



Research article

Organizational culture and leadership style in Spanish Hospitals: Effects on knowledge management and efficiency

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ABSTRACT

Hospital culture and leadership style have attracted considerable attention in research, with compelling evidence indicating their potential competitive advantages, including their crucial role in ensuring the successful implementation of knowledge management and its impact on hospital efficiency. The aim of this paper is to identify the effects of organizational culture and leadership style on knowledge management and hospital efficiency. Fuzzy cognitive maps (FCMs) are relational models that can be used to represent the opinions and knowledge of expert to infer cause-effect relationships among different concepts. The use of FCMs as a simulation tool enables the evaluation of potential scenarios based on different organizational cultures and leadership styles in hospitals. Developing an FCM for this study involved several steps. Firstly, data were collected through interviews with 21 experts in hospital management. The interviews were conducted between May and September 2023 either face-to-face or via videoconference. Once individual cognitive maps had been created, consensus among them was achieved through a multicriteria decision-making process, wherein the expert opinions were averaged. The separate cognitive maps of each expert were then integrated to produce a single FCM using the augmented FCM approach. Reflecting expert insights from the FCM, hospitals with a hierarchy culture exhibit diminished levels of knowledge creation, management, and overall hospital efficiency, whereas those with an adhocracy culture show improvements in knowledge creation, knowledge exploitation, and overall hospital efficiency in comparison to alternative ones. From the experts' FCM perspective regarding leadership style, transformational leadership achieves the highest level of knowledge management and hospital efficiency in hospitals with an adhocracy culture. Finally, this paper offers a reference for practising knowledge management and improving hospital efficiency through adhocracy culture and transformational leadership.

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1. Introduction

The healthcare system in Spain is known as the “National Health System” and is based on a model of universal and free healthcare for all legal residents in the country, regardless of their nationality or employment status. It is mainly financed by general taxes and social contributions and administered at regional level by the autonomous communities, which are responsible for the actual provision of health services [1]. Certain co-payments need to be made, which means that patients have to contribute a small amount when receiving particular services or medicines.

The healthcare system features a comprehensive network of primary care centres, including health centres and doctors’ offices, which provide basic medical services and referrals to specialists as needed. Additionally, Spain has a widespread network of both public and private hospitals. Regardless of this extensive infrastructure, challenges persist in optimizing the utilization and efficiency of these resources.

Public health spending in 2021 in Spain accounted for 87,941 million euros, having increased by 28.37 per cent in the 2017–2021 period. The average annual growth in that five-year period was 6.4 per cent, and the area with the highest expenditure in the field of public healthcare was hospital and specialized services, which represented 61.6 per cent of total spending in 2021 [2]. There was a total of 449 hospitals, with 4 million hospital admissions, 82.1 million consultations, 3.5 million surgical operations (with and without hospitalization), and 23 million emergencies [3]. Despite this growth, there is increasing concern about how effectively these resources are used, especially given the ageing population [4], rising healthcare demands, and limited financial resources. This makes it essential to optimize hospital efficiency, defined as achieving consistent and satisfactory outcomes with fewer resources. It is not just about cutting costs but maximizing resource utilization to provide the best possible care [5].

The challenge for the healthcare sector is to address these issues while maintaining high-quality care [6]. This essentially means that hospitals need to optimize their resources to provide better services [7]. Understanding how hospitals can enhance their efficiency, particularly through effective knowledge management, remains a significant concern.

Knowledge is a valuable resource in the healthcare industry that is found in institutions like hospitals [8], which can lead to a process of competitive advantage [9]. It is also crucial for efficiency, as knowledge management strategies can help managers raise the performance of hospitals and other healthcare organizations [10].

Hospitals face the critical challenge of managing their knowledge effectively, which involves not only generating new insights (exploration) but also exploiting existing knowledge through storage, transmission, and application [11]. Properly leveraging this knowledge is essential for enhancing hospital efficiency and delivering higher-quality care to patients. Understanding how to optimize knowledge management processes to achieve these goals is a key empirical issue in improving hospital efficiency [12].

Hospital culture and leadership style have emerged as important areas of discussion in research, with evidence indicating they might provide competitive advantages. The organizational culture in the healthcare organizations has been recognized as essential for key organizational outcomes [13], clinical outcomes, including reduced mortality rates [14], efficiency and effectiveness of healthcare employees [15], and organizational performance and effectiveness [16], among others. Members of the organization rely on these values, which can greatly influence their behavior and decision-making processes. In this context, healthcare professionals such as doctors and nurses play a dominant role in shaping the organization culture. Leadership is widely recognized as a critical factor that determines the successful operation of hospital performance [17]. Healthcare executives, directors, and managers can enact different leadership styles and influence their followers’ actions [18]. Leaders approximate or choose their style based on a combination of their beliefs, values and performance, with contributions from organizational culture and norms, which favour some leadership styles and disfavor others [18]. These elements also play a role in supporting knowledge management and other critical aspects within healthcare organizations [10–12,19].

To better understand these complex dynamics and uncover the underlying patterns and relationships, researchers often turn to quantitative methodologies. These methods are aimed at acquiring precise and dependable measurements that are suitable for statistical analysis, thereby emphasizing objectivity. They are more appropriate when measurable variables are obtainable, and conclusions can be inferred from samples representing the population. Conversely, qualitative methodologies disregard numerical representation, focusing instead on delving deeply into understanding a specific issue. Their goal is to facilitate comprehension of the complexities of reality and the significance of actions within a particular context [20]. Qualitative methodologies are used with a view to provide detailed and illustrative insights to allow various dimensions of the issue at hand to be grasped. They explore aspects of reality that defy quantification, concentrating on facilitating understanding and elucidating the dynamics of social relations. In brief, qualitative research delves into the realm of meanings, motives, aspirations, beliefs, values, and attitudes, encompassing a profound sphere of relationships, processes, and phenomena beyond mere variable operationalization [13–18,21–123].

While previous research has largely relied on quantitative methods [7], integrating qualitative approaches is essential for a deeper understanding of how organizational factors such as culture and leadership style impact hospital efficiency. Quantitative studies have offered valuable insights into hospital performance, but qualitative methods can reveal the underlying factors that influence efficiency [22]. By examining hospital culture and leadership styles, researchers can better understand how these elements affect knowledge management and efficiency, providing recommendations for improvement.

FCM can be considered a semi-qualitative method that combines elements of qualitative reasoning with quantitative analysis [61]. This article applies FCMs, wherein a panel of experts represents and infers the cause-effect relationships between organizational culture, leadership style, knowledge management, and hospital efficiency. An FCM is a standardized and well-established tool that enables semi-qualitative studies to investigate the existing relationships among qualitative variables in complex problems, and it is already used in the healthcare field [13–18,23–123]. It is a relational model used to infer cause-effect relationships among concepts, applying fuzzy set theory for this purpose [24].

Developing our FCM involved several steps [25]. First, data were collected through interviews with experts in hospital management. Once individual cognitive maps had been created, consensus among them was achieved through a multicriteria decision-making process, wherein the expert opinions were averaged. The separate cognitive maps of each expert were then integrated to produce a single FCM using the augmented FCM approach [26].

In accordance with the knowledge-based view [27] (KBV), which emphasizes the role of knowledge in organizations, this paper interprets the relationship between knowledge management and organizational factors (leadership and culture) as two sources influencing the efficiency of service in healthcare institutions. Knowledge management is seen as the management processes and activities that an organization practices to improve the effectiveness of generating, creating, and sustaining organizational intellectual assets [28], increase innovation [29], and enhance performance [30], among other things.

This paper provides an in-depth analysis of four distinct organizational cultures using the Competing Values Framework (CVF) [31]: hierarchical, clan, market, and adhocracy cultures. Additionally, it explores three prominent leadership styles [32]: authoritarian, paternalistic, and transformational. The challenge lies in understanding how these cultural and leadership dimensions interact and influence hospital efficiency and knowledge management. This research aims to offer valuable insights and practical recommendations for healthcare administrators and policymakers with a focus on improving hospital efficiency.

To the best of the researchers' knowledge, no previous studies have been conducted that are related to, and focused on, the effects of organizational culture and leadership style on the knowledge management and efficiency of Spanish hospitals. Therefore, this study is one of the first investigations to utilize FCMs for analysing these kinds of relationships. Expert consensus using FCM suggests that hospitals with a hierarchy culture offer lower levels of knowledge creation, management, and overall hospital efficiency. Conversely, hospitals with an adhocracy culture reveal an increase in knowledge creation, knowledge exploitation, and overall hospital efficiency compared to others. Finally, from the experts' perspective, transformational leadership achieves the highest levels of knowledge management and hospital efficiency in hospitals with an adhocracy culture. These findings highlight the role that both organizational culture and leadership style play in influencing the operational dynamics of healthcare institutions. This study helps bridge a gap in the literature by revealing the complex relationship between organizational culture, leadership practices, and performance outcomes within the context of Spanish hospitals.

The remainder of the paper is structured as follows. In the next section, we review the related literature on knowledge management, organizational culture, and leadership styles in healthcare organizations. After that, the methodology is explained, and the results are presented. Finally, the discussion includes the theoretical and practical implications, as well as the limitations and potential future extensions of this research.

2. Theoretical background

2.1. Knowledge management and hospital efficiency

The healthcare sector is increasingly recognizing the importance of strategic frameworks that can enhance organizational performance and patient care outcomes. Among these, the Resource-Based View (RBV) and the Knowledge-Based View (KBV) stand out as main paradigms that offer insights into how healthcare organizations can leverage their unique resources and knowledge to gain a competitive edge. The RBV is a managerial framework used to determine the strategic resources a firm can use to achieve sustainable competitive advantage. Originated by Birger Wernerfelt in 1984 and further developed by Jay Barney in 1991, RBV suggests that firms can gain and sustain competitive advantages by possessing valuable, rare, inimitable, and non-substitutable resources [124]. The main theme of RBV is that the internal resources of the firm (both tangible and intangible) are more critical for achieving and maintaining competitive advantage than external market conditions. The KBV of the firm, articulated by Robert M. Grant in 1996, posits that knowledge is the most strategically significant resource of a firm. This view suggests that a company's function is to procure, generate, and apply knowledge, fostering an environment where employees utilize these capabilities to create both knowledge and value for the organization [37]. Hence, companies ought to formulate and execute a range of activities or initiatives aimed at leveraging their organizational capacity and extracting value. In essence, they should embrace what are commonly referred to as "knowledge management practices" [38]. Therefore, by underscoring the significance of knowledge as an essential strategic resource for contemporary business, these frameworks enable healthcare organizations, via knowledge management (KM) initiatives, to develop a sustainable competitive edge in an increasingly complex and dynamic environment.

Danvenport and Prusak [62] defined knowledge as a fluid mix of framed experience, value, contextual information and expert insights that provides a framework for evaluating and incorporating new experiences and information. Nonaka and Takeuchi [105] identified two dimensions of knowledge in organizations: explicit (can be expressed in words and data and codified into many easy to share forms such as books, reports, figures, documents, procedures and databases) and implicit or tacit (related to know-how and individual experience). Most of our knowledge is tacit, and it is hard to formulate and share.

Although the concept of KM lacks a universally accepted definition, and there appears to be no indication that such a consensus will be reached in the near future, KM is fundamentally an organizational process that involves capturing, sharing, and storing existing knowledge while effectively acquiring new knowledge, with the aim of utilizing it in decision-making [19]. KM is likely a value-added strategy, allowing organizations to use knowledge and skills to produce value and increase efficiency [117]. Furthermore, optimal management of the knowledge process has a direct impact on system quality [49], organizational performance [30–33], organizational commitment [50], and innovation [29], among other things.

The healthcare industry, as a knowledge-rich domain, generates a vast amount of knowledge. Workers within healthcare organizations, particularly medical personnel, currently operate with a substantial reservoir of knowledge; however, this constantly

evolving knowledge often goes undocumented, leading to it becoming lost [43]. Consequently, efficient management of knowledge-based resources is particularly relevant in organizations characterized by knowledge-intensive business processes [48] in order to be more efficient. According to previous research literature, KM in healthcare is growing significantly in importance [39]. Numerous studies on this topic emphasize that a healthcare organization's ability to compete depends on how well it manages its knowledge [40,41]. In this sense, previous studies on KM in healthcare organizations have provided detailed theoretical explanations [42], proposed specific research propositions [10], and suggested potential moderating mechanisms [43]. For instance, these studies analyse the main barriers to adopting KM in healthcare [39], the impact of KM practices on healthcare system employees' satisfaction [44], the effect of KM on the performance of hospitals [45,46], the relationship between KM and the quality of healthcare services [12–123,125–127]; and the capacity of KM to improve patient safety and quality [47], among others topics. In conclusion, most studies indicated that the impact and efficacy of KM in healthcare industry were perceived favourably, demonstrating that KM has the potential to reinforce the underpinnings of managerial practices, thereby enhancing the management of healthcare services. Nevertheless, there is still a need to look more deeply at the relationship between KM effects and different phenomena present in healthcare organizations.

It is acknowledged that knowledge serves as a valuable resource for both individual and organizational growth, and effective KM enhances healthcare performance [54]. Therefore, the tasks of generating, disseminating, retaining, and employing or recycling knowledge present significant challenges within healthcare institutions, primarily due to the intricacies of the knowledge itself, the complexity of the systems involved, the potential ramifications of medical errors, the expanding scope of knowledge required in medical procedures, and the elevated expenses associated with healthcare provision [51].

Numerous authors have delineated several frameworks that encompass essential facets of, and procedures involved in, KM [51]: these include knowledge generation, sharing, and utilization [52]; the knowledge creation process, knowledge capture, knowledge storage, the knowledge organization process, knowledge dissemination, and knowledge application [53]; explorative initiatives (to create and identify new knowledge) and exploitative practices (to capitalize on existing knowledge assets through the transfer, sharing, and utilization of such resources) [11]. Abidi [55] defines healthcare KM as the systematic creation, modelling, sharing, operationalization, and translation of healthcare knowledge for the purpose of improving the quality of patient care. Similarly, Popa and Stefan [51], stemming from the core principles of knowledge creation, capture, sharing and utilization proposed by Nonaka [128] (1994), identify three dimensions of the KM process in healthcare: knowledge acquisition, knowledge sharing and knowledge utilization.

Knowledge creation, focuses on producing new knowledge, can be viewed as the procedures for managing inventory, predicting, cutting expenses, or communicating with partners of a corporation based on information [129]. It can also relate to how a company shares, acquires and combines external knowledge or its resources to generate new concepts [130]. A central aspect of the knowledge creation involves an organization's capacity to absorb external knowledge, a phenomenon commonly denoted as "absorptive capacity", which was originally defined by Cohen and Levinthal [131] as the firm's ability to identify, absorb and explore the external environment knowledge, thus fostering innovation, flexibility and competitive advantage for the organization. Similarly, knowledge acquisition contributes to augmenting the "stock" of knowledge within an organization, which can be generated internally or acquired from sources outside its boundaries [56]. In addition to traditional avenues of knowledge acquisition, such as participation in medical congresses, seminars, and specialized publications, one should also consider electronic databases and medical records.

Knowledge sharing, is the process of exchanging knowledge and expertise to complete specified tasks in companies [132]. The purpose of knowledge sharing is to reorganize and enhance the "stock" of knowledge in an organization by bridging the gap between the individual level (where knowledge resides) and the organizational level (where knowledge is applied). It relies heavily on the readiness to share [56] and is thus contingent on interpersonal and organizational factors. In the healthcare context, cooperation and collaboration among organizations, as well as engagement in social learning initiatives like communities of practice and professional networks, can bolster the knowledge-sharing process. At times, informal occasions like coffee breaks or casual meetings are favoured for exchanging professional knowledge [57]. Therefore, knowledge transfer should not only focus on exploiting existing resources and should also explore strategies to improve the efficiency and effectiveness of various operational activities. This underscores the need for further research on knowledge transfer mechanisms in the healthcare industry [133] and to recognize knowledge transfer as a significant factor for the quality of healthcare services [12]. Moreover, the process of knowledge sharing facilitates sustainable engagement in the healthcare system [8]. Consequently, the transfer and acquisition of knowledge are vital elements of job performance, particularly within healthcare organizations, where clinical knowledge evolves rapidly [43].

Knowledge application implies the integration of knowledge from different sources to develop organizational capability through mechanisms based on routines, norms, or decision-making in specific situations [27]. Knowledge application has the potential to significantly improve the quality of patient care, and ensuring the availability of relevant knowledge to healthcare professionals at the right time greatly facilitates informed decision-making for optimal patient care [39]. Therefore, in healthcare organizations, decision-making constitutes a critical point of knowledge application [134] and utilization.

In conclusion, the literature reveals a rich but complex landscape of research on KM and healthcare, with significant implications for the healthcare sector. Consequently, given that KM possesses the potential to assume a strategic role within healthcare organizations, it is imperative to further investigate and develop research that aims to enhance understanding and application of KM strategies, specifically those designed to optimize efficiency in hospitals settings.

2.2. Organizational culture and knowledge management in healthcare

The concept of organizational culture (OC) has been recognized since the 1980s as being central to the understanding of organizational phenomena [58]. OC encompasses a wide range of concepts, including values, assumptions, interpretations, symbols,

organizational beliefs, routines, shared language, myths, ideologies, practices, norms, and social behaviours that characterize an organization. Robbins and Judge [59] define OC as the collective values, practices, principles, and traditions that bind together and shape the behaviour and actions of members within an organization. OC is inherently associated with every dimension of an organization's activities, thus presenting a complex construct to evaluate. A multitude of theoretical frameworks and analytical instruments have been proposed by academics. Notably, among the numerous theoretical models is the Competing Values Framework (CVF), developed by Cameron and Quinn [31], which has been widely applied in empirical studies on OC. (e.g. Aichouche et al. [135], Suppiah and Sandhu [68]).

The CVF is a widely recognized assessment tool that offers a clear definition and a consistent analytical framework of OC types [135]. This framework provides a pragmatic evaluation of OC and serves as an essential instrument for analysing OC in relation to other variables. This model comprises two dimensions: the first dimension relates to formal and informal processes and the second to strategic focus. Formal processes are characterized by high degrees of stability, order, and control, whereas informal processes involve a greater degree of flexibility and laxity [63]. The strategic focus dimension contrasts the emphasis on internal integration with the attention given to external adaptation and differentiation [63]. The CVF maps these two dimensions against each other to delineate four distinct types of OC (Fig. 1): adhocracy culture, hierarchy culture, clan culture, and market culture.

Hierarchy, clan, adhocracy, and market are the four different forms of OC [31]. Each kind of culture is associated with a certain combination of formal (emphasizing stability and control) and informal (emphasizing flexibility) features of their processes, as well as an external or internal focus.

The adhocracy culture is characterized by the development of a dynamic, entrepreneurial, inventive, creative, change-oriented, and flexible work environment [31]. The foundation of this culture is a commitment to learning and a tolerance of risk [64]. Leaders in this culture encourage entrepreneurship and creativity in their employees. Organizations with adhocracy cultures can take bigger risks and respond more quickly to external developments. In this “open system model,” organizations are planning successfully under ambiguity and uncertainty [136].

The hierarchy culture is frequently characterized as bureaucratic, governed by top-down regulations, instructions, or established procedures [65] defining what individuals should always do. This organizational form could be ineffective when there is a need for change because its excessive emphasis on security, predictability, efficiency, stability, and uniformity hinders experimentation [66].

The clan culture bears resemblance to a family-like organization, characterized by a high level of cohesion and participation among its members, with prevailing values such as teamwork, employee involvement, and the company's commitment to its members. This responsibility towards employees and their development aligns well with an innovative philosophy, as it can foster cooperation and contribute to generating shared knowledge [67]. Nevertheless, the significant focus on people-related matters may present a challenge for the implementation of new developments [63].

The market culture is primarily oriented towards the external environment, focusing on transactions with various external groups such as suppliers and customers, and seeking reputation and success. Its dominant values mainly include productivity, efficiency, competitiveness, and a results orientation [31]. Furthermore, with this paradigm of logical culture, an organization operating within a market endeavours, through transparency and outward orientation, to engage in diverse transactions aimed at attaining a competitive advantage and enhancing productivity [137,138].

In the KM literature, it is widely believed the importance of cultural factors in the successful application of KM [139]. In this regard, the KBV framework provides valuable insights into how cultural attributes such as trust, collaboration, and learning orientation impact the effectiveness of KM practices within organizations [27]. This view is highly relevant to the exploration of the influence of OC on KM practices, as it underscores the strategic significance of knowledge and emphasizes the necessity for a conducive cultural environment to manage knowledge effectively [139]. Grant [27] argues that an OC that promotes trust, openness, and continuous learning is essential for effective KM. Such a culture enables the unimpeded exchange of knowledge, fosters innovation, and enhances the firm's ability to exploit its knowledge assets. Thus, understanding and fostering an appropriate OC arises as a critical factor in optimizing KM initiatives and, in turn, improving organizational efficiency.

In this context, previous research has indicated that CVF has the following advantages in terms of understanding the effects of OC on KM process [17,68–123,126–135]. First, the CVF helps in understanding OC by providing clear conceptualizations of culture types [140]. Second, CVF has been widely and substantially validated in several organizations by both practitioners and researchers [63].

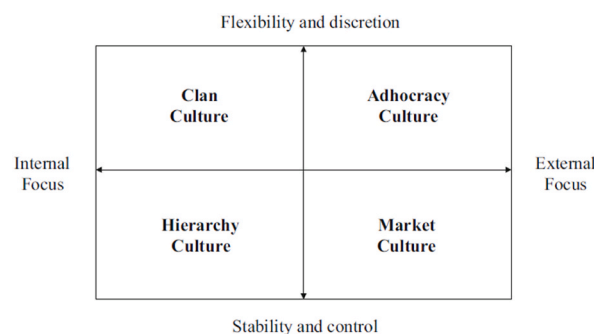


Fig. 1. Competing Values Framework [63].

Third, CVF has been chosen in many studies that analyse interactions between OC and KM process [135]. Consequently, the exploration of cultural typologies through the lens of the CVF may enhance the understanding of the OC-KM relationship.

Previous research has explored the relationship between OC types and KM processes [141,142]. Nonetheless, the outcomes of these remain a topic of ongoing debate.

In the healthcare industry, OC is progressively viewed as an essential component of health system reform, and the CVF has been widely used by researchers to assess OC within healthcare services [13–18,58–64,66–123,126–144].

Understanding OC through the lens of the CVF within healthcare institutions suggests that different cultural types embody distinct sets of behaviours, values, beliefs and assumptions that significantly enhance the KM process in the healthcare industry. Consequently, it is imperative to explore which cultural types are appropriate for KM processes in hospitals in order to understand how to establish the right culture to effectively manage knowledge and improve hospital efficiency.

2.3. Leadership style and knowledge management in healthcare

While the concept of leadership style is frequently mentioned, it is seldom explicitly defined [70,71]. Operating under the assumption that leadership behaviour impacts organizational performance directly, the objective of leadership is to guarantee the seamless operation of the organization [125]. Leaders are seen as climate engineers who shape the organizational climate through their behaviours and actions, which in turn impact work-related outcomes [72]. Their role entails facilitating access to information, nurturing innovation, and empowering employees to embrace KM practices.

Leadership stands as one of the most intricate and multidimensional phenomena. Over the years, it has been extensively researched and has assumed heightened significance in today's fast-paced and increasingly globalized world. Nevertheless, leadership remains the subject of captivating yet perplexing debate owing to its inherent complexity [73]. *The Bass Handbook of Leadership* [74] posited that "leadership and management styles are alternative ways that leaders and managers pattern their interactive behaviour with those they influence".

Benmira and Agboola [73] delineate four primary eras in leadership theory: trait, behavioural, situational, and new leadership. During the trait era, encompassing the great man theory (1840s) and trait theory (1930s–1940s), the emphasis was initially on innate leadership qualities and discerning the traits of effective leaders. Behavioural theory (1940s–1950s) underscores the actions of a leader rather than their traits or characteristics, yet it often overlooks the leader's situation and environment. During the 1960s, contingent and situational theory proposed that the most suitable leadership style is the one that best fits a particular context. In the modern era (1990s–2000s), which encompasses new leadership theories (such as transactional, transformational, shared, collaborative, collective, servant, inclusive, and complexity), a more systemic approach to leadership is adopted, taking into consideration the multifaceted and complex nature of our modern world, and emphasizing the importance of followership in effective leadership [73]. Complexity theory suggests that leadership encompasses structures, activities, and processes that enable firms to flourish in environments characterized by uncertainty [75]. This theory adopts a holistic view, taking into consideration the contextual interactions that occur throughout an entire social system [76].

Building upon the systematic review by Fisher and Sitkin [77], the most influential leadership style research programmes propose drawing distinctions between eight positive (authentic, charismatic, consideration and initiating structure, empowering, ethical, instrumental, servant, and transformational leadership) and two negative (abusive supervision and destructive leadership) leadership styles.

According to Koveshnikov et al. [32], this study focuses on three leadership styles that are widely practised and influential in many countries worldwide, namely authoritarian, paternalistic, and transformational, representing three key aspects of leadership, i.e. charisma, benevolence, and authority.

Authoritarian leadership involves the assertion of strong authority and control over subordinates, with an expectation of unquestioned obedience [13–16,18,20–78,125]. This style is recognized as prevalent and important in cultural contexts characterized by a significant difference in power between leaders and team members. Wang and Guan [79] found that authoritarian leadership enhances employee performance in Chinese organizations, mediated by their learning goal orientation. However, in Western cultures, it is more often associated with negative effects such as decreased commitment and effort from collaborators and increased burnout [32].

Paternalistic leadership is a managerial approach in which a dominant authority figure assumes the role of a patriarch or matriarch, treating the staff as members of a large family. They offer opportunities to enhance interpersonal and professional skills, expecting loyalty, trust, and compliance in return. Paternalistic leadership might foster knowledge sharing among certain types of employees, including both outsiders and insiders, who are more accustomed to paternal leaders [80].

Transformational leadership, by contrast, entails reshaping the values and priorities of employees, inspiring them to perform beyond expectations. Transformational leaders influence and inspire their teams to commit to a shared vision and goals, empowering individuals and resulting in engaged and satisfied staff. In hospitals, this style is associated with inspiring leadership, along with increasing pride and commitment among employees. Transformational leadership is a predominant style that has been associated with organizational learning across various contexts [81]. According to transformational leadership theory, it comprises four distinct dimensions: idealized influence (or charisma), inspirational motivation, intellectual stimulation, and individualized consideration [82]. In this framework, idealized influence pertains to the quality exhibited by a transformational leader who strives to serve as a role model for followers, thereby earning their respect and trust while endeavouring to emulate the leader's behaviours [83]. Inspirational motivation implies that a leader inspires followers by articulating visions that resonate with them, motivating them as a result to embrace and accomplish these visions [83]. These two dimensions underscore the charismatic attributes of a transformational leader. Intellectual stimulation implies that a leader prompts followers to challenge prevailing norms and take risks by approaching problems

in innovative ways [84]. Individualized consideration refers to the practice in which a leader motivates followers by attentively addressing their needs and listening to their concerns, thereby aiding in their development and growth [85]. Transformational leadership facilitates knowledge sharing [86] and fosters an OC that encourages knowledge, learning, and innovation [87].

Previous studies have focused on the impact of transformational leadership on knowledge sharing [88,89]. Le et al. [91] demonstrate that the positive attributes of transformational leadership, such as valuing employees as the organization's most valuable asset and fostering emotional connections with them, empower transformational leaders to positively influence employees' attitudes and behaviours towards knowledge sharing, particularly in knowledge collection scenarios.

In the area of KM, leadership is viewed as the organization's capacity to align KM behaviours with organizational strategy, recognize knowledge opportunities, promote KM principles, and foster learning within the organization [92]. As leadership theories have undergone significant evolution, resulting in various leadership approaches over the last few decades, it remains challenging to develop a comprehensive model that encompasses all the leadership approaches necessary for organizational learning [81]. Previous research has also indicated that there is a significant association between individual leadership styles and the implementation of KM practices [17,83–93].

Leadership is a critical factor in hospital performance, as effective leadership can guide an organization towards better outcomes [17]. Hospital leaders play a crucial role as models by actively listening to staff concerns, admitting mistakes, and reporting anxieties about suboptimal quality of care and patient safety [94]. Healthcare leaders need to comprehend how their actions and behaviours directly shape the work environment (organizational climate) and identify the kinds of behaviours and actions that promote positive organizational climates, resulting in beneficial work outcomes [95].

Research in healthcare has found that transformational leadership and OC are seen by many as the glue that binds learning organizations together [96]. Therefore, leaders need to understand KM processes and actively support KM through their leadership practices to ensure success [19]. In healthcare, senior management needs to display leadership qualities to encourage the involvement of physicians and other stakeholders (such as nurses, management staff, paramedics, etc.) in the implementation of KM practices [39].

Donate and Sánchez [11] found that KM procedures are influenced by a knowledge-oriented corporate culture, and leadership plays a supporting role in these knowledge processes. Leaders should cultivate a culture of knowledge, promote continuous learning, and establish effective communication channels [97]. Given that factors such as hospital culture and leadership play a crucial role in ensuring that the successful implementation of KM and its impact on hospital efficiency becomes evident, it is necessary to study them in the healthcare sector. Therefore, this study aims to identify the optimal types of culture and leadership styles for KM and efficiency in hospitals from the experts' point of view.

3. Methodology

While quantitative research emphasizes outcome prediction over process variables, qualitative research explores understanding organizational processes rather than forecasting outcomes [98]. Techniques in qualitative research tend to offer meaningful contextualization and clarity to research questions and concepts, particularly in organizational domains such as culture, leadership style, and KM [99]. Through thick, in-depth descriptions, qualitative research yields insights that quantitative measures struggle to capture [100], especially concerning organizational issues in real-life contexts within hospital management.

An FCM is “a relational model map used to express knowledge as a signed digraph and infer cause-effect relationships between concepts” [24]. Meanwhile, Zadeh [101] introduced the fuzzy set theory, which addresses the challenge of expressing opinions accurately in the presence of unpredictability, imprecision, or ambiguity. This theory allows us to use fuzzy integers to express ambiguous data and apply mathematics when analysing fuzzy domains.

The use of FCMs offers several advantages compared to other techniques [102–123,126].

- Flexibility: FCMs allow for the representation of complex systems in a flexible and intuitive manner. The flexibility of FCMs lies in their ability to integrate both qualitative and quantitative data (hybrid modelling) and to model cyclical structures, which many other methods, like mind maps and Bayesian networks, cannot. FCM can incorporate various factors and their relationships, making them suitable for modelling diverse domains in social sciences.
- Dynamic modelling: Unlike static representations, FCMs can capture the dynamic nature of systems by incorporating feedback loops and iterative processes. This dynamic modelling capability enables the analysis of system behaviour over iterations and under different conditions.
- Uncertainty handling: FCMs are well suited to handling uncertainty and vagueness inherent in real-world systems. By using fuzzy logic to represent relationships among variables, FCMs can accommodate imprecise or incomplete information more effectively than traditional Boolean logic models.
- Qualitative and quantitative integration: FCMs provide a bridge between qualitative and quantitative analysis. FCMs are semi-qualitative methods that assign fuzzy linguistic values or numerical weights to represent the strength of relationships among variables.
- Visualization and communication: An FCM is a mathematical object that can be represented through an external or additional method. In this way, it can offer a visual representation of complex systems that is easily understandable. This visual representation facilitates communication and collaboration among experts, allowing for a shared understanding of the system under study.
- Decision support: FCMs can be used as decision support tools for exploring the potential impact of decisions on complex systems. By simulating the behaviour of FCMs, decision-makers can assess the likely consequences of different courses of action before implementation.

An FCM can be represented by an adjacency matrix consisting of nodes (C_i), which are also known as “concepts”, and their connections ($\omega_{i,j}$) to one another. These connections illustrate how each node is related to others. When there is a connection between two nodes [103], it indicates that the effect variable is influenced by the causal variable. Edge connections can be either positive or negative [104], and each edge has a value ranging from -1 to 1^{104} .

A connection between two nodes with a positive edge value signifies a favourable relationship, implying that a rise or decline in the causal variable will result in the same directional shift in the effect variable. A negative edge value, on the other hand, denotes the possibility of the effect variable moving in the other direction. The adjacency matrix will display a “0” if there is no causal relationship between any two nodes.

An FCM has a dual purpose in that it makes it possible to evaluate potential forecasting scenarios such as simulating “what-if” experiments and convert subjective knowledge into a quantitative structure [102]. The ability of an FCM to infer the effects of a given scenario is a significant advantage, making it an excellent tool for examining the impact of various factors on hospital efficiency. The overall workflow is shown in Fig. 2.

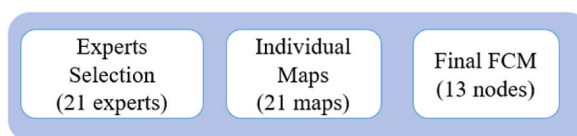
We looked for a panel of experts with a common area of expertise to make sure the FCM reflected hospital efficiency appropriately. Since there are no set standards in the literature, deciding on the right number of experts for a study can be difficult. Although the perfect panel size is determined by the particulars of the project, a panel of between 10 and 20 experts would represent a workable compromise [106]. The selection criteria for participant recruitment were based on both domain expertise and professional experience. Specifically, we sought participants from the Spanish Society of Healthcare Managers -a non-profit organization that brings together professionals in healthcare management-ensuring a range of perspectives by including individuals with varying levels of expertise engaged in tasks related to hospital management, medical direction, human resources, or similar roles. To determine whether someone had the appropriate depth of knowledge, we conducted a pre-screening process to evaluate their professional background, including their roles and responsibilities. We invited 30 experts who met these criteria to participate, and 21 accepted (9 women and 12 men), representing different hospitals across Spain. This group comprised 6 experts with 5–10 years of experience, 8 with 10–20 years, and 7 with over 20 years, ensuring a well-rounded representation of perspectives across different levels of expertise.

The construction of FCMs with experts entails implicit bias due to the subjectivity of the experts in assigning causal relationships. To minimize bias in participants’ responses, several strategies were implemented [107]. First, clear and concise instructions were provided to participants regarding the purpose of the FCM exercise, the concepts being mapped, and the relationships they were asked to define. To ensure participants were well-prepared for the interview process, we conducted in-person, one-on-one training sessions at the beginning of each interview. These sessions focused on key aspects of the FCM methodology. Specifically, we covered the objective of the interview, the types of results we aimed to achieve through the exercise, the process of constructing an FCM, and its practical applicability. We addressed relevant methodological issues to ensure participants had a comprehensive understanding of the task. This preparatory training was essential for aligning participant understanding with the goals of the research and ensuring the quality and consistency of the data collected.

Additionally, we assured the experts that their responses would remain anonymous and be combined with those of other participants, rather than being dealt with individually. The aim of this approach was to reduce social desirability bias and encourage participants to provide honest and unbiased responses. Lastly, a second round of FCM development and refinement was conducted after the interview had been concluded. This process enabled participants to review and provide feedback on earlier iterations of the map. Such an iterative approach can help in identifying and correcting biases in the initial responses.

Inconsistencies in participants’ responses may arise when different participants have divergent views or interpretations of the concepts, leading to discrepancies in the model. To maintain consistency, following Olazabal et al. [108], an interview guide was employed. This guide ensures that the interview focuses on themes deemed essential to the research questions based on prior literature and offers a balance of flexibility and structure [109]. The interviews were conducted between May and September 2023 either face-to-face or via videoconference. All the interviews lasted between one and a half and two and a half hours and were focused on developing a mental map of the effects of OC and leadership style on KM and efficiency in Spanish hospitals (see Appendix A for the interview guide).

Phase I. FCM construction



Phase II. Simulation of what-if scenarios

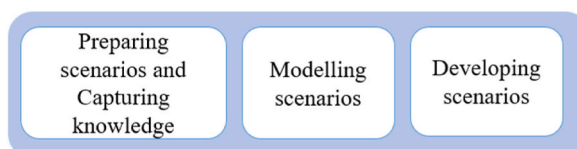


Fig. 2. FCM construction and Simulation of what-if scenarios process.

A prior systematic literature review was conducted with a view to finding organizational factors that might affect hospital efficiency. We eliminated redundant and irrelevant components from our analysis. Eight preliminary factors that emerged from the literature review were used as the study's starting points. However, with experts being given the chance to suggest other considerations, this list was not meant to be exhaustive. Each expert was tasked with designing a suitable FCM, beginning with the initial list of elements presented to them. The expert's valuation was not limited to the preliminary list, and they were free to add or remove nodes as they saw fit. Ultimately, five new nodes were added to the study by experts, namely "communication", "commitment", "values", "technical Competence", and "teamwork", and all of them refer to aspects related to human resources management in the hospital. The resulting FCM was comprised of 13 nodes.

3.1. Preliminary nodes (literature review)

- Hospital efficiency (EFFIC). Using their resources for the best product and services in comparison to their competitors [7].
- Nature of processes (PROCES): formal or informal. Formal processes are characterized by high degrees of stability, order, and control, while informal processes involve a higher degree of flexibility and autonomy [63].
- Strategic approach (STRAT_APP): internal or external. It contrasts internal integration, which gives less attention to market changes, with external integration, which emphasizes adaptation to the environment [63].
- Charisma. A natural quality that a person possesses that attracts individuals solely through their presence, actions, or words [10].
- Benevolence (BENEV). The way of behaving and the character of a person that make them more understanding towards those around them, seeking well-being for themselves and others [10].
- Authority (AUTHOR). The attitude of someone who explicitly exercises the power they have over those around them [10].
- Creation and identification of knowledge (CREAC_KN). The hospital's capacity to create new knowledge, as well as to identify the relevant and necessary knowledge that exists within it [11].
- Knowledge exploitation (EXPL_KN). The hospital's capacity to describe, represent, organize, and apply knowledge, as well as share knowledge among its members [11].

In order to avoid inconsistencies in the interpretations of these concepts, we included the following clarifications in the interview guide (Appendix A) regarding how to consider these variables.

- Nature of processes: Values of this variable close to 1 will be associated with the existence of informal processes, while values close to 0 will represent the existence of formal processes.
- Strategic approach: Values of this variable close to 1 will be associated with an external strategic orientation, while values close to 0 will represent an internal strategic focus.
- Charisma: Values of this variable close to 1 will be associated with a strong presence, while values close to 0 will represent a weak presence of charisma.
- Benevolence: Values of this variable close to 1 will be associated with a strong presence, while values close to 0 will represent a weak presence of benevolence.
- Authority: Values of this variable close to 1 will be associated with a strong presence, while values close to 0 will represent a weak presence of authority.
- Creation and identification of knowledge: Values of this variable close to 1 will be associated with a strong presence, while values close to 0 will represent a weak presence of creation and identification of knowledge.
- Knowledge exploitation: Values of this variable close to 1 will be associated with a strong presence, while values close to 0 will represent a weak presence of knowledge exploitation.

3.2. Nodes added by experts

- Communication (COMMUN). The capacity to exchange information, messages, and ideas among individuals and groups within the hospital to achieve common goals.
- Commitment (COMMIT). The level of enthusiasm, dedication, and motivation that an employee in the hospital feels towards their work and organization.
- Values. This refers to the principles and convictions that guide the behaviour and decisions of individuals, encompassing both universal values and those specific to a hospital culture.
- Technical competence (TEC_COM). The set of knowledge, skills, experience, and behaviours necessary to successfully perform a job.
- Teamwork (TEAMW). Collaboration and cooperation among a group of individuals working towards a common purpose.

Experts are typically responsible for designing an FCM due to their specialized knowledge and expertise. To reflect their mental models, experts produce causal cognitive maps [110]. Each expert is given an initial list of eight nodes with their definitions and is then free to add or remove nodes as they see fit. The expert adds causal links with the corresponding signals after considering the causal connections between the nodes. A seven-point Likert-type scale is used to assign causal weights to each association, with 1 denoting a very weak causal link and 7 a very strong one. To ensure proper documentation, the expert is requested to elaborate on each notion and causal relationship when the process is complete. The result is a cross-impact matrix that includes all the pertinent data from 21 causal

maps, which can then be easily converted into 21 adjacency matrices [111]. The values of the adjacency matrices are changed into numbers between -1 and 1. To validate the structural soundness of individual FCMs, we assessed the coherence of concepts and the logical flow of causal relationships. After completing the map, we repeated the process with the participant to refine any aspects as needed, ensuring that the final FCM accurately reflected their mental model and provided a reliable system representation.

Once the individual FCMs had been created by the experts, the next step was to reach a consensus among them. Recognizing that there are no standardized evaluation criteria or widely accepted standards for what constitutes an effective FCM aggregation procedure [145], the average method serves as the benchmark for FCM aggregation, where the final FCM model is constructed by averaging the numerical values of a given interconnection [146]. Therefore, our study used a process where the expert opinions were averaged [112]. By using the mean, extreme results were avoided, and negative values could also be calculated, which was important for this study. Each expert’s perspective was assumed to be equally significant, and the weights of the matrix were calculated accordingly. The FCM with mean values was used in this study to reflect the consensus of the experts.

The FCMs of each expert are integrated to produce a single FCM using the augmented FCM approach. Combining these FCMs results in a more accurate representation of the causal relationships by eliminating or weakening any conflicting links and strengthening any agreements. This well-known additive method is effective at reducing discrepancies and increasing the model’s precision [113], although may occasionally propagate the errors of a participant, producing an aggregate FCM that fails to accurately represent the system [145].

Each expert’s adjacency matrix is combined to form a single matrix, which is then utilized to produce the upgraded FCM. Any nodes that are absent from a particular expert’s matrix are given a value of 0 in this augmented matrix, which includes all the nodes from the individual matrices. The edge weights (i,j) from the several adjacency matrices are averaged to get the values in the augmented matrix. The augmented FCM may effectively eliminate competing linkages and strengthen agreement among the expert’s causal connections by employing the mean value [113]. As a result, a more complete and accurate depiction of the hospital’s efficiency is produced:

$$w_{ij}^{Aug} = \frac{\sum_{k=1}^n w_{ij}^k}{n}$$

4. Results

The augmented adjacency matrix with 43 edges (Table 1) represents the complete FCM, which displays the connections among all nodes. Without requiring the experts to compromise on their positions to establish an agreement, this matrix was created by integrating their unique adjacency matrices [114].

The augmented adjacency matrix shows the cause-and-effect nodes in the first column and row. Each matrix cell displays how each variable affects the others, with relationships ranging from positive to negative or having no influence at all. The lowest and highest

Table 1
Augmented adjacency matrix.

	AUTHOR	BENEV	CHARIS MA	TEC_CO M	COMMIT	COMMU N	CREAC_ KN	EFFIC	STRAT_ APP	EXPL_K N	PROCES	TEAMW	VALUES
AUTHOR	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.32	0.00	0.27	0.02	0.00	0.00
BENEV	0.13	0.00	0.00	0.03	0.00	0.00	0.43	0.61	-0.01	0.48	-0.02	0.00	0.00
CHARISMA	0.02	0.00	0.00	0.00	0.04	0.00	0.63	0.72	0.00	0.70	0.00	0.00	0.05
TEC_COM	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.09	0.00	0.00	0.00	0.00	0.00
COMMIT	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00
COMMUN	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.20	0.00	0.04	0.00	0.00	0.00
CREAC_KN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.00
EFFIC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STRAT_APP	0.03	0.00	0.00	0.00	0.00	0.00	0.74	0.75	0.00	0.77	0.12	0.00	0.00
EXPL_KN	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.84	0.00	0.00	0.04	0.00	0.00
PROCES	0.00	0.00	0.00	0.00	0.04	0.00	0.67	0.77	0.05	0.77	0.00	0.00	0.00
TEAMW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.03	0.00	0.00
VALUES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.03	0.00	0.00	0.03	0.00

standardized impacts were found on the paths from BENEV to PROCES and from EXPL_KN to EFFIC, respectively. Standardized effects vary from -0.02 to 0.84 .

Validation is an important aspect of developing a complex system. According to Cobelli and Carson [115], a model should be validated in two stages. First, it is important to carry out the validation technique during the model creation process, which necessitates the active involvement of specialists. Second, after it has been constructed, the model needs to be reviewed by the designers. However, as the applicability of the method depends on the availability of data, there is currently no commonly acknowledged way of verifying the model construction process [116]. Therefore, experts were asked in person to review the structure and interconnections within the final FCM. They examined the selection of concepts, the direction and strength of the relationships, and the overall topology of the FCM to ensure that it accurately mirrored the complexities of the real-world system being modelled. They assessed whether the chosen concepts were representative of the key factors in the system and whether the causal links between them were logically consistent.

The results indicate the significant factors that have a major impact on hospital efficiency, including the essential orders of dimensions and criteria, and the connections between the precursors. From the experts' perspective, the top nodes that influence hospital efficiency strongly are EXPL_KN (0.84), CREAC_KN (0.80), PROCES (0.77), STRAT_APP (0.75), and CHARISMA (0.72). According to experts, these factors are the primary determinants that directly affect hospital efficiency. STRAT_APP (0.77) and PROCES (0.77) are the main factors affecting EXPLO_CON. Furthermore, CHARISMA can improve EXPL_KN and CREAC_KN. Also, BENEV can affect hospital efficiency positively (Table 1).

A dynamic FCM enables the analysis of system dynamics and the production of forecasts for numerous possible situations. By allowing concepts to interact, the FCM, which is not a fixed representation, makes it easier to assess how a scenario changes over iterations. It can model how a situation changes over time by giving the FCM an initial stimulus vector state. The vector state C_j^{t+1} at time $t+1$ is obtained using the following formula, where $f(x)$ is the function for transformation: $C_j^{t+1} = f(\sum_{i=1}^n C_i^t \cdot \omega_{ij}); f(x) = \frac{1}{1+e^{-x}}$.

Once the FCM reaches stability, the inference process is considered finished. At this point, the final vector state indicates the influence of each node's value change on the FCM. As reported by Salmerón and López [113], the equilibrium state of the final vector is achieved after 20 iterations, as shown in Table 2.

There are several analytical techniques available for evaluating FCMs, drawn from network science and graph theory, that offer diverse perspectives on the structure and dynamics of FCMs [147]. In this research, we focus primarily on degree centrality to identify key factors within the FCM. Degree centrality captures the direct relationships between concepts, which may overlook indirect influences within the network. The variables were categorized based on their characteristics. The classification and summary of this categorization can be found in Table 3, which provides the overall centrality (total of absolute values of incoming and outgoing arrows) of all variables as well as the outdegree (total of absolute values of outgoing arrows) and indegree (total of absolute values of incoming arrows). This information provides an indication of the significance of these variables within the system.

5. Simulation of what-if scenarios

Scenarios are hypothetical future events that could happen and require action. Such scenarios are planned to create alternative future states for unclear future features and to determine how other components might change under circumstances [118].

Jetter and Schweinfurt [110] outlined the following steps for developing scenarios based on FCMs: preparing scenarios and gathering knowledge, which establishes the goals and limitations of the scenario project; capturing knowledge, which pinpoints potential scenario drivers; modelling scenarios, which gives signs and weights to the scenario drivers; and developing scenarios, which entails building the FCM model for various input vectors that represent conceivable combinations of concept states.

Step 1: Preparing scenarios and Capturing knowledge

Table 2
Results – final vector.

		Iterations				
		(1)	(2)	(...)	(19)	(20)
AUTHOR	1.0000	0.5525	0.5267	0.5265	0.5265
BENEV	1.0000	0.5000	0.5000	0.5000	0.5000
CHARISMA	1.0000	0.5068	0.5034	0.5034	0.5034
TEC_COM	1.0000	0.5085	0.5043	0.5043	0.5043
COMMIT	1.0000	0.5204	0.5107	0.5105	0.5105
COMMUN	1.0000	0.5000	0.5000	0.5000	0.5000
CREAC_KN	1.0000	0.9432	0.8153	0.8103	0.8103
EFFIC	1.0000	0.9957	0.9716	0.9638	0.9638
STRAT_APP	1.0000	0.5170	0.5091	0.5089	0.5089
EXPL_KN	1.0000	0.9535	0.8288	0.8245	0.8245
PROCES	1.0000	0.5458	0.5284	0.5267	0.5267
TEAMW	1.0000	0.5085	0.5044	0.5043	0.5043
VALUES	1.0000	0.5119	0.5060	0.5060	0.5060

Table 3
Variables categorization.

	Variables		Outdegree	Indegree	Centrality
ORGANIZATIONAL CULTURE	Node #1	STRAT_APP	2.40	0.08	2.48
	Node #2	PROCES	2.30	0.22	2.52
LEADERSHIP	Node #3	AUTHOR	0.86	0.21	1.07
	Node #4	BENEV	1.70	0.00	1.70
	Node #5	CHARISMA	2.16	0.03	2.19
KNOWLEDGE MANAGEMENT	Node #6	CREAC_KN	0.80	2.81	3.61
	Node #7	EXPL_KN	0.93	3.02	3.95
HUMAN RESOURCES MANAGEMENT	Node #8	TEC_COM	0.12	0.03	0.16
	Node #9	COMMIT	0.19	0.08	0.27
	Node #10	COMMUN	0.27	0.00	0.27
	Node #11	TEAMW	0.15	0.03	0.18
	Node #12	VALUES	0.14	0.05	0.18
HOSPITAL EFFICIENCY	Node #13	EFFIC	0.00	5.44	5.44

Hospital culture is one of the aspects that can impact on both hospital efficiency and KM. We have found that those variables related to hospital culture show the higher outdegree levels and are therefore good antecedents to understanding KM processes and hospital efficiency. According to the CVF (Fig. 1), hospital culture can be categorized by using two dimensions (strategic approach (node #1) and processes (node #2)), and four OC typologies can be identified by using these two dimensions [63]. Hierarchy culture is identified by (i) an internal strategic approach mainly focused on internal aspects and with less attention to market changes and (ii) the presence of formal processes with high degrees of stability, order, and control. Clan culture also presents (i) an internal strategic approach and (ii) informal processes with high degrees of flexibility and laxity. Market culture is identified by (i) an external strategic focus with greater attention to market changes and an emphasis on adapting to the environment and (ii) the presence of formal processes. Adhocracy culture is associated with (i) an external strategic focus and (ii) informal processes.

Therefore, we can associate these four hospital cultures with values in the variables STRAT_APP (node #1) and PROCES (node #2) as follows.

Hierarchy culture

- Internal strategic focus: mainly focused on internal aspects and with less attention to market changes. (Node #1 value = close to 0)
- Formal processes: high degrees of stability, order, and control. (Node #2 value = close to 0)

Clan culture

- Internal strategic focus: mainly focused on internal aspects and with less attention to market changes. (Node #1 value = 0)
- Informal processes: high degrees of flexibility and laxity. (Node #2 value = 1)

Market culture

- External strategic focus: greater attention to market changes and an emphasis on adapting to the environment. (Node #1 value = 1)
- Formal processes: high degrees of stability, order, and control. (Node #2 value = 0)

Adhocracy culture

- External strategic focus: greater attention to market changes and an emphasis on adapting to the environment. (Node #1 value = 1)
- Informal processes: high degrees of flexibility and laxity. (Node #2 value = 1)

Step 2: Modelling scenarios

The FCM put forward by specialists involves 13 nodes grouped into four groups, as outlined in Table 3. The state vector enables us to simulate the envisioned scenarios, with each of the 13 nodes taking on values ranging from 0 to 1, denoting their absence or presence in the scenario [119]. As such, each scenario can be depicted as a vector following the subsequent construction.

$$\text{Scenario } j = (n1_j, n2_j, n3_j, n4_j, n5_j, n6_j, n7_j, n8_j, n9_j, n10_j, n11_j, n12_j, n13_j)$$

In this context, “ n_i ” denotes the value assigned to node “ i ” in scenario “ j ”. Using this representation approach, we can model the following scenarios according to the hospital culture typology, where nodes #1 and #2 take the values 0 or 1 to represent the internal/external strategic focus and formal/informal processes:

$$\text{“Hierarchy culture” scenario} = (0, 0, n3_j, n4_j, n5_j, n6_j, n7_j, n8_j, n9_j, n10_j, n11_j, n12_j, n13_j)$$

$$\text{“Clan culture” scenario} = (0, 1, n3_j, n4_j, n5_j, n6_j, n7_j, n8_j, n9_j, n10_j, n11_j, n12_j, n13_j)$$

$$\text{“Market culture” scenario} = (1, 0, n3_j, n4_j, n5_j, n6_j, n7_j, n8_j, n9_j, n10_j, n11_j, n12_j, n13_j)$$

“Adhocracy culture” scenario = (1, 1, n3_j, n4_j, n5_j, n6_j, n7_j, n8_j, n9_j, n10_j, n11_j, n12_j, n13_j)

Step 3: Developing scenarios

When used as a simulation tool in scenario planning, an FCM can help with visualizing and assessing potential outcomes based on hospital culture. The primary objective of this simulation process is to understand how hospital culture can impact KM and hospital efficiency. The process begins by setting up a scenario with a set of circumstances by assigning values to the vector. It ends when the vector stabilizes after several iterations with the FCM, producing the final vector that contains the values of each node in the context under consideration. Table 4 shows how hospital culture (nodes #1 and #2) affects KM and operational efficiency.

A hospital’s KM and efficiency may be strongly impacted by its hospital culture. To maximize these characteristics, it is therefore helpful to recognize and comprehend the various cultures that exist inside a hospital.

The development of scenarios enables a collective impact examination of hospital culture variables. This strategy is important because most prior studies looked at these variables separately. The study was able to distinguish four distinct hospital culture typologies by presenting a set of factors that can facilitate a better understanding of the overall impact of hospital culture on KM and hospital efficiency.

Based on experts’ opinions, the findings imply that hospitals with hierarchy cultures perform less effectively in terms of knowledge production and management. This is probably because this kind of hospital culture is tight and hierarchical, which can make it difficult to communicate and work together. In contrast, medical facilities with an adhocracy culture show the greatest standards of knowledge production and exploitation as well as operational effectiveness. This kind of hospital culture promotes creativity, risk taking, and adaptation, which can be advantageous in the healthcare sector. Clan or market-oriented hospitals exist in between these two cultural categories, achieving very comparable goals in KM and hospital efficiency.

However, KM and hospital efficiency depend not only on hospital culture but also on leadership style, as shown by the augmented adjacency matrix (Table 1). In this regard, once it has been identified that hospitals with an adhocracy culture exhibit the highest values in both the creation and exploitation of knowledge and hospital efficiency, the combination of hospital culture and leadership that would yield better results will be analysed.

To do so, three new scenarios will be simulated, one for each type of leadership (nodes #3, #4, and #5), which can be developed in hospitals with an adhocracy culture (nodes #1 and #2 values = 1). According to Koveshnikov et al. [32], each leadership style can be associated with different aspects of leadership: authoritarian leadership with authority, paternalistic leadership with benevolence, and transformational leadership with charisma. Therefore, vectors for new scenarios are as follows:

“Adhocracy culture and Authoritarian leadership” scenario =

(1, 1, 1, 0, 0, n6_j, n7_j, n8_j, n9_j, n10_j, n11_j, n12_j, n13_j)

“Adhocracy culture and Paternalistic leadership” scenario =

(1, 1, 0, 1, 0, n6_j, n7_j, n8_j, n9_j, n10_j, n11_j, n12_j, n13_j)

“Adhocracy culture and Transformational leadership” scenario =

(1, 1, 0, 0, 1, n6_j, n7_j, n8_j, n9_j, n10_j, n11_j, n12_j, n13_j)

Table 5 shows the influence of the combination of adhocracy culture with the three types of leadership on KM and hospital efficiency. Based on the experts’ insights, results suggest that the highest levels of KM and hospital efficiency can be obtained by combining an adhocracy culture and a transformational leadership.

Table 4
Hospital culture effects on knowledge management and hospital efficiency.

			Hierarchy Culture	Clan Culture	Market Culture	Adhocracy Culture
ORGANIZATIONAL CULTURE	Node #1	STRAT_APP	0.0000	0.0000	1.0000	1.0000
	Node #2	PROCES	0.0000	1.0000	0.0000	1.0000
LEADERSHIP	Node #3	AUTHOR	0.5230	0.5231	0.5298	0.5299
	Node #4	BENEV	0.5000	0.5000	0.5000	0.5000
	Node #5	CHARISMA	0.5034	0.5034	0.5034	0.5034
KNOWLEDGE MANAGEMENT	Node #6	CREAC_KN	0.6710	0.8009	0.8118	0.8946
	Node #7	EXPL_KN	0.6792	0.8203	0.8206	0.9080
HUMAN RESOURCES MANAGEMENT	Node #8	TEC_COM	0.5043	0.5043	0.5043	0.5043
	Node #9	COMMIT	0.5051	0.5153	0.5051	0.5153
	Node #10	COMMUN	0.5000	0.5000	0.5000	0.5000
	Node #11	TEAMW	0.5043	0.5043	0.5043	0.5043
	Node #12	VALUES	0.5060	0.5060	0.5060	0.5060
HOSPITAL EFFICIENCY	Node #13	EFFIC	0.9057	0.9628	0.9624	0.9845

Table 5
Effects of hospital culture and leadership style on knowledge management and hospital efficiency.

			Adhocracy culture and Authoritarian leadership	Adhocracy culture and Paternalistic leadership	Adhocracy culture and Transform. leadership
ORGANIZATIONAL CULTURE	Node #1	STRAT_APP	1.0000	1.0000	1.0000
	Node #2	PROCES	1.0000	1.0000	1.0000
LEADERSHIP	Node #3	AUTHOR	1.0000	0.0000	0.0000
	Node #4	BENEV	0.0000	1.0000	0.0000
	Node #5	CHARISMA	0.0000	0.0000	1.0000
	Node #6	CREAC_KN	0.8489	0.8695	0.8911
KNOWLEDGE MANAGEMENT	Node #7	EXPL_KN	0.8609	0.8843	0.9054
	Node #8	TEC_COM	0.5000	0.5085	0.5000
HUMAN RESOURCES MANAGEMENT	Node #9	COMMIT	0.5102	0.5102	0.5204
	Node #10	COMMUN	0.5000	0.5000	0.5000
	Node #11	TEAMW	0.5043	0.5043	0.5044
	Node #12	VALUES	0.5000	0.5000	0.5119
	Node #13	EFFIC	0.9724	0.9798	0.9826

6. Discussion: theoretical and practical implications

The effects of OC and leadership style on KM and organizational efficiency have been analysed previously in the management literature. What is less clear is how different types of OC and leadership styles affect the creation, identification, and exploitation of knowledge, as well as their effects on efficiency in the hospital context. These impacts have been mainly identified independently but are seldom researched in combination.

Our research provides important theoretical and practical contributions. From a theoretical point of view, several implications can be highlighted. This study provides empirical evidence based on the experts' insights about the importance of alignment between OC and leadership style. Specifically, it shows that transformational leadership is most effective in adhocracy environments, while other leadership styles may be less effective in this type of culture. This suggests that leadership effectiveness is context-dependent, which is a significant contribution to leadership and organizational management theory.

The use of FCMs also offers a novel approach to modelling and understanding complex systems such as the interaction between OC, leadership, and KM. This study combines several theoretical models to investigate the connection between OC, leadership styles, KM, and hospital efficiency. OC has been analysed using the CVF, which comprises the formal or informal nature of processes and the internal or external strategic approach to identify OC. Leadership styles have been identified using the modern approach of Koveshnikov et al. [32], who associate different aspects of leadership with leadership style. KM analysis has been grounded in the KBV, which is fundamentally grounded in the RBV, where companies' knowledge is acknowledged as a fundamental strategic asset, a generator of value, and a pivotal element of competitiveness [9–12,19–27,125]. It has been widely used in KM literature [33,34]. According to KBV, firms exist primarily to create, transfer, and apply knowledge, and their competitive advantage is derived from their ability to effectively manage these knowledge processes [139]. KBV posits that a company's function is to procure, generate, and apply knowledge, fostering an environment where employees utilize these capabilities to create both knowledge and value for the organization. The integration of RBV and KBV into their KM practices in healthcare industry emerges as a vital strategy for enhancing operational efficiency, fostering a culture of innovation, and ultimately ensuring high-quality patient care. This dual application not only empowers healthcare providers to address immediate health challenges but also equips them to anticipate future needs, thereby contributing to sustainable advancements in healthcare delivery. The synergy between RBV and KBV facilitates a robust KM framework that promotes collaboration and communication among healthcare teams, essential for continuous improvement in a landscape characterized by increasing complexity and shifting patient needs. Consequently, as healthcare organizations increasingly recognize the importance of these strategic frameworks, there is a growing need to empirically validate their effectiveness within health contexts. Moreover, this methodological approach could be applied in future research to explore other complex organizational dynamics, contributing to the development of more sophisticated analytical tools in organizational research.

In the hospital context, this research has contributed to the advancement of theory by examining the link between these three frameworks and by analysing the combination of hospital culture and leadership style that would yield the best results in KM and hospital efficiency.

Hospital culture and leadership style within a hospital can significantly impact KM and efficiency, making it crucial to identify and comprehend the effects of different hospital culture leadership types to optimize them. We were able to determine how these qualitative variables affected hospital efficiency using an FCM and how these qualitative organizational factors can undoubtedly help to improve the challenges and problems that exist in the health sector in general and specifically in Spanish hospitals.

In light of experts' opinions, results suggest that hospitals with a hierarchy culture exhibit lower levels of knowledge creation, management, and overall hospital efficiency. On the other hand, hospitals with an adhocracy culture show an increase in knowledge creation, knowledge exploitation, and overall hospital efficiency compared to the others.

Finally, transformational leadership achieves the highest levels of KM and hospital efficiency in hospitals with an adhocracy culture. Leaders in this style play a motivating role and incentivize their staff to progress, thus promoting the development of the hospitals' intellectual capital [60].

Our findings are consistent with existing literature in the hospital context. According to Sibbald et al. [19], the culture and leadership style within hospitals are essential factors in facilitating effective KM. These two elements set the tone for how information is valued, shared, and utilized throughout the organization. Our research also corroborates Yun's⁶⁹ findings, indicating that environments characterized by adhocracy cultures exhibit more favourable attitudes toward the adoption of KM systems. Adhocracy cultures, known for flexibility and innovation, foster an atmosphere conducive to embracing and leveraging technological tools for effective knowledge sharing and collaboration. Our findings are consistent with those of Coun et al. [86] and Anselmann and Mulder [87], emphasizing that transformational leadership promotes KM within the hospital context.

As regards the generalization of findings, FCM shows little acknowledgement or direct addressing of the issue of generalization, due to the results being derived from the opinions of a panel of experts [120]. This has repeatedly emerged as a major distinguishing feature between quantitative and qualitative research. However, qualitative research might also seek to claim generalizability for its findings because it helps us recognize connections among concepts or phenomena that might not be evident in certain contexts with specific characteristics, such as the hospital context, which is relevant and useful to theorists and practitioners alike. As stated previously, the Spanish healthcare sector has specific peculiarities. However, some of these peculiarities can also be found in other healthcare sectors around the world. Moreover, similar characteristics can be identified in other sectors. Therefore, this paper empowers readers to build their own understandings and evaluations of how our research findings apply to, and inform, their own experiences and contexts, with the aim of improving their KM and efficiency by utilizing OC and leadership styles as very powerful tools for enhancement.

Consequently, this paper is also valuable to directors/managers in hospitals as a reference for practising KM and improving hospital efficiency through adhocracy culture and transformational leadership. From the experts' perspective, the study shows that adhocracy culture is very appropriate for stimulating the exploration and exploitation of knowledge in hospitals and hospital efficiency. Expert consensus using FCM show that an adhocracy culture based on values such as creativity, dynamism, entrepreneurialism, innovation, readiness for change, adaptability [63], risk tolerance [64], and commitment to learning is the best option for responding more quickly to changes that a healthcare system demands in order to improve hospital efficiency. This is a very interesting finding because the adhocracy culture does not seem to be the predominant approach in the hospital sector. According to Mesfin et al. [143], hierarchical culture emerged as the predominant cultural typology within primary hospitals, with market culture in the second position of most prevalent culture types. Similarly, Saif [148] determined that in private hospitals, hierarchical culture was the most prevalent, whereas clan culture was identified as the least prevalent. It suggests the need to consider a change in the cultural approach of hospitals to gradually adopt approaches more aligned with an adhocracy culture, which do not seem to be the most common at present.

Additionally, the study contends that transformational leadership may be the most effective method for promoting the creation, identification, and exploitation of knowledge in hospitals because it can help employees develop knowledge capital by minimizing the risk and vulnerability associated with interpersonal relationships at work [121].

Therefore, it can be concluded that the use of human resource management techniques can foster the development of leaders who possess the quality of inspiring motivation. These leaders have high expectations for their subordinates and motivate them to commit to, and participate in, the organizational common vision [122]. Thus, the paper suggests that managers should concentrate on using a transformational leadership style by: (1) providing a clear vision and sense of mission (idealized influence); (2) focusing on encouraging employees' intelligence and creativity in problem solving (intellectual stimulation); (3) encouraging employees to act with better moral standards by presenting an alluring future vision (inspirational motivation); and (4) giving more regard to employees' needs, concerns, and feelings in order to provide prompt support and direction (individual consideration) [93].

Having management teams in hospitals capable of playing a strategic role in the management and administration of these healthcare entities can exert a certain influence by creating a hospital culture based on a motivating and productive work environment, increasing staff satisfaction, and improving healthcare, thereby enhancing KM, efficiency, and the quality of work in the hospital. A person exercising transformational leadership can help employees focus on the hospital's mission and vision, fostering interdepartmental collaboration, as well as communication and coordination among professionals, factors that can improve KM and hospital efficiency.

The results also suggest some specific recommendations for governments and policymakers. At the policy level, decision-makers in the healthcare sector should design regulatory frameworks that support the adoption of more flexible and change-oriented OC, as well as the development of leadership styles that enhance efficiency and KM. This could include incentives for organizational innovation and the development of transformational leadership skills. Innovative approaches should be adopted to identify, develop, and support practices that lead to hospital cultures aligned with the characteristics of an adhocracy culture. Governments could convene hospital managers to discuss different leadership models, share best practices, develop solutions to leadership challenges, and collaborate on innovative approaches based on the transformational leadership approach. They could also invest in a hospital manager leadership research agenda and require pilot programmes to include evaluations for best practices. Governments can also consider increasing

funding for innovation in OC and leadership styles that lead to better KM and efficiency in the hospital context, as well as creating regulatory conditions to remove barriers and provide hospital managers with a balanced autonomy to make organizational changes that lead to cultural change.

Regarding the explanations of the findings, experts on the panel have identified and considered additional factors that may influence the observed relationships or affect KM and efficiency in the healthcare context. These factors include: “communication” (node #10), which refers to the ability to exchange information, messages, and ideas among individuals and groups within the hospital to achieve common goals; “commitment” (node #9), which relates to the degree of enthusiasm, dedication, and motivation that hospital employees feel towards their work and organization; “values” (node #12), which encompass the principles and convictions guiding the behaviour and decisions of individuals, including both universal values and those specific to hospital culture; “technical competence” (node #8), comprising the knowledge, skills, experience, and behaviours necessary to perform a job successfully; and “teamwork” (node #11), which denotes collaboration and cooperation among a group of individuals working towards a common purpose.

Additionally, the results obtained from the nodes added by the experts (Table 5) suggest that adhocracy culture and transformational leadership may also have slight positive effects on other variables related to human resource management, such as commitment (node #9), values (node #12), and teamwork (node #11). It is noteworthy that most experts have not focused on identifying the antecedents of OC or leadership styles, as they are not the specific focus of this research work. These findings could represent a potential area for further exploration into the effects of variables related to human resource management in relation to different types of culture and leadership, which could lead to alternative explanations of the findings. To achieve this, specific research work would be necessary, which would be an extension of this study in the hospital setting.

7. Conclusions, limitations and future research directions

To the best of our knowledge, there is a lack of prior research exploring the impact of OC and leadership style on KM and efficiency within Spanish hospitals. Hence, this study represents one of the pioneering investigations employing FCMs to analyse such relationships. As viewed by the experts, hospitals characterized by a hierarchy culture tend to exhibit reduced levels of knowledge creation, management, and overall efficiency. In contrast, those with an adhocracy culture show enhancements in knowledge creation, exploitation, and overall efficiency compared to their counterparts.

Furthermore, within hospitals fostering an adhocracy culture, transformational leadership emerges as the most effective approach for optimizing KM and enhancing hospital efficiency. These findings underscore the importance of considering both OC and leadership style as fundamental elements for healthcare institutions success. These findings underscore the importance of designing management strategies that consider both culture and leadership as fundamental elements for organizational success.

It is important to note that certain limitations may affect the scope of the conclusions. While the panel size has been numerically saturated, the results rely on the quality of knowledge provided by the interviewed experts. This limitation may have significant implications for the application of the findings in real-world healthcare settings. While enough experts were involved in the study, the quality of knowledge provided by these experts is paramount. If the experts did not have a comprehensive understanding of the subject matter or if there were biases in their responses, the conclusions drawn from the study may be less reliable or applicable.

Furthermore, additional studies should be conducted to delve deeper into the relationships between hospital culture and leadership styles and their effects on variables related to human resource management (such as effective management of the healthcare workforce, including workforce planning, appropriate staff allocation, training, and professional development, among others), which also support KM and hospital efficiency. Although FCMs are suitable for representing and modelling imprecise knowledge, they are not sufficient on their own to reach definitive conclusions, which is one of the inherent limitations of the methodology used regardless of the quality of the knowledge of expert individuals. Therefore, an extension of this research is proposed to conduct additional studies based on quantitative data to explore deeper into the relationships between leadership styles, human resource management, KM, and hospital efficiency. It would also be valuable to explore the integration of quantitative data into the FCM, creating a hybrid model that allows for a more comprehensive analysis and helps us understand the complexity of these dynamics. In real-world healthcare settings, effective management of the healthcare workforce is critical for maintaining high-quality care and efficiency. Factors such as workforce planning, staff allocation, training, and professional development play integral roles in shaping OC and leadership effectiveness. Therefore, when applying the findings in real-world healthcare settings, practitioners and decision-makers should exercise caution and consider the context-specific factors that may influence the effectiveness of different leadership styles and OC.

CRedit authorship contribution statement

María-Jesús Moreno-Domínguez: Writing – review & editing, Writing – original draft, Validation, Supervision, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Tomás Escobar-Rodríguez:** Writing – review & editing, Writing – original draft, Validation, Supervision, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Yolanda-María Pelayo-Díaz:** Writing – review & editing, Writing – original draft, Validation, Supervision, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Isabel Tovar-García:** Writing – review & editing, Writing – original draft, Validation, Supervision, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Data availability statement

The data associated with the study has not been deposited into a publicly available repository and will be made available from the corresponding author at domin@uhu.es on request.

Ethics declarations

All participants provided informed consent to participate in the study. Review and/or approval by an ethics committee was not required for this study, as it does not involve research on patients recruited from public or private healthcare systems, clinical data, or biological samples.

Declaration of competing interest

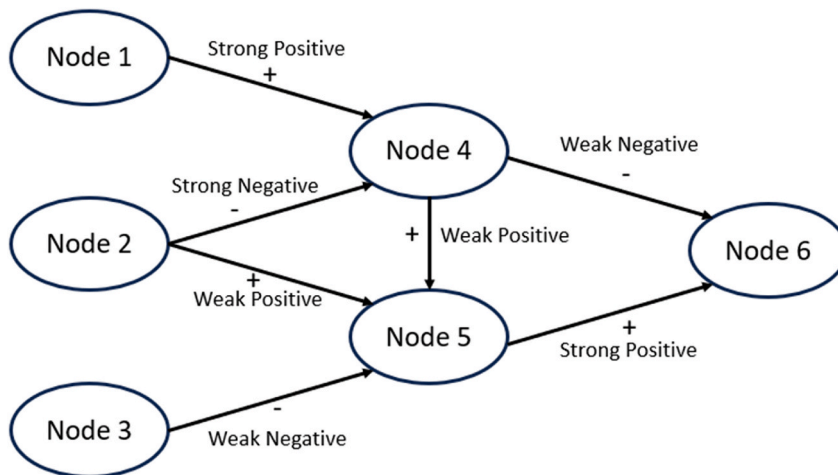
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

APPENDIX A. Interview guidelines

This material was presented to the experts at the beginning of the interviews. The research team presented the visual elements to the experts with verbal explanations following the semi-structured format of face-to-face interviews with a set of questions/topics to guide the discussion.

Title of the interview: “Mental Map of Organizational Culture and Leadership Style in Spanish Hospitals: Effects on Knowledge Management and Efficiency”

- What is the objective of this interview? (Explain)
- What kind of results will we get from this exercise? (Explain)



- What is its applicability?
 - Offering useful insights and advice for Spanish hospitals by investigating the connection between organizational culture, leadership styles, knowledge management, and hospital efficiency.
 - Understanding how hospital culture and leadership styles can impact knowledge management and hospital efficiency.

Visualize ...

Hospital efficiency is defined as using their resources for the best product and services in comparison to their competitors. An analysis of prior research found the following list of factors that might affect hospital efficiency.

- Nature of processes: formal or informal. Formal processes are characterized by high degrees of stability, order, and control, while informal processes involve a higher degree of flexibility and autonomy. In the development of the FCM, and to identify the sign and

relevance of the relationships, values close to 1 of this variable will be associated with the existence of informal processes while values close to 0 will represent the existence of formal processes.

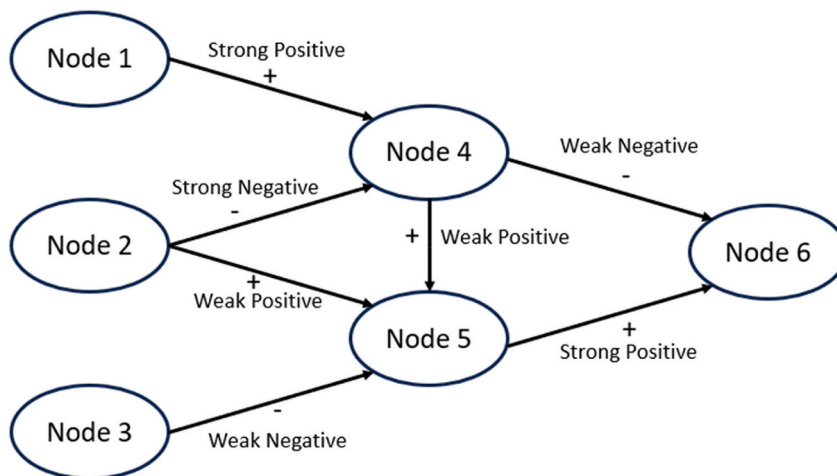
- Strategic approach: internal or external. This contrasts internal integration, which gives less attention to market changes, with external integration, which emphasizes adaptation to the environment. In the development of the FCM, and to identify the sign and relevance of the relationships, values close to 1 of this variable will be associated with an external strategic orientation while values close to 0 will represent an internal strategic focus.
- Charisma. A natural quality that a leader possesses to attract individuals solely through their presence, actions, or words. In the development of the FCM, and to identify the sign and relevance of the relationships, values close to 1 of this variable will be associated with a strong presence and values close to 0 with a weak presence of charisma.
- Benevolence. The way of behaving and the character of a leader that make them more understanding towards those around them, seeking well-being for themselves and others. In the development of the FCM, and to identify the sign and relevance of the relationships, values close to 1 of this variable will be associated with a strong presence and values close to 0 with a weak presence of benevolence.
- Authority. The attitude of leaders who explicitly exercise the power they have over those around them. In the development of the FCM, and to identify the sign and relevance of the relationships, values close to 1 of this variable will be associated with a strong presence and values close to 0 with a weak presence of authority.
- Creation and identification of knowledge. The hospital's capacity to create new knowledge, as well as to identify the relevant and necessary knowledge that exists within it. In the development of the FCM, and to identify the sign and relevance of the relationships, values close to 1 of this variable will be associated with a strong presence and values close to 0 with a weak presence of creation and identification of knowledge.
- Knowledge exploitation. The hospital's capacity to describe, represent, organize, and apply knowledge, as well as to share knowledge among its members. In the development of the FCM, and to identify the sign and relevance of the relationships, values close to 1 of this variable will be associated with a strong presence and values close to 0 with a weak presence of knowledge exploitation.

These preliminary factors that emerged from the literature review can be used as the study's starting points. However, according to your experience, expertise, and perception, what are the additional organizational factors that might affect knowledge management and hospital efficiency?

Write down additional concepts and elements that come to your mind in relation to organizational factors that might affect knowledge management and hospital efficiency. Define them in a few words.

-
-
-
-

With all these elements, create a map/network:
 Place hospital efficiency in the right side of the paper.
 Connect this to others and identify connections between them.
 Identify the sense of each connection: positive (+) or negative (-)
 Example.



For this part of the exercise, get a pen or pencil of a different colour to the first one.

Set weights for each connection between -7 and $+7$:

Weights refer to the importance of the cause-effect relation between those two elements. In other words, on a scale from -7 to $+7$, how much influence does the first element have over the second? For this, identifying one reference connection and setting the weights of the others in comparison to that one can be a good choice.

Once your map has been finished, we will repeat the process to make some refinements to earlier iterations of the map if you consider it necessary.

Thank you very much for your cooperation and support.

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