use of KV formats in decision-making shows higher performance, in terms of speed, appropriateness, accuracy and completeness. KV formats that shape and present information more effectively facilitates better communication and supports sense-making (Al-Kassab, 2014). Visualisation can help to support decision-making processes, but it is important to understand its role in terms of knowledge. Visualisation formats can be interpreted as knowledge enablers and could influence knowledge processes such as sharing, integrating and translating (Canonic et al., 2021). Using appropriate visual representations allows us to present knowledge at a given moment and link it to previous knowledge, facilitating knowledge dissemination for decision-makers and problem-solving. Diagrams, tables and maps are useful for representing precise and indexical information, both quantitatively and qualitatively, supporting decision-making by constraining the set of alternatives that one must consider during a decision-making activity and specifying paths and commonalities among different problem states within an information space (Parsons and Sedig, 2014). Decision-makers need to be aware that KV can enhance knowledge processes and bias them by constraining the attention to a limited set of alternatives, focusing the attention on the wrong variables or encouraging inaccurate comparisons (Al-Kassab, 2014). KV investigates the use of visualisation techniques to facilitate communication in knowledge-intensive processes and support the creation of new knowledge by using visual techniques. It also explicates, shares or develops knowledge and supports the creation of visualisations for contents that constantly change, such as a process or complex project (Burkhard, 2006).

3. METHODOLOGY

In this study, a dual methodological approach has been implemented: qualitative and exploratory. The qualitative research approach is appropriate for obtaining a greater description of the phenomenon by the complex nature of the organisations under observation. In fact, knowledge, due to its immaterial nature (Moustaghfir and Schiuma, 2013; Vesperi, et al., 2019), is difficult to capture and observe with different methodologies. This explains why this approach is used, where the "theory is founded" on the participants' experiences, behaviours, and attitudes. The exploratory nature aims to build the theoretical premises regarding KV, the use of KV in universities and the strategic ability to support decision-making. The case study structure is useful for fully understanding an organisation in its context (Crowe et al., 2011, Hyett et al., 2014). The use of several cases brings out the common characteristics of the same phenomenon in different contexts. The case studies identified in this study are two public universities from two European countries (Italy and Spain). We decided to select two

universities with similar organizational characteristics in terms of size, student population and departmental organisation. The case studies investigate two public universities in two different European countries (Italy and Spain), most affected by the COVID-19 health emergency. The Italian university is "Magna-Græcia" University of Catanzaro (UMG- ITALY) and the Universidad de Jaen (UJA-SPAIN).

The analysis of universities brings us to the organisational actors who above all can teach about the management of the COVID-19 emergency to work in coordination and overcome decision-making problems. While analysing the case studies, the interviews' documents and transcription, the quality indicators of the rigour of the case study research that Yin (2003) proposed, were used. Specifically, the analysis was based on the rigour and relevance of the results. Methodological design and execution define the rigour of the methodological process (Remenyi, 2012).

Three data collection techniques were used: desk analysis, participant observation and semi-structured interviews (Schiele and Krummaker, 2011). The documentary analysis made it possible to understand and identify the organisational characteristics of the case studies and the response models to COVID-19. Several documents were examined: COVID-19 university regulations and measures and university websites. The data collected with the documents' analysis made available and published on the university websites were integrated during the interviews with the university decision-makers. To increase the quality of the material and identify significant consistencies with the aim of the research, a thematic analysis is carried out (Patton, 2002). To make comparable interviews, the researchers conducted interviews with decision-makers from the two universities, who have functions specifically related to the KV. The researchers conducted the interviews via video meetings. The interviews lasted from 40 to 65 min. Specifically, the UMG researchers interviewed the General Manager. The UJA researchers interviewed the Deputy Rector, who is responsible for communication.

At the end of each interview, the researchers who conducted the interview shared and discussed the interviews' results with the interviewees, based on the approach described by Ricoeur (1986; Kahkonen, 2014; Canonico et al., 2021).

Finally, participant observation was done by the researchers who carried out the field work by accessing the university premises and verifying the KV tools present.

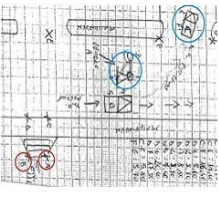
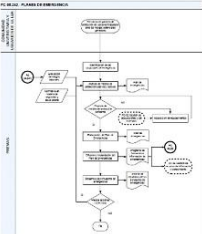



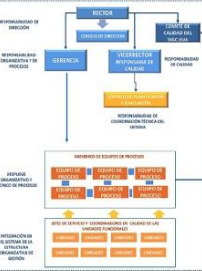

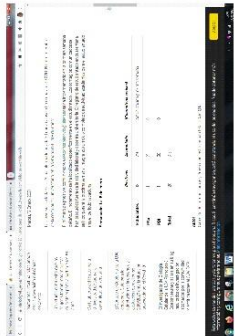
4. FINDINGS AND CONCLUSIONS

This study is based on the framework for KV proposed by Burkhard and Eppler's model (2005, 2007) helps us to identify and understand the use of KV in the university context at UMG and UJA, explaining the interactions of the decision-maker with the use of formats for KV. KV is understood as

a crucial component of Knowledge Management (KM), where decision-makers need to explore and obtain information and then manage and share knowledge.

In the emergency phase, making knowledge visible (accessible, discussed and shared), represented a support tool especially for the universities in this context. The decision-making process—following a temporal sequence—begins when the UJA Deputy Rector and UMG General Manager have to make a feasible and effective decision in a short time (Emergency Phase: COVID-19) using heuristic sketches, diagrams, images, maps, objects, etc. The reason visual archetypes, containing representations of the real world, are used is because humans have the ability to process images quickly and relate them to previous knowledge already associated with a known image. When you see an image, you know what it represents even though you don't remember the name/concept. It's important for the decision-maker to be aware of the type of recipient that identifies the target group and the context of the recipient, which can be an individual, a team, an entire organisation or a network of people. In these case studies, it was fundamental for the two universities to know the context and the cognitive background of the recipient to find the right visualisation method for the KV. KV offers a systematic approach to creating, codifying, transferring and identifying knowledge at various levels: among individuals, from individuals to groups, between groups and from individuals and groups to the entire organisation. To do so, knowledge must be recreated in the mind of the receiver (El Sawy et al., 1997). This depends on the recipient's cognitive capacity to process the incoming stimuli (Vance and Eynon, 1998). Once the knowledge is displayed, the decision-maker acquires feedbacks from the target audience. Thus, the person responsible also needs to convey it in the right context and in a way that it can ultimately be used and remembered.

Fig. 1 – Comparison of KV format in case studies

Formats	UMG	UJA
<p>Sketches Simple drawings that help us visualize the key features and the main idea very quickly. They can be used in group reflections and communication processes as they make knowledge debatable. Additionally, they allow room for interpretation and thus stimulate creativity and keep the attention of a group fixed on the discussed object</p>		
<p>Diagrams Schematic representations that are used to display, explore and explain relationships. They reduce complexity, make abstract concepts accessible and amplify cognition. Unlike sketches, they are precise and determined. Examples of the diagrams are bar- and pie charts and Gantt-, Fern- or process diagrams</p>		
<p>Images They represent reality but can also be artistic. They are able to address emotions and can inspire, motivate or energise the audience and thus are often used for advertisements (images are visual)</p>		
<p>Knowledge Maps Consist of two components: The context, which should be easy to understand for all users of the map, and project milestones are mapped within this context</p>		
<p>Concept Maps Intended to represent meaningful relationships between concepts in the form of propositions</p>		
<p>Interactive Visualization Computer-based interactive visualizations allow you to access, control, explore, combine and manipulate different types of complex data, information and knowledge. They also fascinate the recipients and enable interactive collaborations and thus help create new insights</p>		

Source: our elaboration

The decision-maker, with the help of their competences and acquired experience, will initiate a new decision-making process that will lead to the construction of a new visualisation. In this new phase, the decision-maker will be able to refine or add further KV formats until the creation, codifying, transfer, identification, and so on of knowledge is successful.

The integrated use of multiple formats such as diagrams, graphs, schemes, mind maps and interactive visualisations was indicated by the two interviewees as support during the decision-making process. KV, in the era of the pandemic, has allowed them to homogenise knowledge and speed up choices. The usability of the visual format has improved decision-making, and KV has created a new environment for it. Using this format made it possible to acquire knowledge information as it was supported by visual elements. Particular emphasis was placed on internal customers, actively involved in the design and implementation of the display formats. The display formats have been evaluated very well in terms of performance and preferences by the internal customers themselves, and the analysis of the visual formats has shown that the different types of KV have a specific degree of usefulness depending on the activity. Knowledge visualisations were used to explain and answer questions about why, what, whom, when and how. The diversity of the target audience has emphasised that KV must be adapted to the preferences of the target audience (teaching staff, administrative staff, students, etc.), which then must be implemented into the different types of KV. The formats used in the universities can inform multilevel coordinated decision-makers on how to improve knowledge creation, identification and transfer. In the two universities, to date, a Model for Quality Management and a Strategic Plan for Emergencies have been implemented.

5. DISCUSSION

The results of this study have provided significant insights into theoretical, methodological, and empirical reflections.

From a theoretical point of view highlights the KV central role in the debate on decision-making problems. KV allows you to create, transfer and share knowledge in a new and rapid way, supporting decision-making processes through visual representations. The empirical analysis of the case studies allowed us to answer our research questions. This empirical observation of universities in two different European countries has highlighted the role of KV in supporting decision-makers during the COVID-19 pandemic. The first research question aimed to understand the support that KV provides in the context of emergency management in universities. Through interviews with decision-makers, the analysis of internal documents and participatory observations from both universities, the data collected show that the use of KV has had an overall positive impact on a social and emotional level

(collaboration and involvement), leading to better communication and a better understanding of information and data, as well as decision-making.

The different KV formats adapt to organizations' characteristics, allowing them to speed up their decision-making process. The results of the interviews and the analysis of the documents show that KV is widely used in universities. In the preliminary phase of the interviews, the universities' decision-makers showed their awareness of the potential and importance of KM. However, the use of different KV formats in universities confirmed that decision-makers were not aware of KV. Despite this gap, decision-makers have made extensive use of different KV formats. KV formats have helped decision-makers see patterns in data that are more difficult to detect through rational methods, improving decision-making (Lurie and Mason, 2007). Visual representations can expand problem-solving capabilities by allowing more data to be processed without overburdening the decision-maker (Lurie and Mason, 2007, p. 2).

The results of this study highlight that KV supports decision-makers at all stages of the decision-making process. The interviews with the decision-makers made it clear that visualisation can help support decision-making, but it is important to understand its role in terms of knowledge. Hence, KV formats allow for more efficient and faster knowledge management (e.g., sketches and maps). The formats have been valid support in the COVID-19 emergency phase for both UMG and UJAN. Furthermore, the different formats of KV were used with regard to the recipients (administrative staff, teachers, students, etc.). Strategic plans made it possible to introduce the new KV formats quickly into the organisations. The strategic plans also represented the main way to introduce KV formats to universities. According to Lurie and Mason (2007), the use of KV formats in decision-making shows higher performance, in terms of speed, appropriateness, accuracy and completeness. KV formats shape and present information more effectively, facilitates better communication and supports the creation of meaning (Al-Kassab, 2014).

The empirical observation of universities, in two different European countries, has allowed us to highlight how KV formats fit into the decision-making process.

KV, in its different formats, has allowed decision-makers to make the decision-making process more flexible, quick and shared. The empirical observations revealed that KV is particularly effective in sharing new knowledge. The introduction of new KV formats is linked to the introduction of regulations, confirming that visualisation increases the speed of the dissemination of knowledge.

From the methodological perspective, the results of this study highlight the effectiveness of the methodological tools used (analysis of case studies, interviews and participatory observations) to study the phenomenon of KV in complex organisations. The use of a qualitative methodology, in fact,

has made it possible to grasp the more submerged and emotional aspects of the use of the visualisation of knowledge in the decision-making process during the emergency phase.

Therefore, this article aimed to contribute to the debate on managerial and social implications. First managerial implication is directly related to the real comprehension of KV regarding people involved in decision-making processes. In addition, to understand its real impacts, it is necessary to study how people in organisations act regarding KV by creating sufficient awareness and also acquiring more knowledge, which we hope can be the next step of the investigation.

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