Change Management in Hospital Digital Transformation: Roadmap to promote the Humanization and Efficiency through Technology

Juliana Basulo-Ribeiro[1, *], Francisco Rocha-Gonçalves[2], Alberto Freitas[2, 3] and Leonor Teixeira[1]

[1] Department of Economics, Management, Industrial Engineering and Tourism (DEGEIT), Institute of Electronics and Informatics Engineering of Aveiro (IEETA), Intelligent Systems Associate Laboratory (LASI), University of Aveiro, 3810-193 Aveiro, Portugal;
[2] Department of Community Medicine, Information and Health Decision Sciences (MEDCIDS), Faculty of Medicine, University of Porto, Porto, Portugal
[3] CINTESIS - Center for Health Technology and Services Research, Faculty of Medicine, University of Porto, Porto, Portugal

* Corresponding author (basulojuliana@ua.pt)

Abstract:

Background and Objective: Digitalization offers promising solutions for improving efficiency and accessibility in healthcare. However, it is crucial to balance digital advancements with humanization. This study aims to help digital transformation in healthcare by striking a balance between the technological/digital and human components, by proposing a roadmap for digital transformation focused on people and their culture.

Methods: To achieve this goal, an initial theoretical investigation was carried out, which allowed the preliminary version of the roadmap to be drafted, considering the concerns and solutions reported in the literature. Next, and based on the preliminary version of the roadmap, an empirical study was conducted based on interviews with Portuguese hospital managers, to gather a practical perspective of existing initiatives in the hospital environment. These allowed improvements to be made and the preliminary roadmap to be supplemented based on practical knowledge.

Results: The issue of the human component is something that managers recognize as a fundamental aspect in processes of paradigm shift to digital, which shows the need for a roadmap such as the one described in this paper.

Conclusion: Thus, it can be concluded that, for the digital transformation to be successful, it is essential to use an integrated strategy, considering technology, processes and people, within the organizational culture, an equally important aspect. Theoretically, this study contributes to advancing the literature on change management and digital transformation in the healthcare context. Practically, it offers a management tool-a roadmap - to guide healthcare organizations in initiating or continuing their journey toward digitalization.

Keywords: Healthcare; Digital Health; Digital transformation; Industry 5.0; Humanity; Change management

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.

Acknowledgements

This work was supported by Portuguese funds through the Institute of Electronics and Informatics Engineering of Aveiro (IEETA) (UIDB/00127/2020) funded by national funds through FCT - Foundation for Science and Technology.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Change Management in Hospital Digital Transformation: Roadmap to promote the Humanization and Efficiency through Technology

Abstract:
Digitalization offers promising solutions for improving efficiency and accessibility in healthcare. However, it is crucial to balance digital advancements with humanization. This study aims to help digital transformation in healthcare by striking a balance between the technological/digital and human components, by proposing a roadmap for digital transformation, prioritizing people and organizational culture. An initial theoretical investigation guided the preliminary roadmap, addressing concerns and solutions from the literature. Then, an empirical study was conducted through interviews with Portuguese hospital managers, offering practical insights into hospital digitalization initiatives. These findings refined the roadmap with real-world perspectives. The issue of the human component is something that managers recognize as a fundamental aspect in processes of paradigm shift to digital, which shows the need for a roadmap such as the one described in this paper. Thus, it can be concluded that, for the digital transformation to be successful, it is essential to use an integrated strategy, considering technology, processes and people, within the organizational culture, an equally important aspect. Theoretically, this study advances literature on change management and digital transformation in healthcare. Practically, it offers a management tool-a roadmap - to guide healthcare organizations in initiating or continuing their journey toward digitalization.

Keywords: Healthcare; Digital Health; Digital transformation; Industry 5.0; Humanity; Change management

1. Introduction

1.1 Background

The concept of a VUCA world, characterized by volatility, uncertainty, complexity and ambiguity that emerged after the Cold War, has given way to the notion of a BANI world (introduced by the Covid-19 pandemic), which highlights the fragility, anxiety, non-linearity and incomprehensibility of our times. This change underlines that reality is currently unpredictable and that the only certainty we have is change ("change is the new normal"(Endrejat, 2021)). (Kulinich et al., 2023)

The accelerated urbanization of the global population poses considerable challenges to conventional health systems, making the task of meeting citizens' needs progressively more challenging (Bhushan et al., 2020). Thus, Health 4.0 is emerging as a crucial element in future socio-economic planning, promoting multiple benefits for the health system (Ciasullo et al., 2022).

In the European context, and particularly in Portugal, digitalization is being promoted as a solution to make the health sector more efficient and accessible, potentially generating significant economic benefits (Computerworld Portugal, 2023). However, Huaytan et al. (2024) point out that any digital transformation strategy must be comprehensive and coordinated, encompassing technological, regulatory, educational and financial aspects. The realization of smart health depends on various components, such as smart ambulance systems, smart hospitals, wearable devices and emergency response (Xie et al., 2019), enabling connected medical devices and smart systems to promote diagnostics, health monitoring and well-being (Bhushan et al., 2020).

So, digitalization has emerged as a promising "remedy" for increasing efficiency and accessibility in the health sector. However, it is necessary to digitize healthcare without losing humanity. According to Chaabi (2022), the focus of Industry 4.0 is the automation of processes and the integration of new technologies, but in contrast, Industry 5.0 shifts the emphasis to a human-centred model, repositioning human workers at the center of the production process (Callari et al., 2024).

Like Feki and Boughzala (2015) state, "digital transformation is more than just technological change". Digital transformation in healthcare is therefore a phenomenon that goes beyond mere technological change; it is a reconfiguration of the practices and structures that form the heart of healthcare. We are witnessing an evolution that changes the way healthcare is designed, delivered and managed. The COVID-19 pandemic has accelerated this process, highlighting the urgent need for innovation and the adoption of new ways of providing health services, facilitating diagnoses and ensuring data analysis, as the study by Dal Mas et al. (2023) and the study by Megawati et al. (2024) illustrate.

Furthermore, Wanasinghe et al. (2021) discuss the concept of Human-Centered Digital Transformation, emphasizing the importance of prioritizing the human element in digital initiatives. These insights highlight the need to incorporate human-centered principles on the path to digital transformation in healthcare to ensure that the needs, competencies and perceptions of healthcare professionals and stakeholders are adequately addressed throughout the process (Esmaeilzadeh, 2022). In line with this topic, research by Jarva et al. (2022) highlights the importance of healthcare professionals' perceptions of digital health competence, emphasizing the importance of understanding and addressing the skills and competences required for a successful digital transformation.

The centrality of the human being in digital transformation is not only an ethical issue, but also a strategic one. Cutting-edge technologies, no matter how advanced, need a human touch to ensure that they are effectively adopted and that they really add value to processes in the specific context of healthcare. This means creating systems that are intuitive, accessible and that improve interaction between healthcare professionals and patients. Thus, this balance between technology and humanity is fundamental to building trust and for digitalization to be truly transformative. Adopting practices that promote digital inclusion, ensuring that all healthcare professionals have the necessary skills to use the new technologies, is a crucial step in this process (Golinelli et al., 2020). In this way, it can be ensured that hospital digital transformation is carried out in an inclusive and equitable manner, paving the way for more personalized and patient-centered healthcare. (Gomathi & Mishra, 2023; Haleem & Javaid, 2019; Selvam et al., 2023)

We are moving towards a society 5.0, which aims to address social issues to raise people's standard of living. Achieving this goal will be facilitated by technology and the transition to a socio-economic system that prioritizes the recognition and appreciation of human and environmental capital, to the detriment of the constant search for profits. (Nota et al., 2023). As mentioned by Ciasullo et al. (2022) the concept of Health 4.0 establishes a model for the provision of health services that is consistent with the principles underlying Society 5.0. In this context, Health 4.0 aims to involve professionals and users in making the most of the intellectual capital available to healthcare organizations, with the aim of structuring health promotion and risk prevention services that are consistent with a patient-centred approach to care (Gravili et al., 2021). To achieve this goal, hospitals must adapt to this paradigm shift, and it is crucial to understand how the challenges associated with adopting new technologies in the hospital environment can be mitigated.

Angerer et al. (2022) state in their study that for this paradigm shift to digital in the hospital context to be successful, close collaboration between managers and

technology specialists is essential, focusing not only on technology, but also on its implications for the strategic and operational management of healthcare entities. As a result, it was concluded that hospital digital transformation requires a holistic approach that transcends the simple implementation of new technologies. A well-defined strategy that integrates technological innovation with healthcare processes, organizational culture and the patient experience itself is essential.

1.2 Study Motivation

As we've seen so far, it's common sense that digital transformation brings benefits in general to all areas, especially in the health sector, not only for the patients themselves, but also for health organizations (both on the "demand" and "supply" side).

The results of a previous study based on interviews with 11 health professionals (Basulo-Ribeiro & Teixeira, 2024) reinforced the importance of this research, contributing to the motivation behind this study. In that study, health professionals stated:

- ⇒ That resistance to change on the part of health professionals and low digital literacy are the most common challenges that usually prevent technological adoption in the health sector is also argued by several other studies (Golinelli et al., 2020; Gomathi & Mishra, 2023; Safi et al., 2018).
- ⇒ The study also showed that, for the digital transformation to be successful, it is imperative to have multidisciplinary collaboration between the various health professionals and IT professionals, to optimize the use of these technologies in the provision of health care, thus emphasizing the importance of people, as it is recognized by (Nieboer et al., 2014).
- ⇒ Correctly identifying the problems to be solved implies working on processes to develop robust and effective technologies from the point of view of improving health outcomes and the efficiency and effectiveness of services.

Therefore, for the digital transformation to take place in the best way, a balance is needed between 3 essential pillars: people, processes and technology, guided by cultural aspects, which also reinforces the importance of studying culture. As highlighted by Gomathi & Mishra (2023) in their study, the interaction between humans and technology aims to improve the efficiency and effectiveness of production processes. Furthermore, according to Paul & Zhou (2017) "Having the right balance of people, process, and technology has always been the key to the success of any transformation and the core of company competitiveness, as well as the innovation capability".

People and processes are often (mistakenly) "neglected" during this shift to digital, despite being crucial elements of this transformation, as highlighted by the healthcare professionals interviewed. So it is in this area that this article aims to contribute, with a tool that makes it possible to manage the digitalization process while keeping people at the heart of development. In line with this thinking, Gilli et al. (2024) state in their study that, more than technology, people and their culture drive digital transformation. Furthermore, according to Konttila et al. (2019) health sector organizations must focus on social dynamics in the workplace and foster a positive environment to improve their adaptability to digital transformation.

Thus, the need for a guide-to-guide digital transformation strategies, focused on people and leveraged by processes, can facilitate the adoption and adaptation to new technologies in the hospital environment, and this challenge is the subject of this study (see Figure 1).

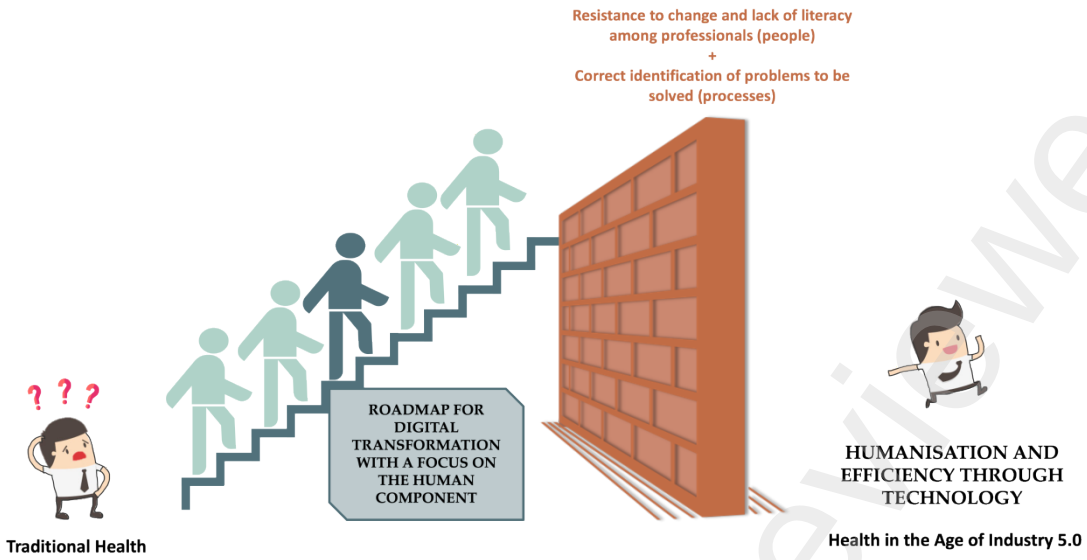

Figure 1. Study motivation.

2. Theoretical Background

2.1. Organisational Culture Management and Organisational Behaviour

Organizational culture, defined as a system or set of values, beliefs and behaviors (feeling, thinking, acting, ...) that shape the way members of an organization interact with each other and with the outside world, is a crucial factor in operational success (Gaspar et al., 2023; Mannion & Davies, 2018a; Tsai, 2011). "Culture is to the organization what personality is to the individual". (Van Der Post et al., 1997)

On the other hand, everyone brings with them a set of beliefs, which are shared between different individuals through social interaction (Castellano as cited in Ellinas et al., 2017). These beliefs may or may not be shared by everyone, however, according to Grabovetter (Ellinas et al., 2017) individuals are predisposed to change their minds if a larger group around them holds that other belief.

Furxhi (2021) points out that employees' reactions to change are fundamental, since they are the ones who implement it. On the one hand, a (negative) culture that shows readiness for change or resistance to change and remains attached to outdated procedures can hinder the process of change in the organization. Some authors argue that resistance to change can be as much an organizational and group issue as an individual one and is caused by factors such as: fear of the unknown, lack of communication and involvement, and bureaucratic organizational structures. (Furxhi, 2021; Hubbart, 2023) On the other hand, a positive organizational culture, which values continuous improvement, innovation and collaboration, can facilitate the implementation of practices that lead to desirable operational outcomes, such as the efficiency and effectiveness of operations. (Gaspar et al., 2023)

Organizational culture influences employee motivation and satisfaction, organizational performance and cognitions, having a direct impact on organizational behavior. (Ellinas et al., 2017; Heritage et al., 2014) Organizational behavior can be defined as: the field of study that seeks to investigate how the individual behavior of each individual impact's behavior within the organization, in order to increase operational efficiency. (Heinitz et al., 2018; Yaakobi & Weisberg, 2020) The dedication and involvement of people within an organization is crucial for operational excellence, so it is important to create a work environment that motivates employees (Kumari et al., 2022).

Thus, it is important to develop a culture that values not only social aspects, but also cognitive ones, creating an environment that encourages positive and productive behaviors, such as: helping colleagues, being punctual, and following company rules in a way that promotes a positive and efficient work environment (Ellinas et al., 2017; Heritage et al., 2014; Yaakobi & Weisberg, 2020).

The effective management of organizational culture is a complex and multidimensional challenge faced by leaders and managers. With the growing understanding that an organization's culture can be a catalyst or inhibitor to its success, the need to adopt robust cultural management models has become imperative.

Van Der Post et al. (1997) identified 15 culture constructs in their study which allow it to be measured: Conflict resolution; Culture management; Customer orientation; Disposition towards change; Employee participation; Goal clarity; Human resources orientation; Identification with organization; Locus of authority; Management style; Organization focus; Organization integration; Performance orientation; Reward orientation; Task structure.

There are several models in the literature that measure organizational culture. However, the literature points to several difficulties in measuring organizational culture, as it is complex and multifaceted, including: the concept of organizational culture is made up of a huge set of interrelated norms; a lengthy process because it has several levels; selection bias can occur, triggered by the attempt to convey a positive image of the company (even if it is not entirely true); and the lack of construct validity of existing scales. (Chatman & Choi, 2019; Ellinas et al., 2017; Helfrich et al., 2007) Table 1 shows some of the organizational culture management models in the literature.

Table 1. Organizational culture management models.

MODEL	EXPLANATION	CITATIONS
Edgar Schein's Organizational Culture Model	Model using 3 levels of cultural analysis: 1. *Artifacts*: The tangible elements of a company's culture. They include things from the physical layout of a workspace to the dress code, and can extend to company rituals, the way employees interact and even company slogans. Although these are the most visible aspects, they can be difficult to interpret because their cultural significance is not immediately apparent. 2. *Expressed values*: This layer concerns the expressed values and norms that are communicated verbally within an organization. These represent the ideal culture that the organization strives to achieve and are the justification for certain behaviours or practices. 3. *Basic assumptions:* This deeper level consists of unconscious beliefs and values that truly define the essence of the organizational culture. They dictate behavior, perception and thinking and are therefore the most difficult to change. To understand how a company behaves, you need to understand these assumptions.	(Sarros et al., 2005; Schein, 1983; Singaram & Mayer, 2022)
Denison Organizational Culture Model	Model focused on 4 cultural traits, interconnected with the organization's performance: 1. *Mission:* Clarifying the organization's purpose and direction through vision, goals and objectives. 2. *Consistency:* Capturing the organization to coordinate activities, reach agreement and integrate efforts. Includes core values, agreement and coordination. 3. *Involvement:* Capturing the organization to encourage team orientation and develop employees' skills. 4. *Adaptability:* The organisation's ability to translate external changes into action, highlighting the importance of customer focus, organizational learning and creating change.	(Denison et al., 2014; Sarros et al., 2005; Vargas-Halabi & Yagüe-Perales, 2023)

O'Reilly, Chatman & Caldwell's Organizational Culture Profile (OCP)	Instrument capable of measuring 7 dimensions of organizational culture, related to the values and norms of the organization: 1. *Innovation:* Reflects a culture that emphasizes novelty and creativity. 2. *Outcome orientation:* Focuses on results and achievements, highlighting a culture that values performance and meeting objectives. 3. *Aggressiveness:* Characterizes a culture that is competitive and motivated, often focused on outperforming competitors. 4. *Detail orientation:* Denotes a culture that values precision, analysis and attention to detail. 5. *Team orientation:* Indicates a culture that values collaboration, teamwork and a sense of unity among employees. 6. *People oriented:* Describes a culture that values fairness, support and respect for the individual. 7. *Stable:* Relates to a culture that emphasizes consistency, predictability and maintaining the status quo.	(O'Reilly et al., 1991, 2014; Sarros et al., 2005)
The Competing Values Framework by Cameron and Quinn	A model that divides organizational culture into 4 main types, spread over 2 axis (stability and flexibility): 1. *Clan culture:* In this type of culture, group cohesion and morale are priorities, facilitating the development of human resources. 2. *Culture of Adhocracy:* This culture emphasizes innovation as a way of growing and adapting to the constant changes in the market. 3. *Market Culture:* Focuses on competition and achieving results, with an emphasis on clear and targeted goals and objectives. 4. *Hierarchical Culture:* Uses a clear and well-defined structure and procedures, with formal communication and centralized decisions to ensure efficiency, order and organizational stability.	(Gong et al., 2022; Kai Shek, n.d.; Zeb et al., 2021)

In addition to these 4 models, there are many others, such as: Culture Audit (assessment method that can include workshops, interviews, questionnaires, among others, to understand organizational culture); The Hofstede's Cultural Dimensions Theory (model that helps to understand cultural differences within the company); Organizational Culture Assessment Instrument (OCAI); among many others. (Van Huy et al., 2020; Wilkins, 1983)

These models make it possible not only to identify and understand the underlying values and rules that guide and influence people's behavior in an organization, but also to offer a strategy for involving people and applying changes that bring the culture into line with corporate goals.

The assessment and management of organizational culture in hospitals is an essential part of the healthcare system (Scott et al., 2003). This is a crucial process for understanding how current beliefs and behaviors reinforce or hinder the achievement of patient care goals and operational efficiency. This cultural assessment, more than a measurement of employee satisfaction, is a comprehensive diagnosis that seeks to align daily practices with the goals of the health service. By identifying behavioural patterns and underlying values, hospital leaders can implement changes that not only improve the patient experience, but also optimize processes, leading to improvements in performance and organizational performance. (Linnander et al., 2021; Mannion & Davies, 2018a)

2.2. Outcomes in Health and Organizational Culture

The quality of healthcare is a constant concern around the world, due to the need to ensure sustainability, control costs, and promote effective, safe and patient-centered care. These measures aim to increase transparency and accountability and improve health outcomes and patient satisfaction. (Beyan & Baykal, 2012; Carini et al., 2020)

To effectively evaluate an organizational change, it is crucial to measure health outcomes, which can be classified into different groups. A WHO (2003) identified six key dimensions for assessing hospital performance: Clinical outcomes; Production outcomes; Patient centeredness; Responsive governance; Staff orientation; and Safety. The table below (Table 2) shows these same groups and the type of metrics that can be measured in each of them. This data allows adjustments to be made on an ongoing basis, to enhance the quality of health services.

Table 2. The six key dimensions of hospital performance.

Outcome Types	**Explanation**	**Metrics**
Clinical outcomes	It refers to the efficient use of resources to optimize health outcomes, guaranteeing the correct application and safety of the care processes themselves.	Technical quality, evidence-based practice and organization, health improvement and results (both individual and patient-related).
Production outcomes	Effective and optimized allocation of available health resources to maximize clinical and operational results, which improves productivity and capacity utilization within the hospital structure. Specifically, it covers the adequacy of the services provided, the effectiveness of clinical processes, and an organizational structure that supports these same processes.	Resources and financial component (financial systems, continuity, additional resources), more highly qualified staff and the use of state-of-the-art medical equipment, technology and techniques.
Patient **centeredness** or Focus on patient	It assesses the orientation towards patients and their families, gauging whether patients are at the center of the delivery of care and services.	Availability to patients: focusing on the client (immediate attention, access to social assistance, quality service provided, selection of service provider), patient satisfaction and patient experience (dignity, confidentiality, autonomy, communication).
Social **accountability** or Responsive governance	It assesses the degree of response to the needs of the community, to ensure continuity and coordination of care, promote health and provide care for all citizens.	Community orientation (response to needs and demands), access to resources, continuity, health promotion, equity, ability to adapt to the growing demands of the population (strategically).
Staff orientation	Meeting the growing demand for human resources, implementing incentive strategies to retain qualified professionals, such as doctors and nurses, and providing a safe and supportive working environment for their professional development. All of this includes: ensuring equitable access to continuing medical education, recognizing individual needs, promoting health and implementing effective safety measures.	Health, well-being, satisfaction, development (e.g. turnover, vacancies, absence)
Safety	Assess whether patients are satisfied with medical services and whether providers are aware of the need to establish effective collaboration with the hospital, within an efficient organizational structure. This applies to both patients and healthcare professionals, emphasizing the ability to avoid, prevent and minimize interventions harmful to them or environmental risks.	Safety of patients and providers, structure and process

Adapted from: (WHO, 2003) | Information taken from: (Beyan & Baykal, 2012; Carini et al., 2020; Ioan et al., 2012; Veillard et al., 2005; WHO, 2003)

As seen above, organizational culture is crucial within an organization and plays a critical role in determining health outcomes (key performance indicators) (Jia et al., 2018).

A strong culture that values collaboration, innovation and commitment can positively influence operational efficiency, patient satisfaction and staff motivation. Furthermore, it is possible to state that in environments where transparent communication, mutual support and continuous learning are encouraged, there is a greater likelihood that processes will be optimized and errors minimized, thus improving clinical outcomes. (Ayanaw et al., 2023; Bø Lyng et al., 2023; Jia et al., 2018; Mannion & Davies, 2018a; Murray et al., 2024). Mannion & Davies (2018a) even point out that organizational culture is often cited as the culprit when health scandals arise, and cultural change is also prescribed as a remedy to solve the problems.

Therefore, investing in organizational culture not only boosts overall performance, but also promotes an environment where professionals feel valued and, consequently, patients receive higher quality care. For this very reason, organizational culture is a crucial vector for driving significant improvements in overall health and well-being. (Ayanaw et al., 2023; Bø Lyng et al., 2023; Braithwaite et al., 2017; Mannion & Davies, 2018b; Mutonyi et al., 2022)

Thus, it is possible to conclude that understanding and shaping organizational culture is essential for healthcare leaders seeking to improve operational results and promote a more effective and safer work environment. Braithwaite et al. (2017) suggests that healthcare administrators and policymakers should focus on cultivating and promoting positive organizational cultures to improve hospital performance.

2.3 Change management

Change management is the method adopted by an organization with the aim of recognizing new demands and/or limitations imposed by the external environment and adapting to them. It also involves determining the strategic and operational initiatives considered crucial to optimizing organizational performance. It also encompasses planning, executing and evaluating appropriate initiatives to ensure the continued success of the organization. (Recardo Ronald J, 1995).

Lichem-Herzog & Sorko (2024) argues that without a well-defined plan, companies have difficulty in change processes. Gilli et al. (2024) states in their study that the digital transformation is no different from other changes at the organizational level, arguing that existing knowledge about change management is applicable to the introduction of the digital paradigm.

Hubbart points out that an organization's culture significantly influences its agility and ability to adapt to changing operations, which are crucial to operational success, further stressing that resistance to change is not only a barrier, but also an instinctive reaction that can be mitigated through proactive leadership and inclusive practices (Hubbart, 2023).

It is therefore essential to understand the causes of employee resistance so that managers can design effective change processes that achieve the desired results. In this context, Prosci identifies organizational culture as one of the main causes of resistance to change, including aspects such as risk-averse cultures, past negative experiences with change, and issues of mistrust between departments and hierarchical levels. (Creasey, n.d.). Furthermore, as stated by Hubbart (2023) the sources of resistance to change among workers include scepticism and insufficient confidence, emotional reactions, apprehension of failing, ineffective communication and time constraints. More are identified: expectations generated from previous experiences, leaving the comfort zone which can generate discomfort, fear of change (Caliskan & Gokalp, 2020; Endrejat, 2021)

The literature presents a series of strategies aimed at developing the culture of organizations, reducing resistance to change and, consequently, improving operational results (Furxhi, 2021; Hubbart, 2023). These techniques involve both the understanding and harmonization of corporate values and practical measures for the continuous improvement of operational processes. Thus, effective strategies for overcoming this resistance and managing change emphasize the importance of transparent communication, the participation of all people in decisions related to change, the alignment of organizational culture and structure with the desired change, and an active leadership role to mitigate employee resistance to change (Creasey, n.d.). Below are different strategies for successful change:

- Effective Communication: It is essential to clearly communicate the purpose, benefits and expected impacts of the changes to be implemented, as this can help align employees with organizational objectives and reduce resistance to change (an inhibiting factor). Furthermore, according to Lichem-Herzog & Sorko (2024) "70% of all change processes fail due to the lack of a clear goal and a systematic approach to change". (Hubbart, 2023; Recardo Ronald J, 1995)
- Participation and involvement: It is crucial to involve employees in the change process, from planning to implementation, so that acceptance and commitment to the proposed changes can be increased. Involving employees in change initiatives can lead to a greater sense of ownership and stronger alignment with organizational goals. Collaboration and cooperation between people is essential for change to be successful, and the transition must take place in an environment of dialogue, trust and reciprocal agreement, rather than being unilaterally imposed on the members of the organization. (Hubbart, 2023; Laidoune et al., 2022; Long et al., 2024; Ricks, n.d.; Sartori et al., 2018)
- Training and development: Training and development serve to empower employees with the skills necessary for change, enabling people to be effective in the workplace. Providing adequate training can help people feel less threatened and more prepared for change, facilitating this transition. (Laidoune et al., 2022; Sartori et al., 2018)
- Supportive leadership: Leaders who demonstrate support during the change process and who are committed to continuous improvement can positively influence organizational culture, encouraging acceptance and adaptation to new practices. (Gilli et al., 2024; Hubbart, 2023; Laidoune et al., 2022; Long et al., 2024)

When organizations are successful in their change processes, they see effort and dedication from their people to the new guidelines, experience fewer fluctuations in productivity throughout the implementation phase and achieve the completion of changes in considerably shorter periods of time. (Recardo Ronald J, 1995). We can therefore conclude that there is a relationship between effective change management and health outcomes.

2.3.1 Main Change Management Models

Change management is therefore a methodology that combines strategies and tactics to promote and facilitate effective change processes (Bader et al., 2023). There are various methods used to facilitate change in an effective and sustainable way. Errida & Lotfi (2021) analyzed 37 organizational change models in their study. Below is a table (Table 3) with 3 example models.

Table 3. Change management models.

MODEL	EXPLANATION	CITATION

ADKAR	The ADKAR approach serves as an effective strategy for managing changes within organizations. Each of the five phases are: • *Awareness:* Understanding the need for change and the benefits of this change; • *Desire:* Foster a personal commitment to support and get involved in change, creating the desire to change; • *Knowledge:* Providing the information and training needed for change, understanding the needs of professionals; • *Ability:* Developing the skills and behaviors needed for change to take place; • *Reinforcement:* Ensuring that change is sustained through positive reinforcement and support, i.e. providing support during the new stage (ensure that the new practices are sustained and are part of the organization's culture)	(Bader et al., 2023; Boca, 2013; Hiatt, 2006; Paul & Zhou, 2017)
Kotter	Kotter proposes an eight-step model to guarantee a successful change process: 1. *Establish a sense of urgency*: Communicate the immediate need for change. 2. *Form a guiding alliance*: Bring together a group with the power and influence to lead the change. 3. *Develop the vision and strategy*: Create a clear vision for the change and strategies to achieve it. 4. *Communicating the vision of change*: Ensuring that the vision is transmitted and understood by everyone in the organization. 5. *Empower large-scale action*: Remove obstacles and enable people to act in line with the vision. 6. *Celebrate short-term victories*: Plan and achieve quick results that reinforce the change process. 7. *Consolidate gains and produce more change*: Use the credibility gained to change systems, structures and policies that don't align with the vision of change. 8. *Sustaining the new approaches in the organizational culture*: Ensuring that the new practices are maintained and become part of the organizational culture.	(Bader et al., 2023; Errida & Lotfi, 2021; Kotter, 1995)
Lewin	Lewin's model is considered the theoretical basis for change management. This model involves three main stages: 1. *"Unfreezing":* involves destabilizing the current state to foster recognition and support for the need for change, preparing the ground for the new way of operating. 2. *"Transition":* refers to implementing the planned changes, moving towards the desired state. 3. *"Refreezing":* takes place after the changes have been implemented, solidifying the new organizational culture with the new behaviours and practices.	(Burnes & Bargal, 2017; Coghlan, 2021; Errida & Lotfi, 2021)

Other change management models include: The Change Formula of Beckhard and Harris; McKinsey's 7-S Framework; Bridges' Model of Transition; Garvin and Roberto's change model; General Electric's change model; and much more, many of which are combinations of each other. (Errida & Lotfi, 2021; Gutiérrez-Iñiguez et al., 2023)

2.3.2 The ADKAR model

Of the various models presented, ADKAR has proven itself in the literature as a tool for managing change in digital transformation, and therefore seems to be in line with the context of this study.

In healthcare, change management is even more crucial due to the specialized nature of clinical work and the complexities inherent in the sector. This area is fundamentally about people, from healthcare professionals to users, which further exacerbates issues of resistance to change and sometimes, given the diversity of people involved, a lack of digital literacy. Digital transformation requires adapting traditional methods, which can be a challenge as it not only alters the provision of care, but also requires new skills. Therefore, the adoption of change management methodologies is

essential to facilitate a smooth transition to these new practices and to fully reap the benefits of digitalization.

In his study, Chaabi (2022) used the ADKAR methodology, combined with another, to establish a roadmap for implementing I5.0 in the context of industry. Also, in a study by Babin & Ghorashy (2019) the authors conclude that incorporating the ADKAR model into the change management process significantly improved the success of their innovation initiatives. Specifically, they found that integrating structured change management using this model during the implementation of digitalization initiatives led to better acceptance and understanding of the change by the entire organization, highlighting the importance of addressing the human side of change to ensure the successful adoption and sustained benefit of new technologies. The author of the model himself writes in his book: "the model provides a Framework and sequence for managing the people side of change".

ADKAR, a model developed by Hiatt (2006) is an acronym representing a structured approach for organizational change management, guiding individuals, and teams through five sequential phases: Awareness, Desire, Knowledge, Ability, and Reinforcement, facilitating a gradual and successful transition to desired changes within a company or project. (Boca, 2013). According to Paul & Zhou (2017) the ADKAR approach serves as an effective strategy for managing changes within organizations, offering a roadmap to assess and rectify resistance, with a focus on planning and executing tailored actions that underpin effective change and ensure the achievement of goals. According to (Boca, 2013) each of the five phases:

- **Awareness** - Understanding the need for change and the benefits of this change;
- **Desire** - Foster a personal commitment to support and get involved in change, creating the desire to change;
- **Knowledge** - Providing the information and training needed for change, understanding the needs of professionals;
- **Ability** - Developing the skills and behaviors needed for change to take place;
- **Reinforcement** - Ensuring that change is sustained through positive reinforcement and support, i.e. providing support during the new stage.

Figure 2 shows each of the phases of the ADKAR methodology.

Digitalization is accepted by healthcare professionals when they understand that it helps to improve the quality of care and supports workflow processes. However, negative experiences, together with a lack of competence, cause frustration and a lack of desire to integrate the digital transformation process. (Konttila et al., 2019) Effectively managing the complexity inherent in digital transformation requires focusing on the mindset and skills of employees. The necessary changes in processes, technologies and strategies can be achieved through training and professional development initiatives, internal communication, and systems that recognize and reward achievements. (Romero et al., 2019)

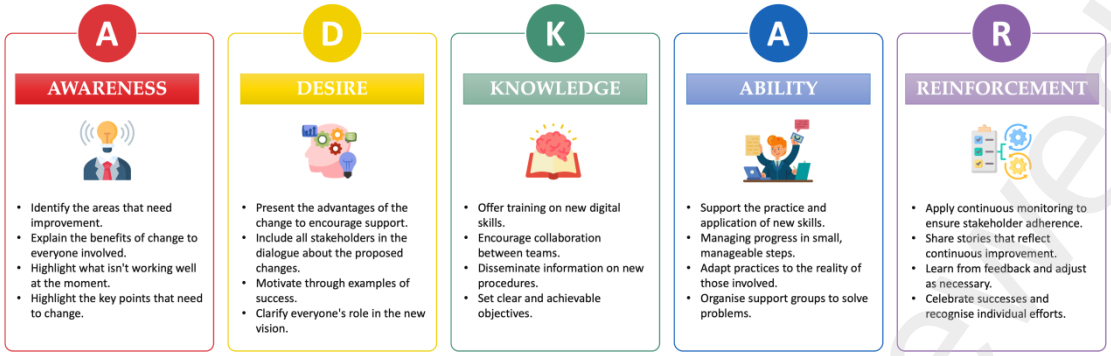

Figure 2. ADKAR methodology.

3. Methods

3.1. Aims and Goals

This paper aims to propose a roadmap for a digital transformation strategy focused on the human component and their culture, which constitutes a change management tool. This roadmap is designed to support hospitals and healthcare sector in general in successfully navigating a paradigm shift, towards a digital transition, with a strong focus on cultural adaptation.

3.2 Methodology

To achieve the objective, a mixed method investigation was conducted, consisting of a theoretical approach and an empirical approach (see methodology in Figure 3).

In the theoretical approach, the essential components for defining a digital transformation roadmap with a focus on the human component were identified. This was drawn up based on the combined knowledge and experience of the authors, complemented by the ideas gathered from the literature review. This tool was structured to identify the essential components for a successful digital transformation in the health sector.

In the empirical approach, a group of hospital management professionals directly or indirectly involved in hospital management and digital transformation were interviewed to gather a practical perspective on existing initiatives in the hospital environment. An analysis was then made of the digital transformation strategies implemented in different Portuguese hospitals. The aim of this approach was to discover best practices and extract lessons learned that could help guide other hospitals in this paradigm shift. With the results of the interviews, it was possible to refine the roadmap initially developed through the literature and the experience of the authors.

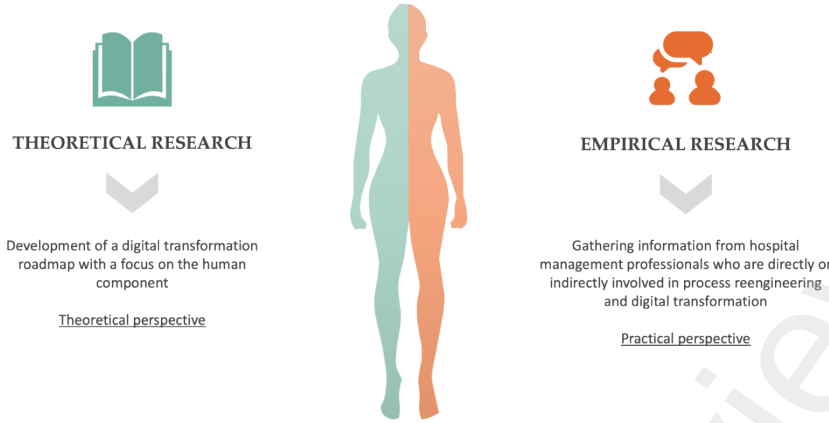

Figure 3. Methodology.

3.2.1. Data Collection Procedures

To gather information, a qualitative approach was chosen, which included semi-structured interviews with a group of experts, various hospital management professionals from various regions from the north to the south of Portugal. These interviews were carried out between May and June 2024, following pre-designed questions according to the established objective and the different phases of the ADKAR methodology, resulting in an interview script with ten questions. In addition to these questions, those introducing the interviewee and those dealing with consent to confidentiality and anonymity were also asked. Table 4 shows the objectives of each group of questions, distributed according to the ADKAR methodology.

Table 4. Objectives of each group of questions according to ADKAR methodology.

ADKAR phases	Explanation
Awareness	To identify the current state of awareness of digital transformation among hospital managers.
Desire	To understand the motivations behind pursuing digital transformation and the perceived benefits.
Knowledge	Gather information on existing knowledge and available guidelines to support digital transformation.
Ability	Explore the actions and measures taken to facilitate the adoption of digital technologies by healthcare professionals.
Reinforcement	Evaluate the metrics and KPIs used to measure the success of digital transformation initiatives.

3.2.2. Data Analysis

In order to draw conclusions from the information obtained, a thematic-categorical content analysis of the transcribed interviews was carried out. This analysis technique aims to extract meaning from texts that deal with a particular subject under study. Thus, the usual stages of content analysis were followed, which consist of: organizing the material and defining the pre-analysis procedures; identifying emerging concepts through textual interpretation during the exploration phase; and finally processing and interpreting the results.

3.2.3. Sample Characterization

Analyzing the profile of the eight interviewees, we can see a diversity of occupational, institutional and geographical profiles. Starting with the demographic data, the

predominant age range of the interviewees is between 40 and 60, suggesting solid professional experience accumulated over the years. Concerning profession, we noted a variety of leadership positions in healthcare organizations, both public and private. The presence of interviewees from both public and private institutions suggests a comprehensive view of the practices and challenges faced by the healthcare sector in Portugal, providing a solid basis for comprehensive analyses and insights into the country's healthcare system. In terms of geographical distribution, the interviewees are spread across different regions from the north to the south of Portugal, such as Porto, the Algarve, Coimbra, Lisbon and Braga, reflecting a representative sample of the country's regional diversity. Additionally, the interviewees were chosen because of their existing experience in digital transformation, helping to provide valuable insights into the challenges and best practices in this process. The sample was selected for convenience. Table 5 shows the profile of each of the interviewees.

Table 5. Profile of the interviewed individuals in general management positions.

Designation	Region	Regime (Public/Private)	Profession	Age
M1	Porto	Public	Director of the Data Intelligence Service	40-50
M2	Porto	Private	Hospital Director	50-60
M3	Algarve	Public	Chairman of the Board of Directors	40-50
M4	Coimbra	Public	Chairman of the Board of Directors	40-50
M5	Coimbra	Public	Hospital Administrator	50-60
M6	Porto	Public	Executive Board Member	40-50
M7	Lisbon	Private	Director at Value based Healthcare	40-50
M8	Braga	Public	Chairman of the Board of Directors	40-50

4. Results

This section is divided into 2 different subsections. The first one shows a roadmap that was developed based on insights from the theoretical investigation. The second part presents the same roadmap with some adjustments coming from the empirical investigation.

4.1 Roadmap for digital transformation with human focus with theoretical investigation

As mentioned before, to establish a roadmap for digital transformation, it is crucial to recognize the pivotal role of human resource practices in implementing such strategies.

A fundamental component of digital transformation is establishing, enhancing and nurturing a Digital Culture "understood as a set of values and characteristic behaviors, at personal and organizational levels, driving new digitally enabled ways of thinking, working and interacting with the customer, among employees and business units, and with new digital tools" (Romero et al., 2019). So, being careful about people and their feelings regarding this transition is necessary.

Taking into account the insights gleaned from the literature, it was possible to come up with a preliminary version of a roadmap for digital transformation focusing on the human component, which includes six phases (see Table 6).

Table 6. Roadmap phases.

PHASES	EXPLANATION

I	5 lean principles to the hospital	The five Lean principles are employed in the healthcare sector to enhance patient value by engaging in continuous improvement. This is accomplished by aligning with patient needs, cutting down on waste, and bolstering the efficiency and effectiveness of healthcare delivery (Acero et al., 2023).
II	Gap between what is real and what is desired	By defining the ideal, it is possible to understand the gap between what is real (where we are) and what is desired (where do we want to go?). At this stage, process improvement is considered a key factor in achieving the goal of adding value to the patient.
III	Which processes to digitalize	During this change, it is imperative to understand which of the processes to be improved and digitized will have the greatest impact, considering not only the organization's long-term vision, but also the resources available (human, investment, time, etc.). These will be the priority processes. (Basulo-Ribeiro et al., 2023)
IV	AS-IS and TO-BE processes	Next, the modeling of processes selected in the previous step should be carried out in two distinct phases. It begins with mapping the AS-IS processes, which consists of recording the processes in their current form. After this stage, the TO-BE processes are defined, outlining how they should be structured in the future.(Koszela, 2016). a. When transitioning from the AS-IS model to TO-BE, it is crucial to initially adopt the Lean methodology when creating the new processes, to eliminate inefficiencies and increase their operational efficiency, thus maximizing the value provided to the patient. Acero et al. (2023) points out that Lean principles support digital transformation in healthcare. Some authors even argue that Lean can be seen as a prerequisite for introducing technology into processes, so as not to digitize waste (Dombrowski et al., 2017; Mayr et al., 2018; Ooi et al., 2023). b. Next, digitalization should be implemented as a mechanism to increase the operational efficiency of processes. This reduces errors, improves execution speed and facilitates monitoring, resulting in a more agile service. c. During this digitization process, it is crucial to understand the need for interoperability between systems, since the degree of interoperability of IS is important for assessing the hospital's degree of digital maturity. (Woods et al., 2022) d. Finally, it is essential to select Key Performance Indicators (KPIs), the operational health outcomes to monitor processes, ensuring that they reflect clear and measurable objectives, aligned with strategic objectives. Understanding and effectively communicating these KPIs is fundamental for the team, and regular analysis of the data collected is essential to maintaining the quality and efficiency of the health service.
V	Action plan	Once the foundations have been laid, it is essential to draw up a detailed action plan. This plan should articulate the steps and timelines, assign responsibilities and allocate the necessary resources. It must be ensured that the plan is flexible enough to adapt to unforeseen changes and challenges, while remaining focused on the long-term vision and the mission of adding value to the patient
VI	Change Management methodology	During hospital digitalization, it is essential to adopt change management focused on both processes and people to ensure a successful transition. Schulte et al. (2023) highlight the importance of the well-being of healthcare professionals in this complex and constantly evolving scenario. Thus, employees who remain receptive during transformation initiatives in the organization are better prepared to absorb and adopt new work concepts and methodologies (Hubbart, 2023). As mentioned in section 2.3, the change management methodology to be used is ADKAR.

Figure 4 shows the proposed change management tool, based on the theoretical research, which was the basis for the empirical study.

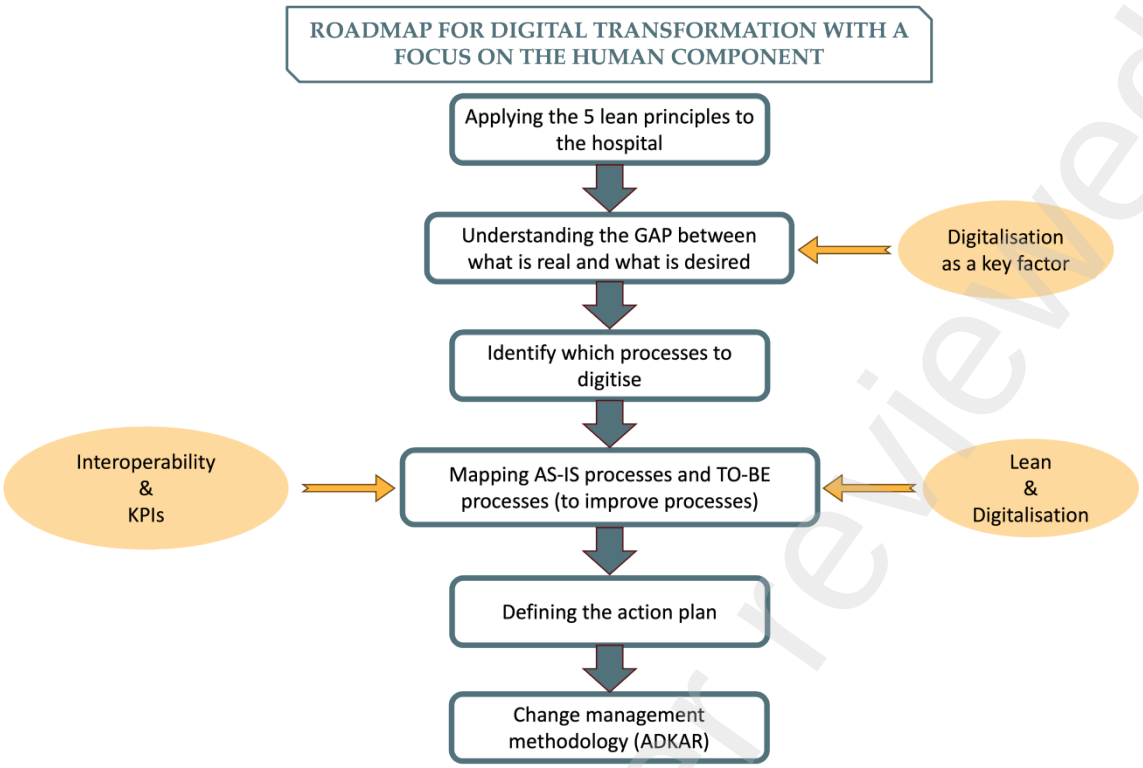

Figure 4. Initial roadmap for digital transformation strategy with human focus.

4.2 Final roadmap for digital transformation with human focus with empirical component

4.2.1. Experts' perception of a possible roadmap for digital transformation in healthcare

The interviews with hospital managers provided a practical understanding of the digital transformation strategies implemented in Portuguese hospitals, helping to improve and adapt the roadmap initially developed.

In general, the professionals agreed with the approach taken to the roadmap, highlighting and valuing the stages presented, the techniques used in each stage and the consideration of the human component. In addition, several professionals reported positive previous experiences with the Lean methodology, highlighting how its application had contributed to the mapping and optimization of processes. They also emphasized that the digitalization process was tackled efficiently within the hospital, demonstrating that the application of these practices is indeed a significant benefit for the institution. The interviewees' feedback reinforces crucial elements for the success of digital transformation in the hospital environment: the importance of managing organizational culture and continuous communication. Below are some of the topics highlighted by the managers regarding the roadmap, and the improvements/opinions they suggested.

- **Inclusion of Health Professionals (M1, M2, M4, M5, M6, M7):** The importance of including healthcare professionals from the start of the project and throughout is highlighted as an important component of the roadmap. This ensures that they accept and support the idea, understand and validate the objectives, and feel an integral part of the project. This initial involvement is crucial to the roadmap's success. [*"In the human component there are two crucial aspects - the involvement of the people who*

are going to benefit from TD is essential and we must allow these people to be on the ground and build the transformed process. They must feel that the work is well done and that they have contributed to the process; another important issue is the involvement of top management" (M4).

- **Promote the Action Plan (M2, M5, M6):** It is important to "sell" the action plan as part of the change to guarantee results. [*You must have the ability to influence, to make people see what they haven't seen yet"* (M5).

- **Organizational Culture Management (M3, M4, M5, M7):** It is suggested that the change in organizational culture occurs throughout the process, with the dissemination of positive results to facilitate the acceptance of new technologies. Bottom-up implementation can be more effective by sharing successes and improvements achieved, to trigger change in the top management of healthcare in Portugal. [*"It is crucial that the Ministry of Health recognizes and supports the importance of digitalization to facilitate a broader transformation."* (M3). *"Organizational culture is difficult to change quickly and cannot be imposed externally. Small changes can be introduced gradually but will take years to be recognized. The advent of technologies can help, but cultural change is more about the essence of the organization. The transformation of culture must be gradual and not just focused on digitalization, to avoid bigger problems"* (M2). "*An organizational culture medication component is needed"* (M7).

- **Roadmap format (M3, M4, M6):** The format of the roadmap should evolve from linear to circular, allowing for a more effective representation of the idea of continuous improvement. This circular approach highlights the importance of constant adjustments, ensuring that the digital transformation process continually adapts to the needs and feedback of those involved, promoting a culture of innovation and efficiency within the institution. [*"I wouldn't change anything in terms of content, but I would give it a more circular note, as a result of the dynamism that the plan has to have."* (M4). *"Continuous feedback from professionals should be incorporated in order to adjust and improve the stages of the roadmap. In addition, allow the process to be circular, so that it can be revisited somewhat frequently, to enable changes, adjustments and corrections to be made to certain steps."* (M6)]

  It was proposed that the roadmap be restructured into a production chain flow format, which includes input, processing and output stages. *"At first it will be ADKAR itself and the assessment of the organizational culture as an initial diagnostic factor to assess where that organization, those people are at, before entering the processing mechanism, in order to have a direct output of what can be my KPIs. In other words, understanding what they need, understanding how they are, understanding how we are going to involve them?"* (M7) At the processing point, people's culture and what they need is modeled, and the entire process is carried out. KPIs should be measured both in the intermediate phase and at the end to monitor and evaluate the progress of the digital transformation.

- **Value in healthcare (M7)**: It is necessary to define what is value in health, value based heathcare in the light of Michael Porter. In his book Porter & Teisberg (2006)proposes a transformation in the healthcare system, arguing that competition should be based on creating value for patients, defined as the relationship between health outcomes and costs. They argue that the quality of health outcomes should be

the focus, promoting a shift from volume-based to value-based competition. This involves a paradigm shift aligning all agents in the healthcare system, including providers, payers and patients, to prioritize efficiency and effective results.

- **Internal communication (M6):** Effective internal communication is fundamental to the success of the digital transformation, and there must be communication between all levels of the organization, ensuring that everyone involved is informed, committed and aligned with the project's objectives. All of this promotes collaboration and strengthens cohesion between teams. [*"It's essential to include an internal communication component to ensure that everyone involved clearly understands the advantages of joining the digital transformation. The more effective this communication is, and the better-informed people are about the benefits of the action, the less resistance they will have."* (M6)]

- **KPIs and Health Outcomes (M5, M7):** It is important to note that KPIs (Key Performance Indicators) and the measurement of health outcomes are essential for the continuous management and updating of the digital transformation project over time. Knowing the state of the process is crucial; ultimately, it is always necessary to measure everything possible. Table 7 shows the KPIs mentioned by the managers interviewed.

Table 7. KPIs for evaluating the success of digital transformation mentioned by interviewees.

KPI	Interviewee
• Amount of paper used; • Number of processes that are already supported by technology; • Number of interactions that exist with the systems; • Number of difficulties that arose in the process.	M2
• Timetables for correcting errors and integrating functionalities; • Number of consultations and exams carried out at the kiosks versus in person; • Analysis of the interoperability maturity level.	M3

• Measure of patient satisfaction with the services provided;
• <u>Operational Efficiency and Quality:</u>
  o Production indicators: Number of services delivered.
  o Financial indicators: profitability, costs and expenses.
  o Performance indicators: Operational efficiency, response times, treatment success rate.
• <u>Patient-team relationship:</u>
  o Level of closeness between the patient and the team: Assessment of patients' trust and safety in relation to the medical team.
  o Easy access for patients to a multidisciplinary team: Measure of how easy it is for patients to access different specialists.
• <u>Systems management and guidance:</u>
  o Possibility of the patient reporting unpleasant symptoms: Frequency and effectiveness in responding to reported symptoms.
  o Rapid guidance: Average response time for guidance after reporting symptoms.
  o Rapid clarification of doubts: Average time taken to clarify patient doubts.
• Rate of satisfaction and gratification of health professionals with innovative projects.
• **<u>Resource Management and Adverse Events</u>**:
  o **Efficiency in resource management**: Indicators of efficient use of available resources.
  o **Possibility of anticipating and better controlling adverse events**: Frequency and effectiveness in anticipating and controlling adverse events.
  o **Emergency resource minimization**: Rate of reduction in the use of emergency services.
	M4

• Adherence rate to the new solutions implemented (platform); (M1, M5, M6, M7) • Rate of use of platform to make clinical decisions; (M7) • Usefulness of Information for Decision-Making (the information generated by this platform was useful for my decision-making); (M7) • Rate of reduction in administrative bureaucracy with the use of this platform. (M7) • Connecting professionals to the usefulness of a platform (M7)	M1, M5, M6, M7

With these suggestions, the roadmap was redesigned to incorporate the suggestions of the managers interviewed, considering their needs and good practices. Section 4.2.2 will explain the final roadmap.

4.2.2. Final roadmap

Considering the experts' validation, the model was updated to a circular version (with the same steps described above in Table 6), incorporating concepts of managing and measuring organizational culture, as well as change management with continuous evolution, reflecting the main focuses of the professionals involved. This measurement of culture is crucial to understanding the strategies that will be used to direct people and teams to achieve the objectives. In addition, the model was structured in a production flow that includes input, processing and output stages. Special focus was given to KPIs as metrics for evaluating the success of the digital transformation. In addition, the concept of value in healthcare was defined as explained by Michael Porter.

To this end, and as mentioned by several interviewees, it will be important in this transformation process to build one or more teams focused on digital transformation, empowered and multidisciplinary teams that have the autonomy to make decisions and implement solutions.

Figure 5 shows the final version of the roadmap for the hospital's digital transformation, with a focus on the human component, a change management tool.

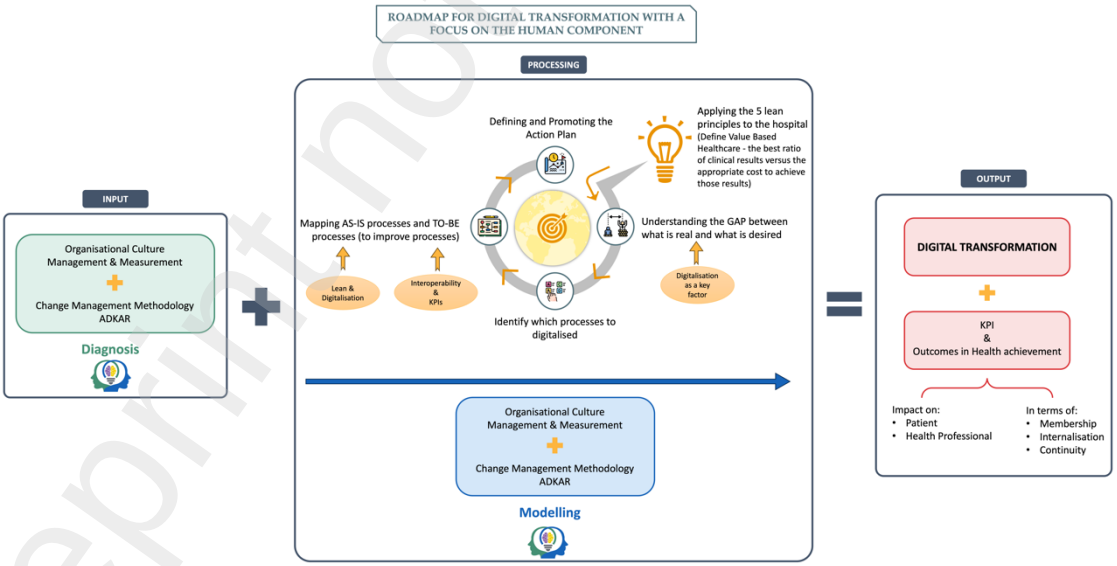

Figure 5. Final version of the roadmap for digital transformation with a focus on the human component.

Table 8 gives a brief explanation of the different phases of the final version of the roadmap, with some specific KPIs to measure the success of the implementation in each phase.

Table 8. A brief explanation of the final version of the roadmap and some KPIs associated with each task.

Step	Task	Explanation	KPI
Input	Organizational culture management & measurement (Diagnosis)	Evaluate and measure the current organizational culture to establish a baseline and identify areas for change.	• Results of questionnaires assessing organizational culture • Professional satisfaction index • Percentage of professionals who remain in the hospital over time; • Measuring the presence of leadership.
	Change management (Diagnosis)	Evaluate current management practices.	• Results of questionnaires assessing the willingness and ability of professionals to change; • Number of management practices beneficial to change; • Number of management practices identified as ineffective; • Number of interactions with systems; • Number of processes already supported by technology; • Amount of paper used (indicates successful adoption of digital systems).
Processing	Applying the 5 lean principles	Using Lean principles to understand and define value in health	• Measurement of how process improvements influence health outcomes; • Evaluation of patient satisfaction with the care received, weighted by health outcomes and associated costs; • Example: Number of consultations and exams carried out at the kiosks versus in person.
	Understanding the GAP	Analyze the differences between the current state and the desired results to prioritize changes. Understanding how digitalization can be a key factor in achieving the goal	• Number of critical gaps identified between the current and desired state; • Evaluation of the impact of digitalization on the reduction of gaps; • Interoperability maturity level analysis.
	Identify which processes to digitalize	Select the main processes that would benefit from digitization, and that bring the most benefits to the institution/people.	• Number of processes already supported by technology; • Measurement of the expected impact of digitalization on these processes (ICE - impact, cost, easiness).
	Mapping AS-IS processes and TO-BE processes	Documenting current processes and outlining future processes, based on lean to eliminate/mitigate waste and digitalization to automate tasks.	• Percentage of processes mapped, of those identified to be digitized; • Number of improvement opportunities identified from AS-IS for the TO-BE process; • Timetables for correcting errors and integrating functionalities.
	Defining and promoting the action plan	Create a detailed action plan based on the needs identified.	• Percentage of planned tasks that have been described in detail and scheduled; • Level of stakeholder support and commitment to the defined plan; • Teams' understanding of the benefits of digitalization; • Connecting professionals to the usefulness of a platform.
	Organizational culture management & measurement (Modelling)	Manage and measure the organizational culture, to align the company's culture with its goals in relation to digital change.	• Measure whether the organizational culture is aligned with the digitalization/change goals; • Rate of satisfaction and gratification of health professionals with innovative projects.

	Change management (Modelling)	It involves planning and implementing organizational changes by creating strategies that ensure that the changes are effectively adopted by professionals, minimizing resistance and maximizing the positive impact on health value.	• Percentage of measures implemented by managers to ensure the success of the change; • Measurement of the reduction in resistance to change by professionals after implementing the strategies; • Monitoring the acceptance of digital technologies over time to assess changes in user attitudes; • Take-up rate of the new solutions implemented.
Output	KPI measurement and achievement of digital transformation	Measurement of KPIs that assess the impact on two main groups: the patient and the healthcare professional: • *Membership*: assesses people's acceptance of and involvement with new digital technologies • *Internalization:* measures the extent to which digital practices are internalized by healthcare teams and patients • *Continuity:* ensures that engagement with digital solutions is sustainable over time.	• Percentage of acceptance and use of new technologies by patients and professionals; • Measuring the impact of new technologies on patients' clinical outcomes; • Percentage of departments that have adopted new digital technologies; • Measuring the digital skills acquired by healthcare professionals and patients after implementing new technologies; • Evaluation of patient autonomy using digital health management solutions; • Measuring the frequency of use of digital solutions by patients and healthcare professionals; • Evaluation of user satisfaction with the technologies implemented, through regular questionnaires; • Measuring how digital technologies have impacted clinical efficiency in terms of time saved on administrative tasks and care; • Measuring the improvement in communication between different departments due to the implementation of digital solutions (interoperability).

5. Discussion and Reflections on the results

The digital transformation takes place at various levels and therefore requires an integrated view of the various decision-making levels. It is imperative to carry out a vertical analysis of the processes to ensure that the transformation reaches all organizational levels, since this type of transformation can normally cause a change in the hierarchical pyramid, leading to a flattening. In addition, it is necessary to understand that a digital transformation can lead to a change in the organizational culture and the methodological culture of the action. Therefore, to enter a digital transformation process, it is first necessary to understand the impact of digital transformation on the healthcare ecosystem and what strategy, operationalization and management mechanisms need to be in place in order to correctly introduce digital transformation practices.

In this work, eight hospital managers were interviewed to gather a practical perspective on existing practices in the hospital environment, and an analysis was made of the digital transformation strategies implemented in different Portuguese hospitals, from the north to the south of the country. These interviews resulted in important insights, from the challenges they face, the strategies they have adopted, perceptions of this new era, among others.

Based on the analysis of the interview responses, it is possible to identify several reasons that motivated the digital transformation process at the hospital. A central reason highlighted by several managers (M1, M2, M5, M6) is the increase in process efficiency, economic efficiency and the need to continuously improve the quality of health services,

as mentioned by Dal Mas et al. (2023). Digital transformation is also seen as a way of improving the provision of a quality service, to be aligned with the growing demands of users and society, providing a better service to users (M5). This transformation aims to facilitate the work process (M2), bring the group's clients closer together by centralizing their information (M2), and broaden the channels of communication with clients, both commercially and clinically (M2).

Another important point mentioned as a critical reason for digital transformation was the need to develop interoperability with other institutions, in order to improve the quality and quantity of clinical information exported, which was highlighted as essential for offering better patient support and, consequently, improving the quality of healthcare (M4), and the literature mentions interoperability as an essential pillar for improving the quality of care. (Woods et al., 2022). In addition, another topic mentioned was the need to adapt to the digital environment as a way of staying "alive" and "surviving" in the hospital market (M8).

It is interesting to note from the analysis of the interviews that there is a duality in the digital transformation: while it drives innovation and efficiency, it also presents significant challenges for the workforce, especially about retraining and adapting to the new roles that emerge. Thus, the transition not only requires investment in technology, but also in training and retraining programs to mitigate adverse social impacts and ensure that technological progress benefits society. This analysis came from the motivations for hospitals to start digital transformation was

> *the "increased flow of demand from users" (M7), and "clearly the lack of human resources" (M3). Another interviewee highlights a recurring concern among health professionals: "one of the things that scares professionals at the moment is the certainty that some professions and some medical specialties are going to disappear with these digitalization processes in the sense of replacing or integrating artificial intelligence into these contexts, but it's clear that there are others that are going to emerge and that are going to, let's say, gain another relevance and another importance." What's more, he stresses the importance of considering that "there are people who can be retrained and others who will not be retrained for new positions. This will be a huge challenge for the social protection system" (M5).*

In line with this, another idea put forward by the professionals is that training is the basis for digital transformation. And in the case of a paradigm shift, which in many cases can be from 2.0 or 3.0 to 5.0, it will also be. However, training is not solely or primarily about formal education. It should focus on fostering an institutional culture that embraces innovation. This verifies what is mentioned in the literature on training, in that it makes people feel less threatened and more prepared for change (Laidoune et al., 2022; Sartori et al., 2018).

One of the professionals mentioned that there are differences in the results when there is a clear objective for the digital transformation, or when the intention is just to modernize without a definition of the purpose, through his statement - *"When we just apply technology to modernize, not taking into account the main objective, instead of calling it a technological solution, people call it a technological burden"* (M7). This corroborates one of the aspects that led to this study, the fact that it is necessary to correctly identify the problems to be solved to develop robust technologies whose implementation effectively contributes to improving health outcomes and the efficiency

of health services. This shows once again the importance of structured change based on the roadmap.

Another idea mentioned by the interviewees during the digital transformation process is the need to keep people involved at all stages of the process to foster commitment and active participation. As one of the managers said, "*The main change is people/involvement, everyone, everyone, everyone, quoting Pope Francis at WYD 2023."* (M4). *"In the human component there are two crucial aspects - the involvement of the people who will benefit from the digital transformation is essential and we must allow these people to be on the ground and build the transformed process. They have to feel that the work is well done and that they have contributed to the process; another important issue is the involvement of top management."* (M4) This verifies the ideas presented in the literature that it is crucial to involve people from the start of the transformation to awaken people's commitment to change (Hubbart, 2023; Laidoune et al., 2022; Long et al., 2024; Ricks, n.d.; Sartori et al., 2018)

It was noticeable that one of the topics mentioned as necessary factors for achieving a successful digital transformation in hospitals is keeping people inspired. As one of the interviewees mentioned.

> *"The biggest challenge is undoubtedly convincing people, teams, that it really is worth doing things differently and going through the pain of changing processes. You have to have the ability to influence, to make people see what they haven't seen yet." "Leadership needs to have a great ability to influence. They need to create memories of the future in people about what they are going to achieve with the digital transformation, in other words, get them to go ahead, see how they could be working ahead, imprint that memory on them and then make them go through the process to get there."* (M5). In addition, it was also mentioned that: *"If we put exactly the same effort and commitment that we put into selling a new product to the customer into promoting changes at work within the company, we'll get different results."* (M2).

This message corroborates what has been found in the literature about the extreme importance of the role of supportive leadership in this transformation (Gilli et al., 2024; Hubbart, 2023; Laidoune et al., 2022; Long et al., 2024)

Another of the managers interviewed highlighted the critical importance of ensuring that healthcare continues to value the patient experience, respecting their dignity and providing a healthy working environment for professionals. As highlighted by Gaspar et al. (2023) professional satisfaction influences organizational results and, therefore, the focus on the human component and humanized care becomes essential. So, as we move towards an increasingly digital future, let's not lose sight of the importance of proximity and empathy in healthcare. The integration of new technologies must be accompanied by a continuous effort to preserve effective communication, multidisciplinary teamwork and a care network that puts the person at the center.

> To paraphrase Sir William Osler (1849-1919), a seminal figure in modern medicine: "Just as important as knowing the disease that man has, is knowing the man who has the disease". *Even with technological advances, this humanism can never be lost."* (M4). What's more, *"In the future, the biggest challenge will be not to lose focus on the person. Let's not forget, however, that modernity, in which AI is embedded, cannot make us forget our commitment to humanization. Responses that value the patient's experience, the proximity of care, full respect for the*

person and their dignity and, on the professionals' side, healthy, safe and sustainable working environments are essential, with communication, multidisciplinarity and networking being fundamental premises to preserve." (M4)

The modernization of medicine must therefore balance technological innovation with maintaining the humanistic values that form the basis of a truly effective health system, and this issue has also been discussed in the literature by Wanasinghe et al. (2021).

6. Final Remarks

6.1. Conclusion

For the digital transformation to be successful, it is essential to use an integrated strategy, considering technology, processes, human resources and organizational culture.

The centrality of the human being in digital transformation is not only an ethical issue, but also a strategic one, and the need to develop a roadmap for digital transformation with a focus on the human component was recognized, an aspect considered essential by the interviewees. The roadmap was adjusted to the needs of the hospital managers interviewed, as illustrated in Figure 5. This approach is in line with what Gilli et al. (2024) state in their study that people, rather than technology, drive digital transformation. The importance of developing the roadmap presented above is therefore clear.

As mentioned earlier, people are central to the success of the digital transformation, and this success is measured through KPIs. One of the key conclusions drawn from the interviews was: To guarantee the effectiveness of the KPIs and obtain satisfactory values for them, it is essential to keep people: involved, informed, inspired, innovating, interconnected, inclusive, influential, interactive, intuitive, invested. In this digital transition, human capital has come to be seen as an enabler and catalyst for innovation. Figure 6 shows a playful diagram of this conclusion.

- **Involved**: "Keep People Involved" - Keeping people involved in all phases of the digital transformation process to foster commitment and active participation.
- **Informed**: "Keep People Informed" - Ensuring that everyone is up to date with the latest digital trends and practices for an informed transition.
- **Inspired**: "Keep People Inspired" - Constantly encouraging the team with visions of the future and innovations that show the positive impact of digitalization.
- **Innovating**: "Keep People Innovating" - Stimulating creativity and experimentation to find new and improved digital solutions.
- **Interconnected**: "Keep People Interconnected" - Ensuring that communication and collaboration networks are optimized in the digital age.
- **Inclusive**: "Keep People Inclusive" - Promoting a culture of diversity and inclusion in the digital environment.
- **Influential**: "Keep People Influential" - Empowering employees to be agents of change and positively influence the direction of digitalization.
- **Interactive**: "Keep People Interactive" - Providing digital interfaces and experiences that promote continuous interaction and involvement.
- **Intuitive**: "Keep People Intuitive" - Developing systems that are easy to understand and use, keeping the user experience at the heart of digital innovation.

- **Invested**: "Keep People Invested" - Cultivating a sense of ownership and commitment to the organization's digital goals.

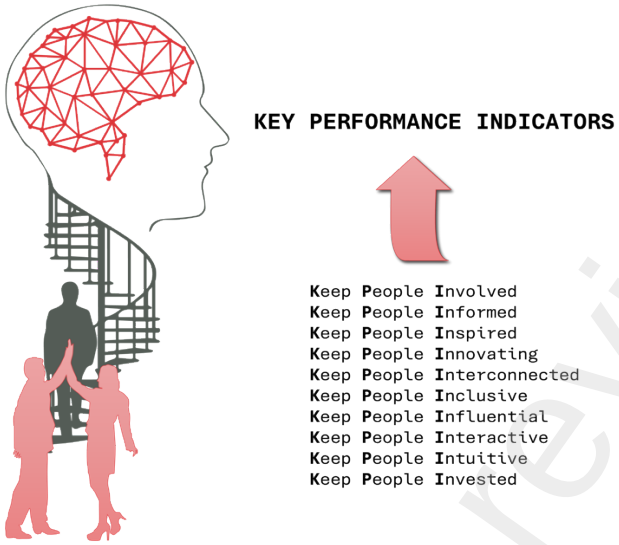

Figure 6. The human factor as a crucial element in the success of KPIs.

Adapted from: Robertson Hunter Stewart (2023)

6.2. Contributions and Implications

- **Theoretical Implications:**

This paper makes a significant contribution to the literature by presenting a roadmap for a digital transformation strategy focused on the human component, conceived as a change management tool. In this way, the study offers valuable insights into an extremely important area of knowledge with a gap in the literature, thus contributing to the advancement of the literature on change management and digital transformation in the healthcare context.

- **Practical Implications:**

By incorporating human component perspectives into the roadmap for digital transformation, healthcare institutions can effectively navigate the complexities of digital transformation while maintaining a focus on the importance of the human element. This holistic approach aims to support healthcare institutions that aspire to shift to a new digital paradigm. It not only facilitates successful implementation, but also ensures the effective acceptance of digital technologies in the healthcare sector, promoting a smooth and efficient transition to more innovative and patient-centered healthcare practices.

6.3. Limitations and Future Work

- **Limitations:**

The study was conducted only with hospital managers, which may not represent all perspectives within the health sector, such as those of health professionals, patients and other stakeholders. In addition, the interpretation of the qualitative data from the interviews may be subject to personal biases on the part of the interviewees and

interviewers. Another risk/limitation is that managers' perceptions may change over time with the advancement of technologies and changes in health policies, making it necessary to periodically reassess the insights gained.

- **Future work:**

Future work would include interviews with other stakeholders, such as doctors, nurses and patients, to get a more holistic view of digital transformation in the healthcare sector. In addition, we plan to implement the roadmap in a real-world context, conducting longitudinal studies to analyze the roadmap's long-term impact on healthcare institutions and adjusting strategies as necessary. Future work also plans to digitize the roadmap, as well as develop and document metrics and performance indicators to assess the effectiveness of digital transformation initiatives and the impact on the quality of healthcare services and patient satisfaction. In addition, it is intended to define a set of KPIs that should be measured as an "output" of the roadmap.

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.

Acknowledgements

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Reference

Acero, R., Torralba, M., Valverde, E.-D., Roc, L., & Rezusta, A. (2023). Integrating Lean and Automation for Enhanced Serology Diagnosis Efficiency in Tertiary Healthcare Microbiology Laboratories. *Applied Sciences*, *14*(1), 241. https://doi.org/10.3390/app14010241

Angerer, A., Stahl, J., Krasniqi, E., & Banning, S. (2022). The Management Perspective in Digital Health Literature: Systematic Review. In *JMIR mHealth and uHealth* (Vol. 10, Issue 11). JMIR Publications Inc. https://doi.org/10.2196/37624

Ayanaw, T., Worede, E. A., Alemayehu, M., Worku, W., Abere, G., & Betew, B. D. (2023). Patient safety culture and associated factors among health care providers in government and private hospitals, Bahir Dar City Northwest, Ethiopia, 2022: a comparative cross-sectional study. *BMC Health Services Research*, *23*(1). https://doi.org/10.1186/s12913-023-09770-4

Babin, P., & Ghorashy, A. (2019). *Leveraging Organizational Change Management to Strengthen Benefit Delivery in Innovation*.

Bader, M., Antony, J., Jayaraman, R., & Swarnakar, V. (2023). Why do Process Improvement Projects Fail in Organisations A Review and Future Research Agenda. In *Article in International Journal of Lean Six Sigma*. https://www.researchgate.net/publication/374472150

Basulo-Ribeiro, J., Amorim, M., & Teixeira, L. (2023). How to accelerate digital transformation in companies with Lean Philosophy? Contributions based on a practical case. *International Journal of Industrial Engineering and Management Original*, *326*.

Basulo-Ribeiro, J., & Teixeira, L. (2024). The Future of Healthcare with Industry 5.0: Preliminary Interview-Based Qualitative Analysis. *Future Internet*, *16*(3), 68. https://doi.org/10.3390/fi16030068

Beyan, O. D., & Baykal, N. (2012). A knowledge based search tool for performance measures in health care systems. *Journal of Medical Systems*, *36*(1), 201–221. https://doi.org/10.1007/s10916-010-9459-2

Bhushan, B., Khamparia, A., Sagayam, K. M., Sharma, S. K., Ahad, M. A., & Debnath, N. C. (2020). Blockchain for smart cities: A review of architectures, integration trends and future research directions. *Sustainable Cities and Society*, *61*, 1–27. https://doi.org/10.1016/j.scs.2020.102360

Bø Lyng, H., Viksveen, P., Parandeh, A., & Ellis, L. A. (2023). *Hospital organizational change: The importance of teamwork culture, communication, and change readiness*.

Boca, G. D. (2013). ADKAR Model vs Quality Management Change. *International Conference "Risk in Contemporary Economy"* . https://www.researchgate.net/publication/266310181

Braithwaite, J., Herkes, J., Ludlow, K., Testa, L., & Lamprell, G. (2017). Association between organisational and workplace cultures, and patient outcomes: Systematic review. In *BMJ Open* (Vol. 7, Issue 11). BMJ Publishing Group. https://doi.org/10.1136/bmjopen-2017-017708

Burnes, B., & Bargal, D. (2017). Kurt Lewin: 70 Years on. *Journal of Change Management*, *17*(2), 91–100. https://doi.org/10.1080/14697017.2017.1299371

Caliskan, O., & Gokalp, G. (2020). *A Micro-Level Perspective in Organizational Change: Cognitive Dissonance, Sense-Making and Attitude Change*. https://doi.org/10.14527/kuey.2020.016

Callari, T. C., Vecellio Segate, R., Hubbard, E. M., Daly, A., & Lohse, N. (2024). An ethical framework for human-robot collaboration for the future people-centric

manufacturing: A collaborative endeavour with European subject-matter experts in ethics. *Technology in Society*, *78*. https://doi.org/10.1016/j.techsoc.2024.102680

Carini, E., Gabutti, I., Frisicale, E. M., Di Pilla, A., Pezzullo, A. M., de Waure, C., Cicchetti, A., Boccia, S., & Specchia, M. L. (2020). Assessing hospital performance indicators. What dimensions? Evidence from an umbrella review. *BMC Health Services Research*, *20*(1). https://doi.org/10.1186/s12913-020-05879-y

Chaabi, M. (2022). Roadmap to Implement Industry 5.0 and the Impact of This Approach on TQM. *Communications in Computer and Information Science*, *1677 CCIS*, 287–293. https://doi.org/10.1007/978-3-031-20490-6_23

Chatman, J. A., & Choi, A. (2019). *Measuring Organizational Culture: Converging on Definitions and Approaches to Advance the Paradigm**. https://haas.berkeley.edu/berkeley-haas-culture-

Ciasullo, M. V., Orciuoli, F., Douglas, A., & Palumbo, R. (2022). Putting Health 4.0 at the service of Society 5.0: Exploratory insights from a pilot study. *Socio-Economic Planning Sciences*, *80*(2). https://doi.org/10.1016/j.seps.2021.101163

Coghlan, D. (2021). Edgar Schein on Change: Insights Into the Creation of a Model. *Journal of Applied Behavioral Science*, *57*(1), 11–19. https://doi.org/10.1177/0021886320924029

Computerworld Portugal. (2023). *A transição digital na saúde em Portugal - uma perspetiva otimista*.

Creasey, T. (n.d.). *Understanding Why People Resist Change*. 2022.

Dal Mas, F., Massaro, M., Rippa, P., & Secundo, G. (2023). The challenges of digital transformation in healthcare: An interdisciplinary literature review, framework, and future research agenda. *Technovation*, *123*. https://doi.org/10.1016/j.technovation.2023.102716

Denison, D., Nieminen, L., & Kotrba, L. (2014). Diagnosing organizational cultures: A conceptual and empirical review of culture effectiveness surveys. *European Journal of Work and Organizational Psychology*, *23*(1), 145–161. https://doi.org/10.1080/1359432X.2012.713173

Dombrowski, U., Richter, T., & Krenkel, P. (2017). Interdependencies of Industrie 4.0 & Lean Production Systems: A Use Cases Analysis. *Procedia Manufacturing*, *11*, 1061–1068. https://doi.org/10.1016/j.promfg.2017.07.217

Ellinas, C., Allan, N., & Johansson, A. (2017). Dynamics of organizational culture: Individual beliefs vs. Social conformity. *PLoS ONE*, *12*(6). https://doi.org/10.1371/journal.pone.0180193

Endrejat, P. C. (2021). When to challenge employees' comfort zones? The interplay between culture fit, innovation culture and supervisors' intellectual stimulation. *Leadership and Organization Development Journal*, *42*(7), 1104–1118. https://doi.org/10.1108/LODJ-07-2020-0307

Errida, A., & Lotfi, B. (2021). The determinants of organizational change management success: Literature review and case study. *International Journal of Engineering Business Management*, *13*. https://doi.org/10.1177/18479790211016273

Esmaeilzadeh, P. (2022). Identification of barriers affecting the use of health information exchange (HIE) in clinicians' practices: An empirical study in the United States. *Technology in Society*, *70*. https://doi.org/10.1016/j.techsoc.2022.102007

Feki, M., & Boughzala, I. (2015). *The Shape of Digital Transformation: A Systematic Literature Review*. http://aisel.aisnet.org/mcis2015

Furxhi, G. (2021). Employee's Resistance and Organizational Change Factors. *European Journal of Business and Management Research*, *6*(2), 30–32. https://doi.org/10.24018/ejbmr.2021.6.2.759

Gaspar, T., Gomez-Baya, D., Guedes, F. B., & Correia, M. F. (2023). Health Management: Evaluating the Relationship between Organizational Factors, Psychosocial Risks at Work, Performance Management, and Hospital Outcomes. *Healthcare (Switzerland)*, *11*(20). https://doi.org/10.3390/healthcare11202744

Gilli, K., Lettner, N., & Guettel, W. (2024). The future of leadership: new digital skills or old analog virtues? *Journal of Business Strategy*, *45*(1), 10–16. https://doi.org/10.1108/JBS-06-2022-0093

Golinelli, D., Boetto, E., Carullo, G., Nuzzolese, A. G., Landini, M. P., & Fantini, M. P. (2020). Adoption of digital technologies in health care during the COVID-19 pandemic: Systematic review of early scientific literature. In *Journal of Medical Internet Research* (Vol. 22, Issue 11). JMIR Publications Inc. https://doi.org/10.2196/22280

Gomathi, L., & Mishra, A. K. (2023). Industry 5.0 for Healthcare 5.0: Opportunities, Challenges and Future Research Possibilities. *IEEE - 7th International Conference on Trends in Electronics and Informatics (ICOEI)*.

Gong, L., Jiang, S., & Liang, X. (2022). Competing value framework-based culture transformation. *Journal of Business Research*, *145*, 853–863. https://doi.org/10.1016/j.jbusres.2022.03.019

Gravili, G., Manta, F., Cristofaro, C. L., Reina, R., & Toma, P. (2021). Value that matters: intellectual capital and big data to assess performance in healthcare. An empirical analysis on the European context. *Journal of Intellectual Capital*, *22*(2), 260–289. https://doi.org/10.1108/JIC-02-2020-0067

Gutiérrez-Iñiguez, Á., Collado-Agudo, J., & Rialp-Criado, J. (2023). The Role of Managers in Corporate Change Management: A Bibliometric Review. In *Sustainability (Switzerland)* (Vol. 15, Issue 14). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/su151410811

Haleem, A., & Javaid, M. (2019). Industry 5.0 and its applications in orthopaedics. In *Journal of Clinical Orthopaedics and Trauma* (Vol. 10, Issue 4, pp. 807–808). Elsevier B.V. https://doi.org/10.1016/j.jcot.2018.12.010

Heinitz, K., Lorenz, T., Schulze, D., & Schorlemmer, J. (2018). Positive organizational behavior: Longitudinal effects on subjective well-being. *PLoS ONE*, *13*(6). https://doi.org/10.1371/journal.pone.0198588

Helfrich, C. D., Li, Y. F., Mohr, D. C., Meterko, M., & Sales, A. E. (2007). Assessing an organizational culture instrument based on the Competing Values Framework: Exploratory and confirmatory factor analyses. *Implementation Science*, *2*(1). https://doi.org/10.1186/1748-5908-2-13

Heritage, B., Pollock, C., & Roberts, L. (2014). Validation of the organizational culture assessment instrument. *PLoS ONE*, *9*(3). https://doi.org/10.1371/journal.pone.0092879

Hiatt, J. M. (2006). *ADKAR: A model for Change in Business, Guvernment and our Community*. Prosci Learning Center Publications.

Huaytan, J. V. P., Rojas, G. G. R., Ruiz-Balvin, M. C., Roldan, F. A. G., Leiva, N. A. D., Gordillo-Flores, R. E., Melly, J. L. I., & Tapia-Silguera, R. D. (2024). DIGITAL TRANSFORMATION IN PUBLIC HOSPITAL MANAGEMENT: IMPROVING THE PATIENT EXPERIENCE. *Revista de Gestao Social e Ambiental*, *18*(4). https://doi.org/10.24857/rgsa.v18n4-046

Hubbart, J. A. (2023). Organizational Change: The Challenge of Change Aversion. *Administrative Sciences*, *13*(7). https://doi.org/10.3390/admsci13070162

Ioan, B., Nestian, A., & Tiţă, S.-M. (2012). Relevance of Key Performance Indicators (KPIs) in a Hospital Performance Management Model. *Journal of Eastern Europe Research in Business & Economics*, 1–15. https://doi.org/10.5171/2012.674169

Jarva, E., Oikarinen, A., Andersson, J., Tuomikoski, A. M., Kääriäinen, M., Meriläinen, M., & Mikkonen, K. (2022). Healthcare professionals' perceptions of digital health competence: A qualitative descriptive study. *Nursing Open*, *9*(2), 1379–1393. https://doi.org/10.1002/nop2.1184

Jia, Y., Fu, H., Gao, J., Dai, J., & Zheng, P. (2018). The roles of health culture and physical environment in workplace health promotion: A two-year prospective intervention study in China. *BMC Public Health*, *18*(1). https://doi.org/10.1186/s12889-018-5361-5

Kai Shek, C. (n.d.). THE COMPETING VALUES FRAMEWORK OF ADMINISTRATORS AMONG PRIVATE COLLEGES IN THE NATIONAL CAPITAL REGION Assistant Professor Dr. Raymond Q. Datuon, DEM. In *IJBTS International Journal of Business Tourism and Applied Sciences* (Vol. 3, Issue 1).

Konttila, J., Siira, H., Kyngäs, H., Lahtinen, M., Elo, S., Kääriäinen, M., Kaakinen, P., Oikarinen, A., Yamakawa, M., Fukui, S., Utsumi, M., Higami, Y., Higuchi, A., & Mikkonen, K. (2019). Healthcare professionals' competence in digitalisation: A systematic review. In *Journal of Clinical Nursing* (Vol. 28, Issues 5–6, pp. 745–761). Blackwell Publishing Ltd. https://doi.org/10.1111/jocn.14710

Koszela, J. (2016). Business process modeling for processing classified documents using RFID technology. *MATEC Web of Conferences*, *76*, 1–5. https://doi.org/10.1051/matecconf/20167604005

Kotter, J. (1995). *Leading change: why transformation efforts fail.*

Kulinich, T., Materynska, O., Aleskerova, Y., Kuzmenko, H., & Balian, I. (2023). Leadership in Unstable Conditions: Change Management Strategies and Effective Crisis Management for Achieving Success. *WSEAS Transactions on Business and Economics*, *20*, 2781–2788. https://doi.org/10.37394/23207.2023.20.236

Kumari, K., Abbas, J., Hwang, J., & Cioca, L. I. (2022). Does Servant Leadership Promote Emotional Intelligence and Organizational Citizenship Behavior among Employees? A Structural Analysis. *Sustainability (Switzerland)*, *14*(9). https://doi.org/10.3390/su14095231

Laidoune, A., Zid, C., & Sahraoui, N. (2022). Innovate and Overcome Resistance to Change to Improve the Resilience of Systems and Organizations. *Journal of the Knowledge Economy*, *13*(4), 2986–3001. https://doi.org/10.1007/s13132-021-00840-8

Lichem-Herzog, C., & Sorko, S. R. (2024). Development of a Strategy Roadmap for the Widespread Implementation of Extended Reality. *Tehnički Glasnik*, *18*(1), 157–162. https://doi.org/10.31803/tg-20230523140033

Linnander, E., McNatt, Z., Boehmer, K., Cherlin, E., Bradley, E., & Curry, L. (2021). Changing hospital organisational culture for improved patient outcomes: developing and implementing the leadership saves lives intervention. *BMJ Quality & Safety*, *30*(6), 475–483. https://doi.org/10.1136/bmjqs-2019-010734

Long, J. C., Roberts, N., Francis-Auton, E., Sarkies, M. N., Nguyen, H. M., Westbrook, J. I., Levesque, J. F., Watson, D. E., Hardwick, R., Churruca, K., Hibbert, P., & Braithwaite, J. (2024). Implementation of large, multi-site hospital interventions: a realist evaluation of strategies for developing capability. *BMC Health Services Research*, *24*(1). https://doi.org/10.1186/s12913-024-10721-w

Mannion, R., & Davies, H. (2018a). Understanding organisational culture for healthcare quality improvement. *BMJ (Online)*, *363*. https://doi.org/10.1136/bmj.k4907

Mannion, R., & Davies, H. (2018b). Understanding organisational culture for healthcare quality improvement. *BMJ (Online)*, *363*. https://doi.org/10.1136/bmj.k4907

Mayr, A., Weigelt, M., Kühl, A., Grimm, S., Erll, A., Potzel, M., & Franke, J. (2018). Lean 4.0-A conceptual conjunction of lean management and Industry 4.0. *Procedia CIRP*, *72*(May), 622–628. https://doi.org/10.1016/j.procir.2018.03.292

Megawati, S., Machmud, A., & Alfarizi, M. (2024). Telemedicine and transformative health access for millennials-Gen Z: PLS-SEM based behavioral exploration. *Technology in Society*, *79*. https://doi.org/10.1016/j.techsoc.2024.102714

Murray, J., Sorra, J., Gale, B., & Mossburg, S. (2024). *Ensuring Patient and Workforce Safety Culture in Healthcare*.

Mutonyi, B. R., Slåtten, T., Lien, G., & González-Piñero, M. (2022). The impact of organizational culture and leadership climate on organizational attractiveness and innovative behavior: a study of Norwegian hospital employees. *BMC Health Services Research*, *22*(1). https://doi.org/10.1186/s12913-022-08042-x

Nieboer, M. E., van Hoof, J., van Hout, A. M., Aarts, S., & Wouters, E. J. M. (2014). Professional values, technology and future health care: The view of health care professionals in The Netherlands. *Technology in Society*, *39*, 10–17. https://doi.org/10.1016/j.techsoc.2014.05.003

Nota, L., Santilli, S., & Zucchini, D. (2023). Inclusion, Sustainability, and Equity at the Heart of a 5.0 Society. *Studies in Health Technology and Informatics*, *303*, 59–67. https://doi.org/10.3233/SHTI230400

Ooi, Y. H., Ng, T. C., & Cheong, W. C. (2023). Implementing Industry 4.0 and lean practices for business performance in manufacturing: Case of Malaysia. *International Journal of Advanced and Applied Sciences*, *10*(3), 143–156. https://doi.org/10.21833/ijaas.2023.03.019

O'Reilly, C. A., Caldwell, D. F., Chatman, J. A., & Doerr, B. (2014). The Promise and Problems of Organizational Culture: CEO Personality, Culture, and Firm Performance. *Group and Organization Management*, *39*(6), 595–625. https://doi.org/10.1177/1059601114550713

O'Reilly, C., Chatman, J., & Caldwell, D. F. (1991). People and organizational culture: A profile comparison approach to assessing person-organization fit. In *Management Journal* (Vol. 34, Issue 3).

Paul, J., & Zhou, Y. (2017). How to build sustainable innovation capability in supply chain management How to build sustainable innovation capability in supply chain management 457. In *Int. J. Business and Globalisation* (Vol. 19, Issue 4).

Porter, M. E., & Teisberg, E. O. (2006). *Redefining Health Care: Creating Value-Based Competition on Results*.

Recardo Ronald J, R. J. (1995). *Overcoming Resistance to Change*.

Ricks, A. (n.d.). *HOW TO COMMUNICATE ORGANIZATIONAL CHANGE: 4 STEPS*. 2020.

Robertson Hunter Stewart. (2023). *KPIs A New Approach*.

Romero, D., Flores, M., Herrera, M., & Resendez, H. (2019). *Five Management Pillars for Digital Transformation Integrating the Lean Thinking Philosophy*.

Safi, S., Thiessen, T., & Schmailzl, K. J. G. (2018). Acceptance and resistance of new digital technologies in medicine: Qualitative study. *JMIR Research Protocols*, *7*(12). https://doi.org/10.2196/11072

Sarros, J. C., Gray, J., Densten, I. L., & Cooper, B. (2005). The Organizational Culture Profile Revisited and Revised: An Australian Perspective. In © *The Australian Graduate School of Management AUSTRALIAN JOURNAL OF MANAGEMENT* (Vol. 30, Issue 1).

Sartori, R., Costantini, A., Ceschi, A., & Tommasi, F. (2018). How do you manage change in organizations? Training, development, innovation, and their relationships. *Frontiers in Psychology*, *9*. https://doi.org/10.3389/fpsyg.2018.00313

Schein, E. H. (1983). *The Role of the Founder in the Creation of Organizational Culture*.

Schulte, P. A., Guerin, R. J., Schill, A. L., Bhattacharya, A., Cunningham, T. R., Pandalai, S. P., Eggerth, D., & Stephenson, C. M. (2023). Considerations for incorporating "well-being" in public policy for workers and workplaces. *American Journal of Public Health*, *105*(8), e31–e44. https://doi.org/10.2105/AJPH.2015.302616

Scott, T., Mannion, R., Davies, H. T. O., & Marshall, M. N. (2003). Implementing culture change in health care: Theory and practice. In *International Journal for Quality in Health Care* (Vol. 15, Issue 2, pp. 111–118). https://doi.org/10.1093/intqhc/mzg021

Selvam, A., Aggarwal, T., Mukherjee, M., & Verma, Y. K. (2023). Humans and robots: Friends of the future? A bird's eye view of biomanufacturing industry 5.0. In *Biotechnology Advances* (Vol. 68). Elsevier Inc. https://doi.org/10.1016/j.biotechadv.2023.108237

Singaram, S., & Mayer, C. H. (2022). The influence of the Fourth Industrial Revolution on organisational culture: An empirical investigation. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.919157

Tsai, Y. (2011). Relationship between organizational culture, leadership behavior and job satisfaction. *BMC Health Services Research*, *11*. https://doi.org/10.1186/1472-6963-11-98

Van Der Post, W. Z., De Coning, T. J., Vd, E., & Smit, M. (1997). An instrument to measure organizational culture. In *J.Bus.Manage* (Vol. 28).

Van Huy, N., Thu, N. T. H., Anh, N. L. T., Au, N. T. H., Phuong, N. T., Cham, N. T., & Minh, P. D. (2020). The validation of organisational culture assessment instrument in healthcare setting: Results from a cross-sectional study in Vietnam. *BMC Public Health*, *20*(1). https://doi.org/10.1186/s12889-020-8372-y

Vargas-Halabi, T., & Yagüe-Perales, R. M. (2023). Organizational culture and innovation: exploring the "black box." *European Journal of Management and Business Economics*. https://doi.org/10.1108/EJMBE-07-2021-0203

Veillard, J., Champagne, F., Klazinga, N., Kazandjian, V., Arah, O. A., & Guisset, A. L. (2005). A performance assessment framework for hospitals: The WHO regional office for Europe PATH project. In *International Journal for Quality in Health Care* (Vol. 17, Issue 6, pp. 487–496). https://doi.org/10.1093/intqhc/mzi072

Wanasinghe, T. R., Trinh, T., Nguyen, T., Gosine, R. G., James, L. A., & Warrian, P. J. (2021). Human centric digital transformation and operator 4.0 for the oil and gas industry. *IEEE Access*, *9*, 113270–113291. https://doi.org/10.1109/ACCESS.2021.3103680

WHO, R. O. for E. (2003). *MEASURING HOSPITAL PERFORMANCE TO IMPROVE THE QUALITY OF CARE IN EUROPE: A NEED FOR CLARIFYING THE CONCEPTS AND DEFINING THE MAIN DIMENSIONS Report on a WHO Workshop*. http://www.euro.who.int/ihb

Wilkins, A. L. (1983). *The Culture A Tool for Understandin Organizations*.

Woods, L., Eden, R., Duncan, R., Kodiyattu, Z., Macklin, S., & Sullivan, C. (2022). Which one? A suggested approach for evaluating digital health maturity models. *Frontiers in Digital Health*, *4*. https://doi.org/10.3389/fdgth.2022.1045685

Xie, J., Tang, H., Huang, T., Yu, F. R., Xie, R., Liu, J., & Liu, Y. (2019). A Survey of Blockchain Technology Applied to Smart Cities: Research Issues and Challenges. *IEEE Communications Surveys and Tutorials*, *21*(3), 2794–2830. https://doi.org/10.1109/COMST.2019.2899617

Yaakobi, E., & Weisberg, J. (2020). Organizational Citizenship Behavior Predicts Quality, Creativity, and Efficiency Performance: The Roles of Occupational and Collective Efficacies. *Frontiers in Psychology*, *11*. https://doi.org/10.3389/fpsyg.2020.00758

Zeb, A., Akbar, F., Hussain, K., Safi, A., Rabnawaz, M., & Zeb, F. (2021). The competing value framework model of organizational culture, innovation and performance. *Business Process Management Journal*, *27*(2), 658–683. https://doi.org/10.1108/BPMJ-11-2019-0464