



An integrated change management model for digital transformation in Colombia's pipeline sector

 **Javier Rosero-García**^{1*}

 **Jon Freddy Hernandez Sanchez**²

 **William Montano-Salamanca**³

¹Electrical Machines and Drives, EM&D, Department of Electrical and Electronic Engineering, Universidad Nacional de Colombia, 111321, Bogotá, Colombia.

¹Email: jaroserog@unal.edu.co

^{2,3}Electrical Machines and Drives Research Group, Universidad Nacional de Colombia, 111321, Bogota, Colombia.

²Email: jonhernandezsa@unal.edu.co

³Email: wmontanos@unal.edu.co



(+ Corresponding author)

ABSTRACT

Article History

Received: 29 October 2025

Revised: 26 January 2026

Accepted: 16 February 2026

Published: 24 February 2026

Keywords

Agile methodologies
Design thinking
Digital maturity
Digital transformation
Hydrocarbon transportation industry via pipelines
Integrated organizational change model
Organizational change management
Sociotechnical approach.

The present study proposes a methodology for managing organizational change amid digital transformation within Colombia's hydrocarbon pipeline sector. The model is employed to analyze established organizational change models, with subsequent adaptation and validation for the specific needs of the pipeline industry. In-depth interviews with industry experts were conducted, digital maturity questionnaires administered, and a case study carried out on two pipelines with different operational characteristics. Data analysis incorporated thematic analysis, concordance coefficient evaluation, and word cloud creation to identify emerging themes. The resultant model, designated the Integrated Organizational Change Model (IOCM), comprises four phases: I) diagnosis and preparation; II) collaborative design; III) agile implementation; and IV) reinforcement and evolution. The model incorporates agile methodologies, design thinking, and socio-technical approaches tailored to the needs of the pipeline sector. The IOCM was evaluated by experts, who assigned high ratings for its structure and adaptability, with most components scoring above 4.5 on a 5-point Likert scale. The organization's key strengths identified include digital maturity assessment, socio-technical strategy development, and a focus on continuous improvement. However, the study also identified areas for enhancement, including the necessity to place greater emphasis on financial aspects and to improve the model's adaptability to organizations of diverse sizes. The following recommendations are proposed for future research: longitudinal studies and the integration of emerging technologies into the model.

Contribution/Originality: This study contributes to the existing literature by proposing and empirically validating an Integrated Organizational Change Model for digital transformation in the hydrocarbon pipeline sector. The paper addresses change management in regulated industrial contexts through a hybrid framework combining agile methodologies, design thinking, and digital maturity assessment.

1. INTRODUCTION

The hydrocarbon pipeline transportation industry in Colombia plays a pivotal role in the nation's economy. It ensures a safe and efficient flow of energy resources, which are essential for industrial production and domestic consumption. However, like many other sectors, this industry must adapt to an increasingly digital and competitive environment (World Economic Forum, 2017).

In 2021, Colombia's pipeline network exceeded 8,500 kilometers, managed by both public and private entities (Colombian Petroleum Association, 2022), Mumford (2006), and Colombian Ministry of Mines and Energy (2021). The sector faces challenges such as price volatility, infrastructure investment needs, and strict environmental and safety regulation compliance (Fedesarrollo, 2018).

In this context, digital transformation emerges as a pivotal strategy for enhancing operational efficiency, promoting sustainability, and augmenting competitiveness. The integration of digital technologies, such as the Internet of Things (IoT), advanced analytics, and artificial intelligence, has the potential to improve asset management, automate processes, and facilitate real-time risk prediction. These technologies have been shown to enhance efficiency, safety, and sustainability in operations (Deloitte, 2019).

Additionally, the hydrocarbon transportation industry in Colombia is undergoing an energy transition (Colombian Ministry of Mines and Energy, 2023) with the objective of reducing emissions and integrating renewable sources (DNP, 2018). This shift necessitates that organizations develop agile and resilient change capabilities. Digital transformation has emerged as a strategic priority for businesses, as it presents substantial opportunities to enhance operational efficiency, safety, decision-making processes, and customer satisfaction (Deloitte, 2019).

Nevertheless, the efficacy of digitization depends on implementing effective organizational change management, which involves profound changes in culture, structures, and human talent competencies (Tushman & O'Reilly, 1996). Conventional models, such as those proposed by Kotter (2012a) and Lewin (1947), provide a foundational framework. However, these models must be adapted to reflect the accelerated pace and intricate nature of the digital era, as well as the unique characteristics of the pipeline sector. These models emphasize the importance of creating urgency, establishing a clear vision, building a support coalition, communicating change, and consolidating accomplishments to institutionalize new practices (Kotter, 2012a; Lewin, 1947).

In a similar vein, (Tushman & O'Reilly, 1996) theory of organizational ambidexterity offers a pertinent framework for understanding the challenges associated with digital transformation in this sector. This theory posits that organizations must leverage their existing capabilities to maintain operational efficiency while exploring new opportunities (Tushman & O'Reilly, 1996), which are often linked to emerging technologies. In the context of oil pipelines, this dual approach is of paramount importance. The implementation of disruptive digital solutions must be undertaken in a manner that ensures the continuity and security of existing operations.

Complementary approaches, such as Kotter and Schlesinger (2008) theory of planned change and Meyer and Allen (1991) model of organizational commitment, offer valuable tools for addressing resistance to change and developing digital skills. These frameworks emphasize establishing credibility, managing staff perceptions effectively, and aligning organizational incentives with change objectives. In sectors like hydrocarbon transportation, where specialized technical knowledge and operational experience are essential, gaining acceptance of change from operational and technical staff is critical for success.

From an economic and strategic perspective, numerous studies have demonstrated the potential of digital transformation to generate value within the hydrocarbon industry. According to the World Economic Forum (2017), the digitization of the industry has the potential to generate annual savings amounting to \$1 billion through enhanced operational efficiency, reduced downtime, and optimized supply chain management. Technologies such as the Internet of Things (IoT), advanced analytics, and artificial intelligence have demonstrated to provide enhanced visibility and control over critical infrastructure. These systems facilitate swifter and more precise responses to failures, threats, or extreme conditions (McKinsey & Company, 2019).

Beyond immediate economic and operational gains, digital transformation is essential for addressing environmental and social challenges. As regulatory, investor, and community pressures increase, companies must demonstrate a commitment to sustainability. Implementing digital solutions that improve energy efficiency, reduce emissions, and promote renewable energy sources not only ensures compliance but also strengthens an organization's reputation as a leader in environmental sustainability (Deloitte, 2019).

Digital transformation is a process that is altering the transportation sector of the oil and gas industry. Innovations that enhance operational efficiency and safety are emerging (Bento & Tagliabue, 2023). The integration of smart sensors, real-time analysis, and automated monitoring systems has been demonstrated to enhance hydrocarbon flow supervision, facilitating early anomaly detection and leak prevention (Singh, Mishra, Rusinkiewicz, & Katz, 2022). These innovations have been demonstrated to enhance productivity and fortify the resilience of critical infrastructure against operational and security challenges (Ramírez-Mendoza, Morales-Menendez, Iqbal, & Parra-Saldivar, 2021).

The aforementioned technologies include digital twins, which simulate and optimize complex operations; artificial intelligence, which enhances decision-making and decreases operating costs; and blockchain, which improves traceability and transparency in the supply chain, aiding in compliance and stakeholder trust (García-Martínez & López, 2022; Johnson & Smith, 2023).

This case study analyzes the experiences of an organization responsible for managing two oil pipelines, each with distinct operational characteristics. The objective is to identify critical success factors, challenges, and lessons learned. The study is based on the current context and recognizes gaps in existing literature. It aims to address the following research question: how can organizations effectively manage change to drive digital transformation in the oil pipeline transportation sector in Colombia?

In order to address this inquiry, the article methodically organizes its analysis into four distinct phases: diagnosis and preparation, collaborative design, agile implementation, and reinforcement and evolution. The proposal calls for an integrated model that combines theoretical depth with practical applicability. The model has been validated by sector experts.

2. LITERATURE BACKGROUND

This section presents the main theoretical and conceptual approaches supporting the development of the Integrated Organizational Change Model (IOCM) proposed in this research. Firstly, it discusses various models of organizational change management, both classic and contemporary, which form the basis for a methodology adapted to the pipeline sector's context. In the subsequent section, the concepts of digital transformation and digital maturity are analyzed to understand how these processes are redefining organizational capabilities in industrial sectors that are intensive on critical infrastructure. These frameworks are instrumental in developing a comprehensive understanding of the factors influencing effective change management in highly regulated, technologically dynamic, and operationally demanding environments, such as hydrocarbon pipeline transportation.

2.1. Models of Change

The following is a summary of the main approaches to organizational change management, highlighting their applicability in digital transformation processes in oil pipelines.

1. Lewin's Change Model in the Digital Context - Lewin's three-stage model

This approach is based on the three classic stages of change theorized by Kurt Lewin: unfreezing, change, and refreezing.

- Unfreezing is defined as the process of raising awareness about the necessity of digital transformation and overcoming organizational inertia (Burnes, 2004).
- Change: This dynamic process entails the integration of advanced technologies and digital methodologies, in addition to cultivating new competencies (Burnes & Bargal, 2017).
- Refreezing: The focus of this study is to examine the development of novel digital practices and the establishment of a culture of continuous innovation (Cummings, Bridgman, & Brown, 2016).

2. ADKAR model in digital transformation

The model discussed was developed by Prosci (Hiatt, 2006). It delineates five desired outcomes, making it particularly useful for addressing the human dimension of digital transformation and managing the adoption of specific technologies.

- It is imperative to raise awareness regarding the necessity of digital transformation.
- The objective is to elicit a desire that will serve as the impetus for individuals to engage in digital transformation.
- It is imperative to acquire knowledge in the following areas: new technologies, processes, tools, and digital methodologies.
- The development of skills and competencies to operate in a digital environment is imperative.
- It is imperative to reinforce digital change in order to ensure its sustainability over an extended period.

The practical emphasis on individuals makes it a valuable tool for measuring and managing the adoption of specific technologies. This model is noteworthy for its focus on individual resistance management; however, it should be complemented by structural frameworks that consider the organizational level (Hornstein, 2015).

3. Kotter's 8-step change model (accelerators), updated for digital transformation

The original proposal of Kotter's eight-step model was made in 1995. Subsequently, it underwent an update to address the challenges posed by digital transformation in an increasingly volatile and complex business environment (Kotter, 2014). In this latest iteration, the conventional steps are reimagined as "accelerators" that function in a concurrent and uninterrupted manner, deviating from the rigid linear sequence characteristic of prior iterations. This methodological shift acknowledges the dynamic and interconnected nature of digitization processes, underscoring the necessity for enhanced organizational agility and expanded employee involvement at all levels (Kotter, 2012a).

The revised model emphasizes the importance of instilling a sense of urgency regarding digital prospects, establishing diverse and adaptable coalitions, and nurturing a "network of volunteers" to catalyze change across multiple organizational domains (Appelbaum, Habashy, Malo, & Shafiq, 2012). It also incorporates elements specific to the digital age, such as data management, cybersecurity, and fostering a culture of innovation, as essential components for ensuring the success of transformation (Pollack & Pollack, 2015).

Kotter's updated model offers a framework based on the original eight steps: creating a sense of urgency, forming a guiding coalition, developing a vision and strategy, communicating the vision for change, empowering employees, generating quick wins, consolidating gains, and anchoring the changes in the culture. These steps serve as simultaneous accelerators that foster agility and digital innovation. Digital transformation is conceptualized as a process of continuous acceleration and constant evolution. In this paradigm, early victories, agile coalitions, and active participation of people at all levels are essential for responding effectively to highly volatile environments.

Originally proposed in Kotter (2014) eight-step model was updated to address the challenges of digital transformation in an increasingly volatile and complex business environment (Kotter, 2014). In this new version, the traditional steps become "accelerators" that work simultaneously and continuously, rather than following a strict linear sequence. This methodological change recognizes the dynamic and highly interconnected nature of digitization processes, emphasizing the need for greater organizational agility and broader employee participation at all levels (Kotter, 2012a).

The revised model emphasizes the importance of creating a sense of urgency around digital opportunities, forming diverse and agile coalitions, and cultivating a "network of volunteers" to promote change from multiple points within the organization (Appelbaum et al., 2012). It also incorporates elements specific to the digital age, such as data management, cybersecurity, and fostering a culture of innovation, as essential components for ensuring the success of transformation (Pollack & Pollack, 2015).

4. DICE change model

The DICE model presents a quantitative framework for evaluating the probability of success in modifying projects, based on four factors: duration, integrity, commitment, and effort. The factors identified as most significant in determining success include these four elements.

- The term "duration" is used to denote the time between major project reviews. In the context of digital transformations, it is imperative to establish frequent and measurable milestones to ensure effective monitoring and enable timely adjustments (Kane, Phillips, Copulsky, & Andrus, 2019; Sirkin, Keenan, & Jackson, 2005).
- The integrity of a project team is evaluated based on its capacity and experience. Digital transformation requires interdisciplinary teams that have a clear understanding of technology's role in the business (Aguirre & Alpern, 2014; Westerman, Bonnet, & McAfee, 2019).
- The concept of commitment is multifaceted and can be distinguished between the commitment of senior management and that of employees. Both factors are critical and must be supported by adequate training and clear communication of the benefits of change (Bonnet & Westerman, 2021; Sirkin et al., 2005).
- Effort is defined as the additional demands placed on employees due to digitization implementation. This transition often requires acquiring new skills and methodologies, which can lead to exhaustion from change (Sirkin et al., 2005; Tabrizi, Lam, Girard, & Irvin, 2019). Consequently, effective management of this effort is paramount to ensure the successful integration of digitization within the organizational structure.

The implementation of the DICE model in the context of digital transformation initiatives facilitates a multifaceted evaluation process, encompassing the identification of potential risks, the delineation of critical domains, the continuous monitoring of progress, and the agile adjustment of implementation strategies. The proposed methodology is intended to provide a structured approach to the prioritization of projects, with the objective of encouraging a culture of adaptability. The present study hypothesizes that this will result in a significant increase in the likelihood of success in the adoption of technological and organizational changes (Kane et al., 2019; Sirkin et al., 2005; Westerman et al., 2019).

5. Sociotechnical approach to change

The core principles of the model include:

- Joint optimization: ensuring that both the technical and social systems develop in parallel to guarantee sustainable transformation (Eason, 2014).
- Participatory design: actively involving employees in redesigning processes and adopting new technologies, which promotes acceptance of change and leverages staff's tacit knowledge (Mumford, 2006).
- Adaptability and flexibility: creating structures that can respond to changing and digitally demanding environments (Clegg, 1989).
- Autonomy and self-regulation: promoting self-managing teams, encouraging innovation and effective problem-solving.

The socio-technical approach (STA) acknowledges the interdependence between social systems (i.e., people, culture, relationships) and technical systems (i.e., processes, technology, tasks) within organizations (Appelbaum, 1997). The concept's genesis can be traced to the Tavistock Institute during the 1950s, and it has undergone a metamorphosis in response to contemporary challenges posed by digital transformation, where the harmonious integration of social and technological dimensions becomes paramount (Baxter & Sommerville, 2011). The fundamental principles of the model are as follows:

- The concept of joint optimization involves the deliberate and coordinated development of both technical and social systems, with the objective of ensuring that these two dimensions of change operate in a complementary and synergistic manner. This approach, as articulated by Eason (2014), is predicated on the premise that the evolution of both technical and social systems must occur in a synchronous manner to ensure the efficacy and sustainability of the transformation process.

- Participatory design is defined as the active involvement of employees in redesigning processes and adopting new technologies. This approach has been shown to promote acceptance of change and leverage staff's tacit knowledge (Mumford, 2006).
- The ability to adapt and demonstrate flexibility in one's structures is paramount in the face of evolving and technologically sophisticated environments (Clegg, 2000).
- The promotion of autonomy and self-regulation is of paramount importance in the context of contemporary team dynamics. The establishment of self-managing teams, the cultivation of innovation, and the facilitation of effective problem-solving are fundamental to this endeavor (Van Eijnatten & Van Der Zwaan, 1998).

In the context of digital transformation, STA offers key advantages.

- A holistic vision that integrates technology and the human factor is essential for successful digitization (Sarker, Chatterjee, Xiao, & Elbanna, 2019).
- Greater emphasis must be placed on effective change management, which entails a thorough consideration of the social ramifications of innovation and a concerted effort to mitigate resistance (Wieringa et al., 2021).
- Sustainable innovation is predicated on robust solutions that respect technical and human capabilities (Pasmore, Woodman, & Shani, 2019).
- According to the findings of Winter, Griffiths, and Green (2014), the level of engagement and satisfaction among employees was found to be positively correlated with active participation in the specified process.
- It is imperative to enhance organizational adaptability, as it is a fundamental component of resilience in digital business environments (Bednar & Welch, 2020).

In the contemporary digital age, the socio-technical approach emerges as a particularly pertinent framework, facilitating the integration of intricate technological systems with prevailing social structures. This integration fosters a more robust and sustainable transformation, ensuring that technological advancements are harmoniously interwoven with existing social frameworks, thereby enhancing overall societal resilience and sustainability (Baxter & Sommerville, 2011).

6. Theory of diffusion of innovations

Rogers (2003) theory elucidates the mechanisms, dynamics, and velocity of the diffusion of novel concepts and technologies within social systems. Its relevance has persisted across various disciplines, from technology to public health, and it is especially useful in explaining digital transformation within organizations. The model is structured around four main elements.

- Innovation is defined as an idea, practice, or object perceived as new. Its adoption depends on characteristics such as relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003).
- The following communication channels are identified as both interpersonal and mass media; they are essential for sharing information and building trust (Dearing & Cox, 2018).
- The temporal element is intricately intertwined with decision-making, individuals' innovative disposition, and the rate of adoption.
- A social system is defined as "a set of actors who interact to achieve shared goals" (Rogers, 2003).

A fundamental element of the model is the classification of adopters, which identifies five distinct categories.

1. Innovators (2.5%) are characterized as adventurous, with a high tolerance for risk and the necessary resources for experimentation (Dedehayir, Ortt, & Seppänen, 2017).
2. According to Chang (2010), "early adopters" are defined as "opinion leaders who validate innovation and accelerate diffusion."
3. The Early Majority (34%) is characterized as a group of practical adopters who utilize social media to establish connections (Talukder, 2019).

4. The Late Majority (34%) has been shown to exhibit a greater degree of skepticism (Mehmood, Natgunanathan, Xiang, Hua, & Guo, 2016). This demographic has been observed to adopt new practices due to external pressures or economic necessity.
5. Laggards (16%) are defined as traditionalists who exhibit a strong attachment to past experiences and limited resources (Sahin, 2006).

The value of this classification lies in the possibility of designing segmented implementation strategies, which include the following: identifying internal opinion leaders (Wisdom, Cavaleri, Onwuegbuzie, & Green, 2014), anticipating resistance (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004), and adapting training programs to each group (Straub, 2017). In the context of digital transformation, this model facilitates the planning of targeted interventions that enhance the acceptance and impact of change (Kahn, 2018).

The application of this theory has been observed in various domains, including the adoption of blockchain, artificial intelligence, and virtual reality (Kamble, Gunasekaran, & Sharma, 2018), organizational digital transformation (Vial, 2021) the dissemination of sustainable practices (Olsson, Folke, & Hughes, 2019), and digital health (Greenhalgh et al., 2017). These findings provide substantiation for the efficacy of this theory as a management instrument for innovations in dynamic environments.

7. Design Thinking for digital transformation

The notion of Design Thinking has given rise to a discourse surrounding its categorization as a model or a methodology. As a model, it provides a structured framework for addressing complex problems through a series of defined stages, including the following: The following five steps are recommended for effective problem-solving: (1) establishing empathy, (2) defining the problem, (3) ideation, (4) prototyping, and (5) testing. The methodology under discussion is notable for the practical and repeatable techniques it provides, which have been shown to foster creativity and innovation (Brown, 2008).

When applied to the context of digital transformation, Design Thinking integrates design principles with the requirements for business adaptation, thereby proposing an iterative and non-linear process oriented toward user-centered solutions (Brown & Katz, 2019). The five key stages of the process are as follows:

1. Empathize: This involves understanding the needs of users, customers, and employees through collecting both qualitative and quantitative data. This process enables the identification of opportunities for change (Liedtka, Salzman, & Azer, 2017).
2. The following definition is provided to delineate the digital problem or challenge: the problem or challenge is to be defined by aligning transformation objectives with organizational needs. This definition is based on insights gained (Gruber, Zuberbühler, Clément, & Van Schaik, 2015).
3. In an environment conducive to creativity and divergent thinking, the ideation phase involves generating multiple solution alternatives, encompassing both technological and organizational possibilities (Vetterli, Uebernickel, Brenner, Petrie, & Stermann, 2016).
4. Prototype: construct tangible, cost-effective representations of the most promising solutions, such as application mockups or process simulations (Yoo, Boland, Lyytinen, & Majchrzak, 2006).
5. An evaluation of test prototypes with real users is necessary to collect feedback and iteratively refine solutions before mass implementation (Kolko, 2015).

Design Thinking, in this sense, presents a malleable, human-centered methodology that fosters sustainable digital innovation, mitigating the risks associated with organizational resistance and aligning solutions with stakeholder expectations.

8. Practical application of Design Thinking

The implementation of Design Thinking in the context of digital transformation confers several benefits that extend beyond the technological, encompassing both human and organizational dimensions. First, its user-centered approach ensures that digital initiatives respond to real needs, increasing the likelihood of adoption and success

(Rosenbaum, Rubin, & Imbens, 2021). Furthermore, the model fosters rapid iteration, enabling continuous improvement and agile adaptation to constantly evolving environments (Magistretti, Dell'Era, & Petruzzelli, 2019).

Another significant contribution is holistic innovation, which incorporates technical, human, and cultural dimensions. This is a crucial element for the sustainability of digital transformation (Ciriello, Richter, & Schwabe, 2018). Conversely, the participatory approach of Design Thinking has been demonstrated to promote more effective change management by engaging stakeholders in the design and implementation of solutions, thereby reducing resistance and fostering a culture of innovation (Elsbach & Stigliani, 2018). Finally, it fosters organizational adaptability by promoting experimentation and continuous learning, which are imperative for developing dynamic capabilities in the digital age (Schmiedgen, Rhinow, Köppen, & Meinel, 2016).

9. Agile change management model

The Agile Change model adapts the principles of the Agile Manifesto to the field of organizational management. It prioritizes people and interactions, collaboration with stakeholders, incremental value delivery, and responsiveness to change (Cobb, 2011). Its approach is characterized by short planning and implementation cycles, aimed at continuous adaptation (Kotter, 2014), early delivery of value (Worley & Mohrman, 2014), team empowerment (Holbeche, 2018), and transparent and frequent communication (Dikert, Paasivaara, & Lassenius, 2016).

The following components are of particular significance: an adaptive, continuously adjusted vision (Bushe & Marshak, 2015), a change backlog that prioritizes initiatives (Adrian, Abdullah, Atan, & Jusoh, 2018), and change sprints with specific objectives (Rigby, Sutherland, & Takeuchi, 2016). Other components include a change backlog that prioritizes initiatives (Aghina et al., 2018), change sprints with specific objectives (Rigby et al., 2016), and retrospectives that drive organizational learning (Kotter & Schlesinger, 2008).

The implementation of this model has been shown to yield a number of advantages, including enhanced speed and flexibility (Denning, 2018), increased employee engagement (Worley & Mohrman, 2014), reduced risk through incremental deliveries (Kotter, 2014), and improved strategic alignment (Aghina et al., 2018). However, the implementation of these changes is not without its challenges. These challenges include the need for cultural change (Holbeche, 2018), the balance between agility and stability (Dikert et al., 2016), and the development of new skills (Bushe & Marshak, 2015).

In summary, agile change is an adaptive, value-focused approach to managing organizational complexity in volatile contexts, combining iteration, collaboration, and continuous learning (Denning, 2018; Rigby et al., 2016).

10. Digital maturity change model

Digital maturity, as defined by Westerman et al. (2019), refers to an organization's capacity to align its processes, culture, and strategy with the ever-evolving digital landscape. Kane et al. (2019) identify four core dimensions: strategy and culture, people and skills, processes and governance, and technology and infrastructure. It is imperative that these dimensions be developed in a balanced manner. A comprehensive digital strategy, a culture of innovation (Kane, Palmer, Phillips, Kiron, & Buckley, 2017; Westerman et al., 2019) the enhancement of digital competencies (Sousa & Rocha, 2019) the digitization of processes (Berghaus & Back, 2016) and the adoption of emerging technologies with flexible and secure infrastructure (Matt, Hess, & Benlian, 2015) are pivotal components.

In their initial version, Westerman et al. (2019) proposed a model based on two axes: digital intensity and transformation management capability. This model was used to classify organizations as beginners, conservatives, "trendy," digital masters, and, subsequently, digital natives. Subsequent models, such as that of Kane et al. (2017), expand this vision with more detailed stages of evolution, while Berghaus and Back (2016) develop the St. Gallen Model, with nine dimensions as a roadmap for transformation.

The digital maturity model fulfills several functions: it provides an assessment of the current state (Teichert, 2019), supports strategic planning (Heavin & Power, 2018), measures progress over time (Valdez-De-Leon, 2016), and facilitates benchmarking with the industry (Rossmann, 2018). In addition, it has been adapted into sector-specific versions (Chanias & Hess, 2016) and integrated with other frameworks, such as talent management (Tracz-Krupa,

Stachowska, & Wziątek-Staśko, 2021). Recent models underscore the significance of agility and organizational resilience as critical determinants of digital maturity (Warner & Wäger, 2019).

When considered as a whole, this approach provides a flexible framework that enables organizations to comprehend their position on the path to digital transformation, plan their evolution, and measure results (Kane et al., 2017; Teichert, 2019). However, its value lies in its use as a guide for orientation and adaptation to context, rather than as a rigid prescription (Berghaus & Back, 2016; Warner & Wäger, 2019). The Figure 1 presents the timeline evolution of the models considered in the case study and their relationship according to the literature consulted.

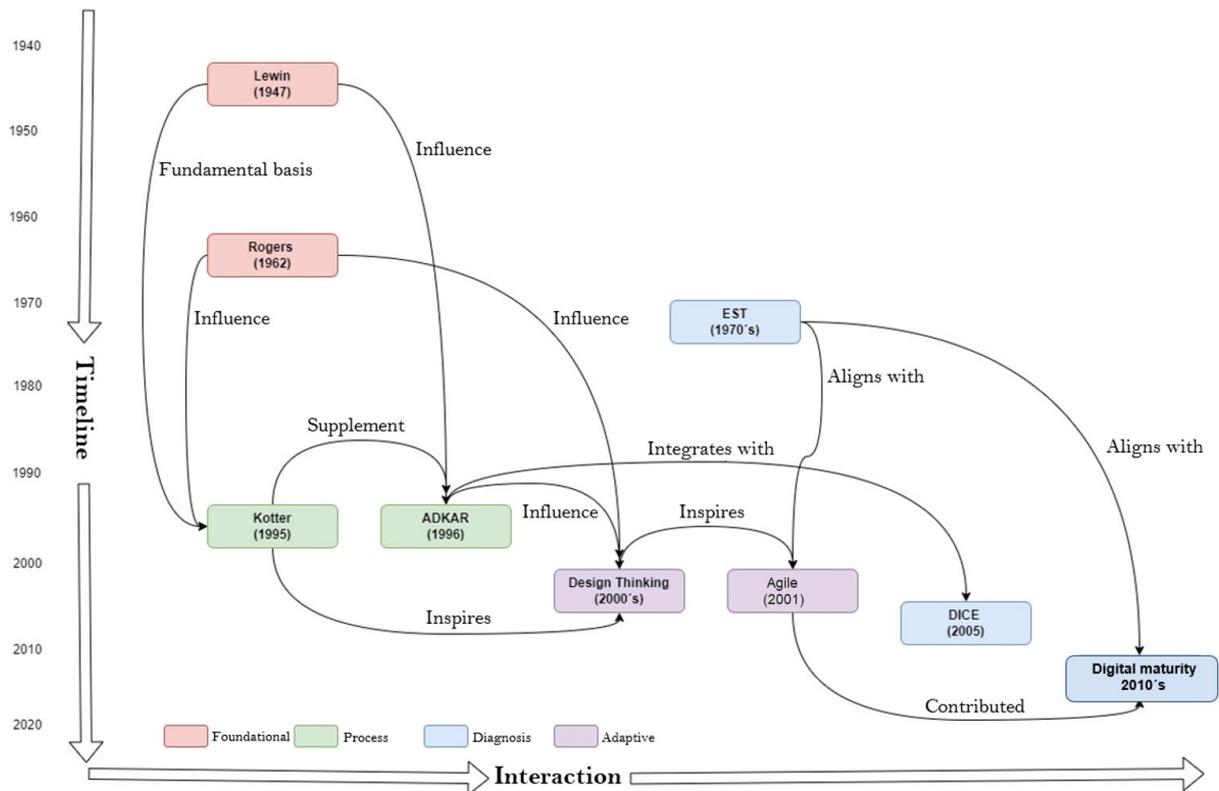


Figure 1. Sociogram - Evolution and relationship of change models over time.

The relationships between the various organizational change models represented in the sociogram have been defined based on the historical evolution of change management theories and the mutual influences between these models. The main connections are explained below:

The relationships between the organizational change models represented in the sociogram are based on the historical evolution of management theories and their mutual influences.

- **Fundamental basis:** Lewin to Kotter. Lewin's three-stage model (Lewin, 1947) laid the conceptual foundations for change, which were later expanded by Kotter (2012b) in his 8-step model (Burnes, 2004; Cummings et al., 2016).
- **Influence:** Rogers to Kotter. Rogers' diffusion of innovations theory Rogers (2003) influenced Kotter's vision, especially in coalition building and change communication (Pollack & Pollack, 2015).
- **Integration:** ADKAR and DICE. ADKAR (Hiatt, 2006) and DICE (Sirkin et al., 2005) are complementary, addressing both the individual dimension and the management of change projects (Bejinariu et al., 2017).
- **Inspiration:** Kotter to Design Thinking and Agile. Kotter's model served as a foundational basis for contemporary approaches, including Design Thinking and Agile methodologies. These methodologies were developed by disseminating principles related to vision, communication, and the attainment of initial successes (Brown, 2008; Cummings & Worley, 2014).

- Alignment: Sociotechnical and digital maturity. The sociotechnical model (Appelbaum, 1997) and the concept of digital maturity are congruent in their integration of social, cultural, and technological dimensions to achieve effective transformation (Kane et al., 2017).
- Contribution: Design Thinking and Agile to digital maturity. It is evident that both approaches are conducive to achieving high levels of digital maturity through their emphasis on user-centered innovation and adaptive agility (Westerman et al., 2019).
- Rogers and Design Thinking. Rogers' seminal theory, published in 1962, exerted a significant influence on the field of Design Thinking, as evidenced by its emphasis on empathy, iterative prototyping, and adaptation to the social context (Brown, 2008; Norman & Verganti, 2014).

Collectively, these relationships mirror the progression of thought regarding organizational change, spanning from Lewin's foundational principles to contemporary models of digital maturity. Each proposal has been developed to build upon its predecessors, thereby addressing increasingly intricate organizational and technological contexts.

Despite the variety of existing models, including classical frameworks (Lewin, Kotter, ADKAR), quantitative approaches such as DICE, socio-technical perspectives, agile methodologies, and digital maturity models, there is a lack of integrated frameworks tailored to the specific challenges of digital transformation and safety-critical operations in pipeline infrastructures. Existing models tend to focus on human adoption, technological implementation, or cultural alignment in isolation, creating a gap regarding the combination of these dimensions into a coherent, operationalizable methodology. This gap prompted the development of the IOCM, which aims to unify these approaches into a model adapted to the specific needs of Colombia's hydrocarbon pipeline sector.

2.2. Digital Transformation

Digital transformation is defined as the integration of digital technologies into all areas of a company, resulting in the modification of its operations, business models, and organizational culture to generate value (Vial, 2021). This phenomenon extends beyond mere technological adoption, necessitating strategic, cultural, and operational modifications. The fundamental components of the aforementioned system are as follows.

- The prevailing organizational culture is marked by a high degree of agility, innovation, continuous learning, and a pronounced customer focus (Hartl & Hess, 2017; Kane, Palmer, Phillips, Kiron, & Buckley, 2015; Teece, Peteraf, & Leih, 2016; Westerman et al., 2019). Leadership has been demonstrated to drive vision, empowerment, and data-driven decision-making (Fitzgerald, Kruschwitz, Bonnet, & Welch, 2014) while a growth mindset has been shown to encourage experimentation and improvement (Dweck, 2016; Matt et al., 2015).
- Digitization is defined as the process of converting analog information into digital form. This process serves as the foundation for digital transformation. This paradigm encompasses not solely conversion processes but also the reengineering of operational procedures through the integration of digital technologies, including the Internet of Things (IoT) and data analytics (Legner et al., 2017; Westerman et al., 2019).
- Digital innovation is defined as the creation of products, services, and business models enabled by digital technologies (Nambisan, Lyytinen, Majchrzak, & Song, 2017).
- Organizational agility is defined as the ability to adapt quickly to changes in the digital environment by adjusting processes, structures, and operations (Warner & Wäger, 2019).

In the contemporary business landscape, digital transformation has emerged as a pivotal strategy for maintaining competitiveness (Sebastian et al., 2017) enhancing operational efficiency (Hess, Matt, Benlian, & Wiesböck, 2016) delivering superior customer experiences (Verhoef et al., 2021) propelling innovation (Nambisan et al., 2017) and fortifying organizational resilience, as exemplified during the pandemic (Fletcher & Griffiths, 2020).

In the hydrocarbon industry, digital technologies are driving transformation; the most relevant are described below.

- The Internet of Things (IoT) facilitates real-time monitoring of pipelines and equipment, thereby enhancing safety and efficiency (Alsubaie, Almalki, & Almalki, 2023; Shukla, Singh, & Sharma, 2021).
- The utilization of artificial intelligence (AI) and machine learning algorithms has emerged as a pivotal strategy to enhance production efficiency, predict potential failures, and facilitate secure remote operation (Mohammadpoor & Torabi, 2020).
- Big Data & Analytics have been demonstrated to facilitate predictive maintenance and reduce operational incidents (Rahman, Perry, Müller, Siepmann, & Klauser, 2023).
- Cloud computing is a technological framework that facilitates the storage and analysis of substantial volumes of data, as well as remote collaboration (Kohli & Johnson, 2011).
- Digital twins have been demonstrated to facilitate the simulation of pipeline systems, with the objective of optimizing flows and efficiency (Krishnamurthy, Radhakrishnan, & Ganesan, 2024).
- The field of cybersecurity is concerned with the protection of critical infrastructure, data, and interconnected operations through proactive detection and response approaches (Alazab, Alhyari, Awajan, & Abdallah, 2024; Aldawood & Skinner, 2023; Manworren, Letwat, & Daily, 2023).
- Blockchain: The implementation of these technologies ensures the provision of traceability, smart contracts, and transparency within the supply chain (Kshetri & Voas, 2024; Mohanta, Jena, Panda, & Sobhanayak, 2019; Zhang, Wu, & Xu, 2023).
- Augmented and virtual reality have been demonstrated to be effective in training, maintenance, inspection, and data visualization applications. These technologies have been shown to enhance safety measures and reduce financial expenditures (Eiris, Jain, Wen, & Abdelkarim, 2023; Gómez-Sánchez, Pontes-Pedrajas, & Sánchez-Cañizares, 2024; Palmarini, Erkoyuncu, & Roy, 2024).

In the oil pipeline sector, the implementation of these technologies has demonstrated benefits, including improved asset management, real-time monitoring, predictive maintenance, and reduced operational risks.

2.3. Digital Maturity

Digital maturity is defined as the extent to which an organization has adapted its processes, culture, and strategy to leverage digital opportunities (Westerman, Bonnet, & McAfee, 2012). This concept encompasses both technological adoption and the ability to adapt and demonstrate resilience in constantly changing environments.

In this context, digital capabilities play a central role. They are not limited to the implementation of technologies; rather, they involve their integration into all aspects of the business (Kane et al., 2017). The implementation of this initiative necessitates establishing technological infrastructure, utilizing data analytics for decision-making, providing digital experiences for customers, automating processes, and continuously innovating existing practices. As Jäfvvert and Gustafsson (2019) have demonstrated, organizations that achieve the greatest success in their digital transformation processes are those that combine investment in technology with staff skill development and the adaptation of internal processes. However, these capabilities only reach their true potential when accompanied by effective digital leadership, understood as the combination of traditional skills with a deep understanding of the implications of digitization (Westerman et al., 2019). Such leadership is characterized by the capacity to articulate a coherent digital vision, institute governance frameworks, promote innovation, and navigate the organization through periods of transformation. Research by Jäfvvert and Gustafsson (2019) confirms that organizations with leaders capable of articulating and sustaining a coherent digital vision tend to advance more rapidly in their digital maturity.

To comprehensively assess an organization's digital maturity and position it on its evolutionary trajectory, a systematic evaluation approach is imperative. The model developed by the MIT Center for Digital Business and Capgemini Consulting posits two dimensions: digital capability (technology investment) and transformation intensity (leadership to drive change) (Westerman et al., 2012). Contemporary approaches, however, have proposed the inclusion of additional dimensions, such as digital strategy, organizational culture, processes, technological

infrastructure, innovation, and customer experience (Jäfvvert & Gustafsson, 2019). Digital maturity is not a static final state but a dynamic, ongoing process of adaptation and improvement. Organizations combine technological and leadership capabilities to ensure their survival and success in the digital age.

2.4. Case Study Sector: Hydrocarbon Transportation by Pipeline in Colombia

Pipelines represent a foundational element of the global energy infrastructure, assuming a pivotal function in the realm of national and international energy security. According to the International Energy Agency (2023), pipelines are the most efficient and secure means of transporting oil and natural gas, moving large volumes over long distances at relatively low operating costs. According to the American Petroleum Institute (2022), pipelines play a pivotal role in the energy supply chain within the United States, as they are responsible for the transportation of approximately 70% of crude oil and refined products.

In Colombia, pipelines play a crucial role in transporting hydrocarbons. There are some differences between pipeline infrastructure in Colombia and the United States. According to the National Hydrocarbons Agency (2022), Colombia has a pipeline network extending approximately 8,500 kilometers, facilitating the transportation of most of the country's oil production. According to the Colombian Ministry of Mines and Energy (2023), pipelines facilitate the transportation of approximately 95% of the crude oil produced in the country, a figure that exceeds the percentage observed for the United States.

Cenit, the Colombian corporation leading in hydrocarbon transportation and logistics, reported that in 2022, it transported an average of 1,033,000 barrels per day through its pipeline network (Ecopetrol, 2023). This volume is estimated to account for approximately 90% of the country's total oil production, which, according to the National Hydrocarbons Agency (2022), averaged 1,145,000 barrels per day in 2022.

It is noteworthy that, in contrast to the United States, Colombia is even more dependent on pipelines for crude oil transportation. This phenomenon can be attributed to the country's topography, characterized by a predominance of mountains, and the limited development of alternative transportation infrastructure. Furthermore, pipeline transportation in Colombia is vital not only for the domestic market but also for exports, as it facilitates the connection between production fields and export ports in the Caribbean (National Hydrocarbons Agency, 2022).

Pipeline management organizations assume responsibility for the operation, maintenance, and management of transportation systems. These parties are involved in activities such as monitoring product flow, scheduling deliveries, performing preventive and corrective infrastructure maintenance, safety management, and ensuring compliance with regulations (Pharris & Kolpa, 2012).

3. METHODOLOGY

This study adopts an interpretive case study design with a mixed-methods approach to analyze the management of organizational change in the digital transformation of the hydrocarbon pipeline transportation sector in Colombia. The research follows a sequential logic in which empirical evidence from qualitative and quantitative sources is used to develop an integrated organizational change model and subsequently to assess its relevance and applicability through external expert validation. The methodology integrates a systematic literature review, the design of the research strategy and instruments, data collection and analysis, and discussion of results, ensuring a comprehensive and contextualized understanding of the phenomenon.

The methodological design was structured as a sequential and integrative process, beginning with a systematic review of literature on digital transformation and organizational change, which informed the conceptual framing of the study and the design of data collection instruments. Subsequently, qualitative and quantitative empirical data were collected through three complementary instruments: semi-structured interviews, a digital maturity assessment questionnaire, and expert validation interviews to identify patterns, practices, and challenges related to change management in the organizational context studied. The insights derived from this process supported the development

of the Integrated Organizational Change Model, which was then evaluated and refined through external expert validation.

3.1. Design of the Strategy and Instruments

The study follows an interpretive and inductive approach, focusing on how participants experience and manage organizational change during digital transformation initiatives within their operational context (Creswell & Poth, 2018). This approach allows for an in-depth exploration of change management practices in the Colombian oil pipeline sector, based on participants' perspectives rather than predefined hypotheses.

For analytical clarity, participants were grouped into three defined categories: (i) internal staff, including human talent specialists and managers; (ii) internal leaders, including process leaders and IT leaders involved in digital transformation, technology, and innovation; and (iii) external experts, who participated exclusively in validating the proposed model. The study draws upon the experience of internal staff and internal leaders within the organization under study, as well as the validation of external experts in digital transformation from other sectors. This approach acknowledges the intricacies and subjectivity of organizational realities (Merriam & Tisdell, 2016) and emphasizes a thorough examination of the phenomenon within its particular context (Yin, 2018).

The inductive nature of the research was fundamental, as the analysis was based on concrete observations through in-depth interviews and questionnaires without preconceived hypotheses, allowing patterns and themes to emerge from the data (Patton, 2015; Saldaña, 2021). This open and flexible approach proved to be particularly well-suited to exploring how organizational change models adapt to the context of digital transformation, capturing nuances and complexities that might otherwise go unnoticed in a more structured or deductive design (Flick, 2018; Stake, 2010).

The methodological process was structured in three complementary phases. First, in-depth interviews were conducted with internal staff and internal leaders, conceived as guided conversations (Yin, 2018). These semi-structured interviews were designed to provide the necessary flexibility to explore emerging themes while also facilitating an analysis of how organizational change models are applied and adapted in practice within the context of digital transformation. In a subsequent phase, a digital maturity assessment questionnaire was administered, adapted from the work of Jäfvert and Gustafsson (2019). This assessment utilized a seven-point Likert scale, encompassing technological, strategic, cultural, and operational dimensions. This quantitative instrument enabled the identification of the organization's strengths and opportunities for improvement in its digital transformation process, integrating strategic and operational perceptions.

The results obtained from these two phases were used to develop a methodological proposal that articulated the primary evidence with a review of academic and professional literature on models of change and digital transformation. The resulting model was structured into four sequential phases, which are described and evaluated in detail in the Results and Discussion section. The triangulation of primary and secondary sources enabled a thematic synthesis that identified patterns, trends, and best practices, generating a methodological framework adapted to the particularities of the pipeline sector while maintaining principles of broader applicability.

The third phase involved evaluating the 'Integrated Organizational Change Model' through in-depth interviews with external digital transformation experts from various sectors, including professionals with extensive experience in the hydrocarbons sector. This panel of external experts, selected through purposive sampling (Patton, 2015), provided critical assessments of the model's applicability, relevance, and effectiveness. To this end, a combination of Likert scales and open-ended questions was utilized, in accordance with the methodological recommendations of Kvale and Brinkmann (2015). The responses were analyzed using thematic analysis techniques (Braun & Clarke, 2021), which allowed the model to be refined and its external validity strengthened.

The field of study consisted of an organization that manages two oil pipelines with different operational characteristics, representing 5.47% of the national network, which exceeds 8,500 km (National Hydrocarbons Agency,

2022). In this context, the key informants included human talent specialists, managers, process and IT leaders from the organization, and strategic external experts. Furthermore, a panel of national and international experts in digitization and change management was consulted, with an average of more than 16 years of experience in sectors such as hydrocarbon transportation, manufacturing, virtual banking, and Fintech platforms. The diversity of profiles ensured a comparative and enriched view of the phenomenon.

The collected data was then systematically coded with the assistance of NVivo 14 software, facilitating both qualitative and quantitative analysis while ensuring methodological consistency. The research made a significant contribution to the advancement of knowledge in the field of organizational change management in the context of digital transformation in the oil pipeline sector. The proposal entailed the implementation of a validated and contextualized prescriptive model, which has the potential to serve as a foundational framework for future transformation initiatives within this sector and other industrial domains.

3.2. Information Collection, Processing, and Analysis Strategy

Data collection was designed using a mixed-methods approach that combined qualitative and quantitative techniques across three sequential phases, all conducted virtually to facilitate participation. In the initial phase, in-depth interviews were conducted with professionals in the organizational field. These interviews were recorded and transcribed for subsequent analysis. This methodological approach enabled the collection of rich and contextualized testimonies on the processes of change and digital transformation. In the second phase, a quantitative questionnaire was administered to key leaders in the organization via an online platform, thereby facilitating the efficient and systematic collection of information. In the third phase, in-depth interviews were conducted with external experts from various sectors. These external experts were able to provide a comparative perspective, thereby contributing to the evaluation and refinement of the preliminary findings. The entire process was carried out in accordance with the principles of informed consent, participant confidentiality, and strict compliance with ethical research principles.

To enhance clarity and transparency regarding the composition of the sample and the sources of empirical evidence, Table 1 summarizes the participant groups involved in the study, their roles, the number of participants in each group, and the type of data collected from each one.

Table 1. Summary of participants and data collection methods.

Participant Group	n	Role	Data Collected
Internal staff – Human talent specialists	2	Human talent management specialists.	Interviews
Internal staff – Managers	2	Strategic area managers	Interviews
Internal staff – Process leaders	4	Leaders of processes associated with digital transformation.	Interviews and digital maturity questionnaire
Internal staff – IT leaders	1	Technology and innovation leader	Interviews
External experts – Validation panel	6	Experts in digital transformation and change management	Model validation through interviews

The primary instrument used to validate the Integrated Organizational Change Model (IOCM) was an ad hoc expert questionnaire complemented by open-ended questions. The questionnaire items were developed based on the core components and phases of the IOCM, as well as evaluation criteria commonly reported in the literature on organizational change and digital transformation, such as logical consistency, completeness, added value, flexibility, and alignment with agile principles (Brown & Katz, 2019; Kotter, 2012b; Vial, 2021). Each relevant element of the model was translated into specific evaluative statements assessed using a five-point Likert scale.

Prior to its final application, the questionnaire was reviewed by a small group of specialists in change management and digital transformation to assess item clarity, relevance, and coverage. Subsequently, a pilot test was conducted with two external experts not involved in the case study. Their feedback led to minor wording adjustments and the inclusion of additional guidance for open-ended questions, improving clarity and interpretability.

Despite the limited size of the expert sample ($n = 6$), internal consistency of the instrument was assessed using Cronbach's alpha, yielding a value of 0.93, which indicates excellent reliability and coherence among the items (Mohamad, Sulaiman, Sern, & Salleh, 2015; Taber, 2018). The result supports the robustness of the instrument for expert-based validation in exploratory and model evaluation studies (Ursachi, Horodnic, & Zait, 2015).

The information was processed using a systematic and rigorous approach with the support of NVivo 14 software. The interviews were meticulously transcribed and coded, facilitating the identification of emergent themes related to digital transformation and organizational change management. Concurrently, the outcomes of the digital maturity assessment were incorporated into the analysis, enabling triangulation between qualitative perceptions and quantitative metrics. The construction of thematic nodes in NVivo, supported by both literature and empirical evidence, facilitated an iterative analysis that allowed for the recognition of patterns, comparison of perspectives, and strengthening of findings. Moreover, interviews with external experts contributed essential insights, thereby validating and enriching the methodological proposal, which enhanced the understanding of organizational change processes in the hydrocarbon pipeline transportation sector.

The primary information was derived from three complementary groups of actors. Initially, human talent specialists and process & IT leaders of the organization's operational processes offered an insider's perspective on the challenges of implementing digital transformation initiatives. Conversely, leaders of processes directly associated with digitization provided quantitative evidence on the current state of digital and leadership capabilities in the organization through their responses to the digital maturity questionnaire. In conclusion, a panel of external experts in digital transformation and change management, both from the oil pipeline sector and other industries, validated the proposed methodological approach and provided a comparative perspective enriched by the diversity of experiences and contexts. The integration of these perspectives fostered a comprehensive and multifaceted understanding of the phenomenon under investigation.

Furthermore, secondary sources that were instrumental in developing the theoretical and conceptual framework of the study were reviewed. The present review encompassed a wide range of academic material, including specialized literature, peer-reviewed articles, books, technical reports, and previous studies. Moreover, it drew upon conference proceedings and theses related to change management and digital transformation in industrial environments. Despite the fact that many of these sources were not specifically focused on the pipeline sector, their contributions were essential for identifying trends, patterns, and best practices that could be transferred to this context. This documentary collection played a dual role in the design process, providing both a conceptual framework for the design of the instruments and a foundation for interpreting the empirical findings.

In general, the collection and processing of information were carried out in accordance with rigorous ethical principles. Participation in the study was voluntary, and all subjects provided informed consent. The confidentiality and anonymity of the data collected were guaranteed at all times, using identification codes and restricting access to the information to the research team. In a similar manner, the results were presented objectively and respectfully, thus ensuring that the conclusions and recommendations remained in accordance with ethical and sustainable practices in the hydrocarbon pipeline transportation sector. The combination of methodological rigor, diversity of sources, and ethical responsibility ensured the credibility and validity of the study. Additionally, it furnished significant insights into the processes of organizational change and digital transformation in complex industrial contexts.

4. RESULTS AND DISCUSSION

The findings of this study demonstrate the practical implementation and validation of the Integrated Organizational Change Model (IOCM) within the hydrocarbon pipeline transportation sector in Colombia. The model was developed from a combination of existing theory and empirical evidence collected in a case study applied to two pipelines with different operational characteristics.

4.1. Culture and Organizational Change Models in Digital Transformation

The analysis of organizational culture yielded insights into how the company confronts the challenges posed by digital transformation. Preliminary analysis of the study, as indicated by the interviews and word clouds developed for the study, suggests certain values, including teamwork, people, and communication. Additionally, the analysis suggests certain aspirations, including agility, solidity, and compliance. These elements suggest a balance between human capital and technological adoption in an environment that seeks to be adaptable and results-oriented. The application of the Cameron and Quinn (2011) matrix demonstrated a clear inclination toward adhocracy, which was predominant in five of the six participants. This finding indicates a disposition toward innovation, dynamism, and experimentation (Hartl & Hess, 2017). However, features of clan culture were identified, which value cohesion, a sense of community, and personal development (Schein & Schein, 2019). This combination reinforces the idea of fertile ground for change, where innovation and flexibility are balanced with support and collaboration.

With respect to antecedent experiences of technological change, participants described strategic projects, emphasizing integrated processes, indicators, and platforms. They highlighted the relevance of the human factor in change management. However, a discrepancy emerged in the utilization of formal models of organizational change, with only 33% of respondents admitting to their application, in contrast to the 67% who did not employ such models. This observation aligns with findings reported in the extant literature concerning disparities in digital maturity (Westerman et al., 2019).

The evaluation of various organizational change models enabled the identification of those that are most intuitive within this context. As demonstrated in Table 2, Lewin's model was the most widely recognized by internal staff and internal leaders, distinguished by its simplicity and practical applicability. The DICE model was highly regarded by human talent for its project management structure, while Design Thinking was praised for its innovative, user-centered approach. Conversely, models like ADKAR, Kotter, or Rogers were not seen as the most intuitive, although their irrelevance is not necessarily a certainty.

Table 2. Participants' affinity approach to the models.

Which of these models do you find most intuitive for your context?	Participant					
	TH1	TH2	LP2	LP3	LP4	LP11
Lewin			X	X	X	X
ADKAR						
Kotter						
DICE	X	X			X	
EST						
Rogers' Diffusion						
Design Thinking	X			X	X	
Agile change						X
Digital maturity						

In a similar vein, the study's findings on the stages of the ADKAR model revealed that the "awareness" phase emerged as the most challenging (67%), followed by the phases of knowledge and desire. Conversely, the skill and reinforcement phases were not perceived as problematic (see Figure 2). The findings of this study suggest that the primary challenge lies in effectively communicating the necessity for change and generating adequate initial

motivation. This underscores the importance of employing comprehensive, segmented communication strategies and adopting inspirational leadership (Kotter, 2012b; Lewis, 2019).

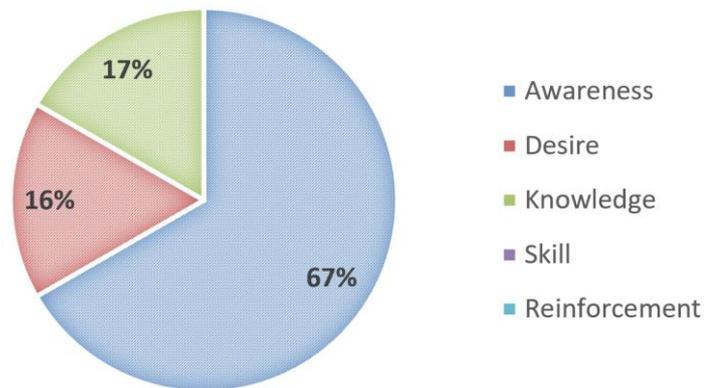


Figure 2. Perception of challenge in the stages of the ADKAR model.

The findings indicate that the organization possesses an organizational culture conducive to innovation, exhibiting strengths in flexibility and cohesion. However, the organization encounters challenges in formalizing its change practices and in the initial awareness stage. This finding indicates that enhancing change management necessitates implementing more structured models and a heightened emphasis on strategic communication and the cultivation of early commitment. Conversely, the findings underscore the pivotal role of effective communication in change management. A consensus was reached among all participants regarding the necessity of adapting messages according to organizational roles and responsibilities. This adaptation included differentiating the manner of communication with managers from that with operational teams. This finding aligns with the extant literature on segmented communication (Kotter, 2012b; Lewis, 2019), which underscores the personalization of discourse as a pivotal factor in generating commitment and mitigating resistance in transformation processes (Armenakis & Harris, 2009). Another salient aspect pertains to the cultivation of a sense of urgency, in accordance with Kotter (2012b). The respondents' responses indicated that terms such as "understanding," "economic," and "necessity" are pivotal to this process. This suggests that participants perceive urgency as a collective endeavor that integrates economic motivations with individual and group ownership of change, a factor critical for overcoming inertia and natural resistance to change (Armenakis & Harris, 2009). Concurrently, the research demonstrated that participants acknowledged the significance of support networks in facilitating change. These networks are regarded as strategic entities that require deliberate creation and management to cultivate collaboration and facilitate change, leveraging the diversity of perspectives and experiences (Battilana & Casciaro, 2012; Cross, Gray, Cunningham, Showers, & Thomas, 2013). The emphasis on people and support underscores that these connections are conceived as both social support and a key organizational resource for digital transformation.

The findings also reveal that the alignment of new technologies with existing practices, as well as the redesign of processes around digital initiatives, are seen as gradual processes that require understanding and holistic integration. Additionally, the identification of innovators and early adopters serves to substantiate the pertinence of Rogers (2003) theory of diffusion of innovations, underscoring the strategic function of these agents in affecting the behavior of the majority of an organization. In this regard, methodologies such as Design Thinking and agile approaches were extensively valued by participants (83%) for their capacity to streamline processes, promote collaboration, and cultivate innovation (Ciriello et al., 2018; Magistretti et al., 2019). Nonetheless, a critical voice also emerged, calling into question the applicability of these methodologies to the hydrocarbons sector. This voice further underscored the necessity of adapting these methodologies to each industry's specific context.

4.2. Framework for Change for Digital Transformation in the Oil Pipeline Transportation Sector in Colombia

The proposed framework was developed based on a characterization of the sector, an assessment of the organization's digital maturity, and the formulation of a methodological model adapted to its particularities.

The subsequent section will address the challenges currently faced by the sector. Participants identified that managing one or more pipelines does not entail substantial differences in the digital technologies required, but rather in the need for parameterization and adaptation to specific conditions. The management of multiple systems is a complex undertaking, underscoring the necessity for flexible and scalable approaches. Furthermore, it was proposed that digital transformation is significantly influenced by the political and regulatory environment of the nation, which exerts a direct impact on operations and the business model. The interviewees concurred that, if digitization is implemented correctly, it tends to reduce operational risks. From a strategic standpoint, digital transformation is regarded as being in complete alignment with organizational objectives, serving as a key differentiating factor and a catalyst for enhancing efficiency and competitiveness. Projections made by half of the participants indicate that by 2030, establishing a "digitally native" pipeline will be deemed a feasible undertaking, though it is not yet regarded as a sectoral imperative. Finally, it is imperative to acknowledge that a monolithic model of change is inadequate in addressing the multifaceted nature of organizational transformation. A multifaceted approach, encompassing a combination of methodologies such as Kotter's, ADKAR, DICE, agile methodologies, and design thinking, is regarded as the most efficacious strategy to achieve the desired outcomes.

Digital maturity assessment: The application of the model developed by Jäfvert and Gustafsson (2019) enabled the assessment of 20 dimensions of digital maturity. Strengths include the integration of technologies into processes and customer focus, while governance of digital initiatives and automation of core processes are critical areas for improvement. Organizational culture and vision show significant progress in supporting change, which is a key enabler for digital transformation, in line with Hartl and Hess (2017) on the central role of culture in digitization processes. These results are consolidated in the box and whisker plots (Figure 3).

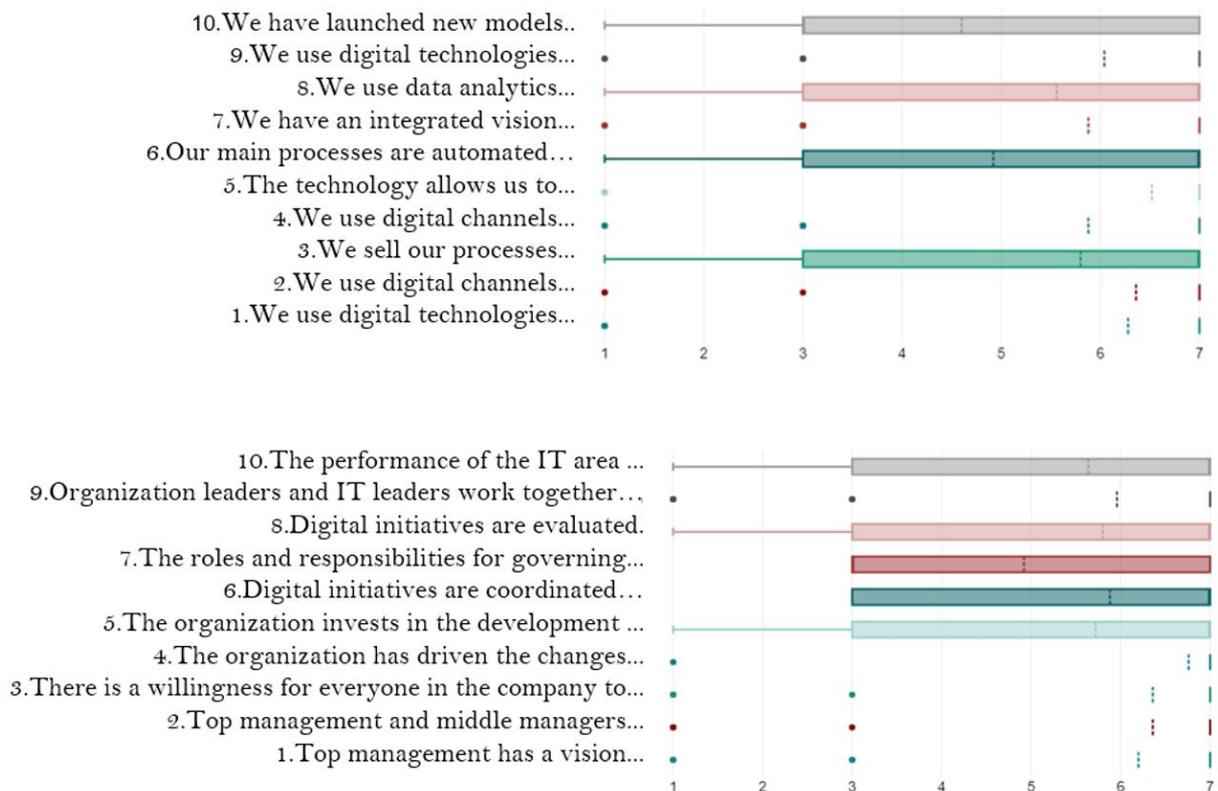


Figure 3. Box and whisker plots - Digital maturity measurement.

The maturity measurement results in the organizational synthesis are presented in the radar chart in Figure 3, which allows us to visualize both the general trend toward higher levels of maturity and the internal differences between areas and roles.

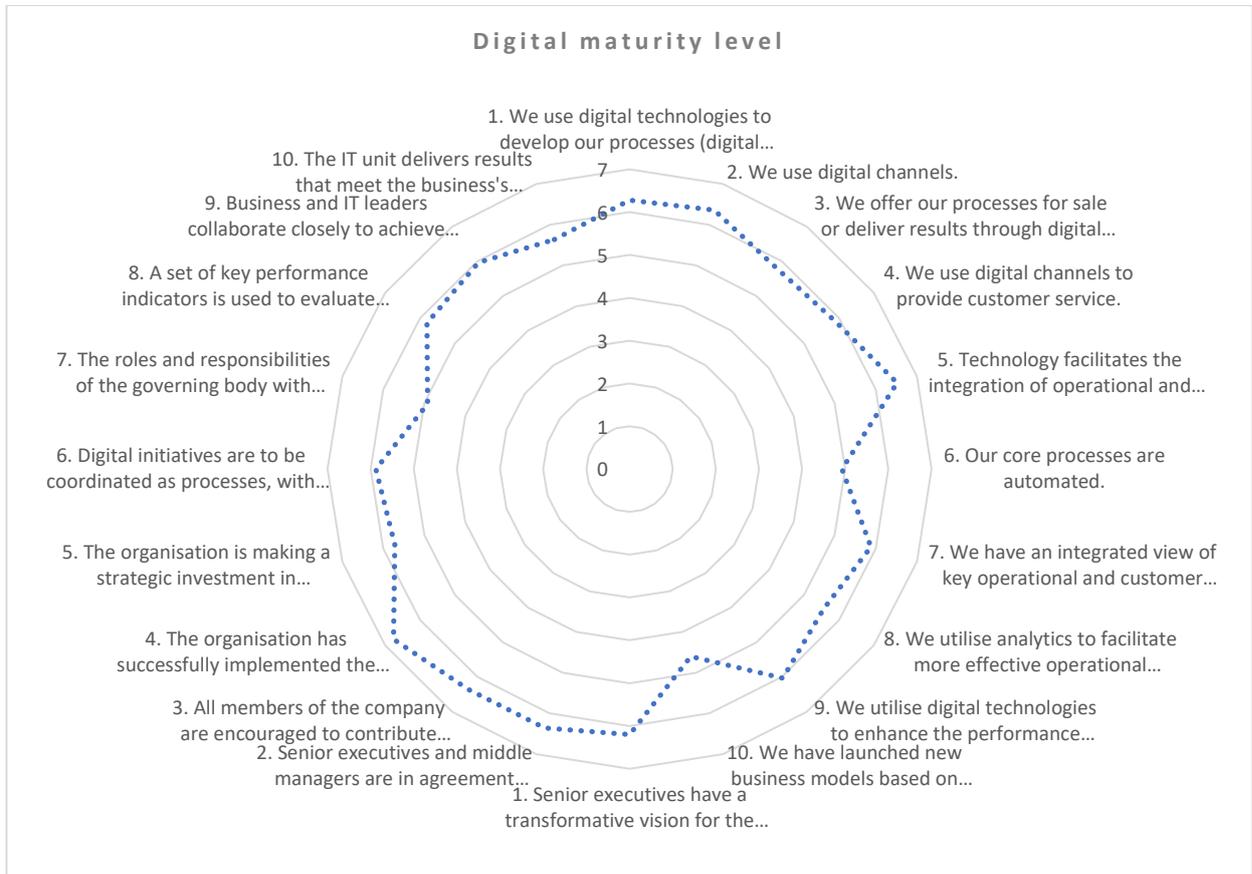


Figure 4. Maturity measurement results - Organization.

As demonstrated in Figure 4, the organization has a robust foundation for its transformation, characterized by synergy between strategy, culture, and digital capabilities.

The concentration in the digital master's quadrant demonstrates an advanced positioning consistent with the notion of digital ambidexterity (Teece et al., 2016), while the marginal presence of participants at initial levels reflects specific opportunities for strengthening.

Additionally, the absence of fashionista profiles suggests that technology adoption is driven by strategic and leadership support, thereby circumventing potential risks associated with superficial implementations. The findings indicate that the organization is undergoing a comprehensive digital transformation. However, it is imperative that the organization continues to manage existing gaps to ensure consistency at all levels.

Figure 5 illustrates the distribution of digital maturity results by participants, highlighting a predominant concentration in the digital teacher's quadrant and the absence of fashionista profiles.

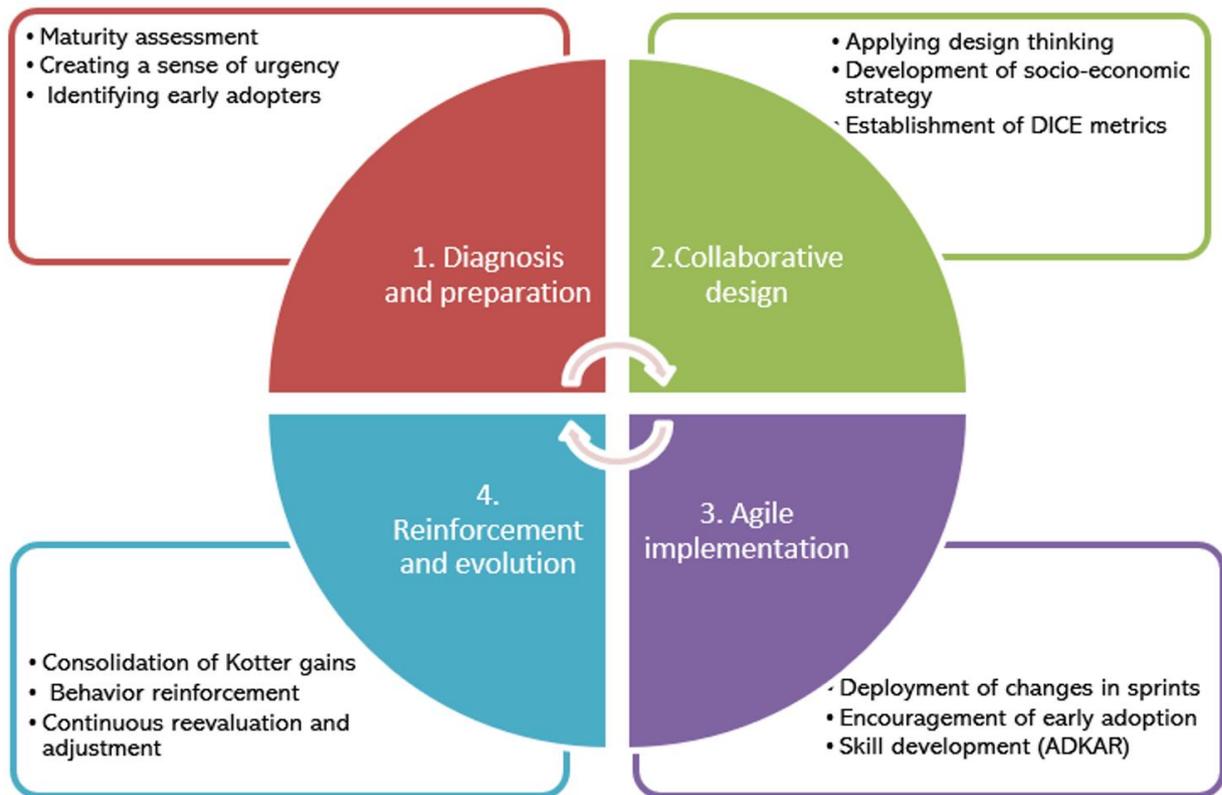


Figure 6. Integrated organizational change model (IOCM).

The findings indicate that digital transformation in hydrocarbon pipeline transportation in Colombia requires a hybrid change management framework sensitive to the regulatory environment. This framework must be supported by robust governance, innovation in business models, and a sustained focus on organizational culture.

4.3. Evaluation of the Integrated Organizational Change Model (IOCM)

The final phase of the research program focused on evaluating the Integrated Organizational Change Model (IOCM). Developed to guide digital transformation in the hydrocarbon pipeline transportation sector, the IOCM was validated by a team of internal and external experts. These experts assessed the model using several key criteria, including feasibility, alignment with strategic objectives, capacity to address challenges, and relevance in digital change contexts. The evaluation employed a questionnaire with both closed and open-ended questions, enabling a quantitative and qualitative assessment of each model phase, as well as its theoretical and practical components.

The findings suggest a substantial degree of acceptance for the model under consideration. On average, the experts evaluated its ability to address the challenges of digital transformation at 4.67/5, the logic and completeness of its phases at 4.83/5 (the highest score), and the added value derived from the integration of various approaches to change at 4.67/5. Additionally, it was determined that the IOCM possesses sufficient flexibility to adapt to varying organizational contexts (4.50/5) and that its iterative and agile approach is highly appropriate for digital transformation (4.67/5). The model's scores indicate that it has been successful in achieving a robust methodological framework, accompanied by a satisfactory degree of practical adaptability. This renders it a reliable and versatile instrument for digital change management.

The qualitative analysis supports this perception, enabling the observation of consistency between the numerical results and participants' discursive assessments. In Phase 1—Diagnosis and Preparation, the experts emphasized the importance of digital maturity assessment (5.00) as a starting point for identifying gaps and opportunities, followed by the identification of early adopters (4.67) and creating a sense of urgency (4.33) as key elements for generating organizational commitment. In Phase 2—Collaborative Design—the application of Design Thinking methodologies

received a rating of 4.17, while the development of a socio-technical strategy achieved the highest score in this phase (4.83). This reflects the importance of balancing technological and human components. The establishment of DICE metrics (4.67) was valued for its contribution to traceability and change control. In Phase 3—Agile Implementation, experts identified the need to improve deployment in sprints (4.17) and promote early adoption (4.00). They highlighted the efficacy of skills development under the ADKAR model (5.00) as the most effective practice. In Phase 4—Reinforcement and Evolution—the consolidation of gains according to Kotter (4.83) and reinforcement of behaviors (4.67) were noted. Continuous reassessment and adjustment (5.00) was recognized as a crucial strength for maintaining the sustainability of change.

These assessments indicate that the IOCM provides a methodical sequence in which each phase contributes to the consolidation of organizational change. The preponderance of expert opinion emphasizes the relevance of the model in enabling digital transformation processes by integrating strategic planning with adaptive change management.

It is recommended that the consideration of costs, financial metrics, and organizational impact be broadened; that more specific deliverables be defined for each phase of the project; and that the information management strategy be strengthened. Additionally, the proposal calls for the enhancement of the digital governance component through the incorporation of indicators of maturity in leadership, cybersecurity, and operational sustainability. Furthermore, participants recommended incorporating mechanisms to ensure the traceability of results, the measurement of return on investment (ROI), and the management of risks associated with technological change. It was also posited that the establishment of modular versions of the IOCM would allow for fine-tuning its level of complexity in accordance with the maturity and resources of each organization. This initiative entails the formulation of a streamlined iteration tailored to small and medium-sized enterprises, with a particular emphasis on technological integration and cultural evolution. Concurrently, an advanced version will be developed for corporations that possess well-defined mechanisms for innovation and digital transformation. In this regard, the experts reached a consensus that the model's adjustability and scalability would be pivotal to its successful implementation in various contexts within the energy and industrial sectors.

The consolidated statistical evaluation (Figure 7) demonstrates the reliability of the results, with means consistently exceeding 4.5 on a 5-point scale. The low variability in assessing the model's logic and completeness suggests an almost unanimous consensus on its structural soundness. When evaluated in its entirety, the evidence indicates that the IOCM constitutes a suitable, adaptable, and reliable methodological framework to facilitate digital transformation in organizations within the pipeline hydrocarbons sector. Additionally, the capacity for adaptation to diverse industrial contexts is a possibility.

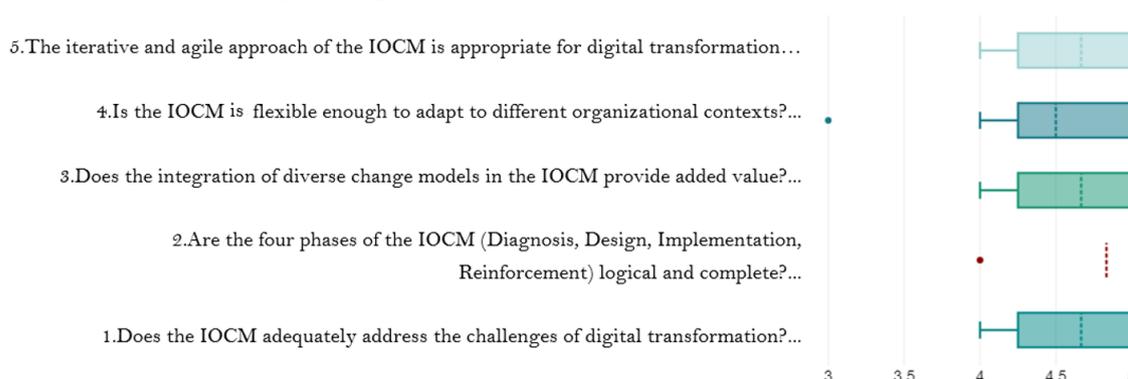


Figure 7. Box and whisker plot – Affinity results from participants.

To complement the descriptive analysis presented in Figure 7, additional statistical measures were calculated for the expert validation of the IOCM. For each item assessed using a five-point Likert scale, the mean and standard

deviation were computed (Table 3), allowing both the overall level of agreement and the dispersion of expert responses to be examined.

Table 3. Descriptive statistics of expert evaluation of the IOCM.

Evaluated item	Mean Score	Standard Deviation
Does the IOCM adequately address the challenges of digital transformation?	4.67	0.52
Are the four phases of the IOCM logical and complete?	4.83	0.41
Does the integration of diverse change models in the IOCM provide added value?	4.67	0.52
Is the IOCM flexible enough to adapt to different organizational contexts?	4.50	0.55
Is the iterative and agile approach of the IOCM appropriate for digital transformation?	4.67	0.52

In addition, inter-rater agreement among experts was assessed using the Intraclass Correlation Coefficient (ICC), yielding a value of 0.89, which indicates a high level of agreement and reliability in the evaluations (Koo & Li, 2016). Along with the low dispersion observed across items, these results suggest that expert assessments were both consistent and robust, strengthening the empirical validation of the proposed model.

In summary, the evaluation of the IOCM demonstrated its technical validity and practical applicability in complex industrial contexts. The findings, incorporating both quantitative and qualitative data, show that the model integrates strategic planning, change management, and digital transformation coherently, supported by an adaptive, evidence-based approach. The balance between methodological structure and operational flexibility highlights the tool's importance as a support mechanism for organizations in Colombia's hydrocarbons sector.

4.4. Discussion

The study's findings confirm the validity of the IOCM as an effective tool for managing organizational change in complex and heavily regulated industrial environments. The high level of acceptance by experts, both in terms of its structure and adaptability, corroborates the need for integrative and contextually sensitive approaches in digital transformation processes as proposed in the extant literature (Nambisan, Wright, & Feldman, 2019; Vial, 2021). The model also demonstrates a capacity for the practical translation of established theories of organizational change to the technical-operational field of hydrocarbon transportation, which constitutes a relevant contribution to the management of digital change in critical infrastructure sectors.

The phase of diagnosis and preparation was identified as a critical component, receiving an average rating of 4.67. It is noteworthy that the digital maturity assessment component received the highest possible rating of 5.00. This finding aligns with the conclusions of Teichert (2019), who asserts that this assessment constitutes the most pivotal strategic starting point for effective digital transformation. The predominant consensus on this matter suggests that digital transformation processes within the sector should commence with a thorough understanding of existing capabilities. This understanding facilitates the establishment of realistic goals, the prioritization of investments, and the conception of progressive interventions aimed at quantifiable outcomes.

The collaborative design phase received an average rating of 4.56, with the development of socio-technical strategies (4.83), DICE metrics (4.67), and the application of design thinking (4.17) being particularly noteworthy. These results underscore the importance of integrating human and technological factors from the planning stage of change, ensuring the viability and people-centeredness of digital solutions. The high rating of the socio-technical approach confirms the need to balance technology, culture, and processes. The use of design thinking and DICE metrics reinforces the model's focus on practical innovation and objective progress assessment.

Conversely, the agile implementation phase received a score of 4.39, with the development of ADKAR skills (5.00) being a notable aspect. This highlights the significance of human capital and digital skills as critical success factors. The implementation of agile sprints and the empowerment of early adopters have proven effective tactics for

increasing technology adoption. This finding aligns with the prevailing notion that organizational agility is not confined to project methodologies but encompasses a culture of continuous learning and rapid adaptation to change. This assertion is in accordance with the findings reported by Rigby et al. (2016) and Konopik, Jahn, and Schuster (2021).

The reinforcement and evolution phase, which received a score of 4.83, underscored the significance of institutionalizing novel practices and establishing mechanisms for continuous learning. This outcome aligns with the proposals for continuous enhancement in digital environments outlined by Appelbaum et al. (2017) and Denning (2018). Conversely, the exceptional rating for reevaluation and continuous adjustment (5.00) substantiates that the viability of digital transformation depends on an organization's ability to provide feedback, assess, and refine its processes in response to performance and environmental changes.

The comparative analysis conducted by experts using open-ended questions and word clouds revealed a strong identification of the IOCM with proven methodological approaches and a clear focus on results. The terms "implementation," "digital," "processes," "success," and "achievement" emerged as predominant, reflecting perceptions of the model's applicability and practical value in real-world contexts. Experts also emphasized the relevance of the socio-technical component, noting that the IOCM adequately balances technological management and human change management, facilitating organizational acceptance and ownership of digital initiatives. This balance, often overlooked in conventional frameworks, constitutes a pivotal contribution of the proposed model.

Consequently, the discourse pinpointed avenues for enhancement that would fortify the external validity of the model. For instance, it is recommended to further incorporate financial and return on investment (ROI) indicators into the change success metrics. Additionally, it is recommended to develop modular versions of the IOCM that can be adjusted to the size, maturity, and resources of different organizations. These proposals are a response to the need, as articulated by Sheng, Amankwah-Amoah, and Wang (2020) and Vial (2021) to adapt digital transformation models to the economic and operational reality of each sector. The aforementioned elements, when considered collectively, serve to reinforce the IOCM as a dynamic framework that has been validated by experts. This framework is capable of evolving in accordance with technological advancements and shifting conditions within the industrial environment.

5. CONCLUSIONS

This study makes a significant contribution to the field of organizational change management applied to digital transformation. It developed and validated the Integrated Organizational Change Model (IOCM), specifically designed for the hydrocarbon pipeline transportation sector in Colombia.

The research confirms that digital transformation in this sector cannot be viewed solely as a technological process but as a profound organizational change involving structural, cultural, operational, and human dimensions. In this context, the IOCM is designed as a comprehensive, flexible, and methodologically sound tool to support this process, integrating principles from classic models (such as Kotter, Lewin, and ADKAR) with contemporary approaches like design thinking, agile methodologies, and digital maturity assessment.

Empirical validation of the model was achieved through the application of instruments to process and human talent leaders in the sector, as well as to experts in digital transformation. This methodological approach permitted a comparison of perceptions and enriched the model with practical insights. The findings indicated that the organization under scrutiny exhibited a high degree of digital maturity (92% of participants situated in the "digital masters" quadrant), concomitant with an ad hoc culture that fosters innovation. However, only 33% of respondents reported the formal use of change management models, which lends further support to the assertion that the IOCM is a relevant structured framework to guide the digital transition.

The validation of the model by industry experts confirms its relevance and applicability, highlighting the usefulness of the collaborative diagnosis and evolutionary reinforcement phases. The findings also demonstrate the

importance of integrating strategic dimensions such as digital governance, cultural alignment, and skills development into the design of any organizational digital transformation process.

Furthermore, the experts placed significant value on the balanced integration of various methodological approaches (Lewin, ADKAR, Kotter, DICE, Design Thinking, and agile change), as well as its adaptability to the context of Colombian oil pipelines. The observations collected indicate potential avenues for enhancement, particularly concerning the integration of financial indicators and return on investment (ROI) metrics to augment the prevailing organizational performance metrics.

5.1. Implications

The IOCM has significant practical implications for actors in the hydrocarbons sector, especially for organizations facing challenges from digitalization, the energy transition, and pressure to improve operational sustainability.

- The program provides both structured and adaptable guidance for managing organizational change in regulated and critical infrastructure environments.
- The aforementioned method facilitates an accurate diagnosis of the level of digital maturity, thereby enabling the prioritization of resources in areas exhibiting the most significant deficiencies.
- The integration of classic approaches (e.g., Lewin, Kotter, ADKAR) with contemporary methodologies (e.g., agile, design thinking, socio-technical) results in a holistic framework applicable to the sector.
- It has been demonstrated that this contributes to strategic alignment between culture, processes, and technology. This, in turn, is key to the sustainability of digital transformation.
- The provided reference framework is characterized by its replicability, a quality that renders it potentially beneficial to analogous industrial sectors, including but not limited to gas pipelines, mining, and energy.
- The promotion of data-driven decision-making is achieved by the integration of DICE metrics with digital maturity and performance indicators, thereby enhancing the traceability of results.

5.2. Limitations

The study's scope is subject to certain methodological limitations, which must be considered when interpreting the results.

- This is a single case study, which limits the generalizability of the findings to the entire sector.
- Both pipelines analyzed belong to the same organization, which may introduce cultural and structural biases.
- The model was validated with a small number of experts (n=6), which limits the diversity of perspectives.
- The study was conducted during an exploratory stage of digital transformation, without yet evaluating the longitudinal impacts of the model over time.
- The incorporation of financial and sustainability metrics was absent from the model's development process. This omission has the potential to impede the comprehensive evaluation of the model's impact on organizational performance.

5.3. Future Research Suggestions

In light of the findings and their limitations, the following research lines are proposed for future exploration.

- A longitudinal study is necessary to analyze the sustained impact of the IOCM on the culture, productivity, and sustainability of organizations over time.
- The application of the model in other sectors that are intensive in physical infrastructure and regulations, such as electricity, water, mass transportation, or telecommunications, is necessary to evaluate its adaptability.

- The development of supplementary instruments for the IOCM includes creating indicators of return on investment in digital transformation, financial change management models, and interactive dashboards for phase monitoring.
- Exploration of emerging technologies (Generative artificial intelligence, next-generation blockchain, advanced digital twins) as catalysts for organizational change, and their incorporation into the IOCM as a fifth phase.
- Comparative analyses between public and private organizations to understand how governance structures influence digital change management.
- In-depth study of the relationship between digital maturity, leadership, and organizational culture to understand how these factors reinforce each other in sustaining change.
- Evaluation of the role of internal strategic communication in the acceptance of change.

Funding: This research is supported by Electrical Machines & Drives Research Group (EM&D) from Universidad Nacional de Colombia (Hermes Code: 59384 UNAL).

Institutional Review Board Statement: This study was approved by the Institutional Review Board of Electrical Machines & Drives Research Group (EM&D) / Universidad Nacional de Colombia, under protocol number COMET-EMD-012, dated 2 February, 2025. Informed verbal consent was obtained from all participants, and all data were anonymized to protect participant confidentiality.

Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.

Competing Interests: The authors declare that they have no competing interests.

Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

Disclosure of AI Use: The author(s) used OpenAI's ChatGPT to refine the wording of the manuscript, and DeepL to translate from Spanish to English. All outputs were reviewed and verified by the authors.

REFERENCES

- Adrian, C., Abdullah, R., Atan, R., & Jusoh, Y. Y. (2018). Conceptual model development of big data analytics implementation assessment effect on decision-making. *International Journal of Interactive Multimedia and Artificial Intelligence*, 5(1), 101-106. <http://doi.org/10.9781/ijimai.2018.03.001>
- Aghina, W., Ahlback, K., De Smet, A., Lackey, G., Lurie, M., Murarka, M., & Handscomb, C. (2018). *The five trademarks of agile organizations*. New York: McKinsey & Company.
- Aguirre, D., & Alpern, M. (2014). 10 principles of leading change management. *Strategy+ Business*, 75, 1-10.
- Alazab, M., Alhyari, S., Awajan, A., & Abdallah, A. B. (2024). Cybersecurity in Industry 4.0: The case of oil and gas pipeline infrastructure. *Computers & Industrial Engineering*, 179, 108743.
- Aldawood, H., & Skinner, G. (2023). Contemporary cyber security social engineering solutions, measures, policies, tools and applications: A critical appraisal. *International Journal of Security and Networks*, 18(1), 1-14.
- Alsubaie, N., Almalki, F., & Almalki, M. (2023). IoT-based pipeline monitoring system for early leak detection: A comprehensive review. *Sensors*, 23(2), 981.
- American Petroleum Institute. (2022). *Pipeline safety excellence performance report*. United States: American Petroleum Institute.
- Appelbaum, S. H. (1997). Socio-technical systems theory: An intervention strategy for organizational development. *Management Decision*, 35(6), 452-463. <https://doi.org/10.1108/00251749710173823>
- Appelbaum, S. H., Cameron, A., Ensink, F., Hazarika, J., Attir, R., Ezzedine, R., & Shekhar, V. (2017). Factors that impact the success of an organizational change: a case study analysis. *Industrial and Commercial Training*, 49(5), 213-230. <https://doi.org/10.1108/ICT-02-2017-0006>
- Appelbaum, S. H., Habashy, S., Malo, J. L., & Shafiq, H. (2012). Back to the future: Revisiting Kotter's 1996 change model. *Journal of Management Development*, 31(8), 764-782. <https://doi.org/10.1108/02621711211253231>
- Armenakis, A. A., & Harris, S. G. (2009). Reflections: Our journey in organizational change research and practice. *Journal of Change Management*, 9(2), 127-142. <https://doi.org/10.1080/14697010902879079>

- Battilana, J., & Casciaro, T. (2012). Change agents, networks, and institutions: A contingency theory of organizational change. *Academy of Management Journal*, 55(2), 381-398. <https://doi.org/10.5465/amj.2009.0891>
- Baxter, G., & Sommerville, I. (2011). Socio-technical systems: From design methods to systems engineering. *Interacting with Computers*, 23(1), 4-17. <https://doi.org/10.1016/j.intcom.2010.07.003>
- Bednar, P. M., & Welch, C. (2020). Socio-technical perspectives on smart working: Creating meaningful and sustainable systems. *Information Systems Frontiers*, 22(2), 281-298. <https://doi.org/10.1007/s10796-019-09921-1>
- Bejinariu, C., Darabont, D.-C., Baci, E.-R., Georgescu, I.-S., Bernevig-Sava, M.-A., & Baci, C. (2017). Considerations on applying the method for assessing the level of safety at work. *Sustainability*, 9(7), 1263. <https://doi.org/10.3390/su9071263>
- Bento, F., & Tagliabue, M. (2023). Digital transformation in oil and gas transportation: A systematic review. *Energy Research & Social Science*, 96, 102952.
- Berghaus, S., & Back, A. (2016). *Stages in digital business transformation: Results of an empirical maturity study*. Paper presented at the MCIS 2016 Proceedings.
- Bonnet, D., & Westerman, G. (2021). The new elements of digital transformation. *MIT Sloan Management Review*, 62(2), 82-89.
- Braun, V., & Clarke, V. (2021). One size fits all? What counts as quality practice in (reflexive) thematic analysis? *Qualitative Research in Psychology*, 18(3), 328-352. <https://doi.org/10.1080/14780887.2020.1769238>
- Brown, T. (2008). Design thinking. *Harvard Business Review*, 86(6), 84-92.
- Brown, T., & Katz, B. (2019). *Design thinking: Ideas, tools and methods for innovation*. Brazil: Alta Books.
- Burnes, B. (2004). Kurt Lewin and the planned approach to change: A re-appraisal. *Journal of Management Studies*, 41(6), 977-1002. <https://doi.org/10.1111/j.1467-6486.2004.00463.x>
- 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>
- Bushe, G. R., & Marshak, R. J. (2015). The dialogic mindset in organization development. *Research in Organizational Change and Development*, 23, 55-97.
- Cameron, K. S., & Quinn, R. E. (2011). *Diagnosing and changing organizational culture: Based on the competing values framework* (3rd ed.). United States: Jossey-Bass.
- Chang, H. (2010). Early adopters in Rogers' diffusion of innovations model: Analysis and practical applications. *Revista de Innovación y Gestión del Cambio*, 15(3), 245-267.
- Chanias, S., & Hess, T. (2016). *How digital are we? Maturity models for the assessment of a company's status in the digital transformation* (Management Report No. 2). Institut für Wirtschaftsinformatik und Neue Medien.
- Ciriello, R., Richter, A., & Schwabe, G. (2018). Digital innovation. *Information Systems Engineering and Business*, 60(6), 563-569.
- Clegg, S. R. (1989). *Frameworks of power*. United Kingdom: SAGE Publications Ltd.
- Clegg, S. R. (2000). *Modern organizations: Organization studies in the postmodern world*. London, UK: SAGE Publications.
- Cobb, P. (2011). *Analyzing the mathematical learning of students in classrooms: A study of the social construction of knowledge*. United States: Springer.
- Colombian Ministry of Mines and Energy. (2021). *Energy sector overview and annual report*. Bogotá, Colombia: Colombian Ministry of Mines and Energy.
- Colombian Ministry of Mines and Energy. (2023). *Energy transition in the hydrocarbon transportation sector in colombia: Reducing emissions and integrating renewable sources*. Bogotá, Colombia: Colombian Ministry of Mines and Energy.
- Colombian Petroleum Association. (2022). *Annual report on Colombia's pipeline network and energy sector*. Bogotá, Colombia: Colombian Petroleum Association.
- Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). United States: Sage Publications.
- Cross, R., Gray, P., Cunningham, S., Showers, M., & Thomas, R. J. (2013). The collaborative organization: How to make employee networks really work. *MIT Sloan Management Review*, 55(1), 83-90.

- Cummings, S., Bridgman, T., & Brown, K. G. (2016). Unfreezing change as three steps: Rethinking Kurt Lewin's legacy for change management. *Human Relations*, 69(1), 33-60. <https://doi.org/10.1177/0018726715577707>
- Cummings, T. G., & Worley, C. G. (2014). *Organization development and change* (10th ed.). United States: Cengage Learning.
- Dearing, J. W., & Cox, J. G. (2018). Diffusion of innovations theory, principles, and practice. *Health Affairs*, 37(2), 183-190.
- Dedehayir, O., Ortt, J. R., & Seppänen, M. (2017). Disruptive change and the reconfiguration of innovation ecosystems. *Journal of Technology Management & Innovation*, 12(3), 9-21.
- Deloitte. (2019). *Digital transformation in the energy sector: Enhancing efficiency and sustainability*. New York: Deloitte.
- Denning, S. (2018). The role of the C-suite in agile transformation: The case of amazon. *Strategy & Leadership*, 46(6), 14-21. <https://doi.org/10.1108/SL-10-2018-0094>
- Dikert, K., Paasivaara, M., & Lassenius, C. (2016). Challenges and success factors for large-scale agile transformations: A systematic literature review. *Journal of Systems and Software*, 119, 87-108. <https://doi.org/10.1016/j.jss.2016.06.013>
- DNP. (2018). *Strategic framework for energy transition and sustainable development in Colombia*. Bogotá, Colombia: National Planning Department.
- Dweck, C. S. (2016). What having a "growth mindset" actually means. *Harvard Business Review*, 94(5), 56-64.
- Eason, K. (2014). Afterword: The past, present and future of sociotechnical systems theory. *Human Factors and Ergonomics in Manufacturing & Service Industries*, 24(3), 345-367.
- Ecopetrol. (2023). *Integrated sustainability management report 2022*. Colombia: Ecopetrol.
- Eiris, R., Jain, A., Wen, J., & Abdelkarim, A. (2023). Immersive virtual reality safety training for the oil and gas industry: A systematic review. *Safety Science*, 160, 106103.
- Elsbach, K. D., & Stigliani, I. (2018). Design thinking and organizational culture: A review and framework for future research. *Journal of Management*, 44(6), 2274-2306. <https://doi.org/10.1177/0149206317744252>
- Fedesarrollo. (2018). *Energy infrastructure and regulatory challenges in Colombia*. Bogotá, Colombia: Fedesarrollo.
- Fitzgerald, M., Kruschwitz, N., Bonnet, D., & Welch, M. (2014). Embracing digital technology: A new strategic imperative. *MIT Sloan Management Review*, 55(2), 1-12.
- Fletcher, G., & Griffiths, M. (2020). Digital transformation during a lockdown. *International Journal of Information Management*, 55, 102185. <https://doi.org/10.1016/j.ijinfomgt.2020.102185>
- Flick, U. (2018). *An introduction to qualitative research* (6th ed.). United States: Sage Publications.
- García-Martínez, R., & López, S. (2022). Blockchain applications in the oil and gas industry: A comprehensive analysis. *Energies*, 15(3), 1053.
- Gómez-Sánchez, J. A., Pontes-Pedrajas, A., & Sánchez-Cañizares, S. M. (2024). Augmented and virtual reality in oil and gas industry: Current applications and future trends. *Journal of Petroleum Science and Engineering*, 238, 111611.
- Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., & Kyriakidou, O. (2004). Diffusion of innovations in service organizations: Systematic review and recommendations. *The Milbank Quarterly*, 82(4), 581-629. <https://doi.org/10.1111/j.0887-378X.2004.00325.x>
- Greenhalgh, T., Wherton, J., Papoutsi, C., Lynch, J., Hughes, G., Hinder, S., . . . Shaw, S. (2017). Beyond adoption: A new framework for theorizing and evaluating nonadoption, abandonment, and challenges to the scale-up, spread, and sustainability of health and care technologies. *Journal of Medical Internet Research*, 19(11), e8775. <https://doi.org/10.2196/jmir.8775>
- Gruber, T., Zuberbühler, K., Clément, F., & Van Schaik, C. (2015). Apes have culture but may not know that they do. *Frontiers in Psychology*, 6, 91. <https://doi.org/10.3389/fpsyg.2015.00091>
- Hartl, E., & Hess, T. (2017). *The role of cultural values for digital transformation: Insights from a Delphi study*. Paper presented at the Proceedings of the 23rd Americas Conference on Information Systems (AMCIS 2017). Boston, MA: Association for Information Systems.
- Heavin, C., & Power, D. J. (2018). *Data-based decision making and digital transformation: Nine laws for success*. New York: Business Expert Press.
- Hess, T., Matt, C., Benlian, A., & Wiesböck, F. (2016). Options for formulating a digital transformation strategy. *MIS Quarterly Executive*, 15(2), 123-139.

- Hiatt, J. M. (2006). *ADKAR: A model for change in business, government, and our community*. Loveland, CO: Prosci Learning Center Publications.
- Holbeche, L. (2018). *The agile organization: How to build an engaged, innovative and resilient business* (2nd ed.). London, England: Kogan Page.
- Hornstein, H. A. (2015). The integration of project management and organizational change management is now a necessity. *International Journal of Project Management*, 33(2), 291-298. <https://doi.org/10.1016/j.ijproman.2014.08.005>
- Jäfvert, A., & Gustafsson, P. C. (2019). Digital transformation in digitally mature organisations: Managers' perspectives on challenges in progressing in digital maturity. Master's Thesis, Lund University School of Economics and Management. Lund University.
- Johnson, L., & Smith, K. (2023). Digital twin technology in pipeline operations: Case studies and future prospects. *Journal of Petroleum Science and Engineering*, 224, 110599.
- Kahn, K. B. (2018). Understanding innovation. *Business Horizons*, 61(3), 453-460. <https://doi.org/10.1016/j.bushor.2018.01.011>
- Kamble, S. S., Gunasekaran, A., & Sharma, R. (2018). Analysis of the driving and dependence power of barriers to adopt industry 4.0 in Indian manufacturing industry. *Computers in Industry*, 101, 107-119. <https://doi.org/10.1016/j.compind.2018.06.004>
- Kane, G. C., Palmer, D., Phillips, A. N., Kiron, D., & Buckley, N. (2015). *Strategy, not technology, drives digital transformation: Becoming a digitally mature enterprise*. Retrieved from Research Report. Cambridge, MA: MIT Sloan Management Review; Deloitte University Press.
- Kane, G. C., Palmer, D., Phillips, A. N., Kiron, D., & Buckley, N. (2017). *Achieving digital maturity: Adapting your company to a changing world*. Retrieved from Research Report. Cambridge, MA: MIT Sloan Management Review; Deloitte University Press.
- Kane, G. C., Phillips, A. N., Copulsky, J., & Andrus, G. (2019). How digital leadership is (n't) different. *MIT Sloan Management Review*, 60(3), 34-39.
- Kohli, R., & Johnson, S. (2011). Digital transformation in latecomer industries: CIO and CEO leadership lessons from Encana Oil & Gas (USA) Inc. *MIS Quarterly Executive*, 10(4), 141-156.
- Kolko, J. (2015). Design thinking comes of age. *Harvard Business Review*, 93(9), 66-71.
- Konopik, J., Jahn, C., & Schuster, T. (2021). Digital competencies for a digital transformation initiative in the oil and gas industry. *Procedia Computer Science*, 181, 734-742.
- Koo, T. K., & Li, M. Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of Chiropractic Medicine*, 15(2), 155-163. <https://doi.org/10.1016/j.jcm.2016.02.012>
- Kotter, J. P. (2012a). Accelerate! *Harvard Business Review*, 90(11), 44-58.
- Kotter, J. P. (2012b). *Leading change*. Boston, MA: Harvard Business Press.
- Kotter, J. P. (2014). *Accelerate: Building strategic agility for a faster-moving world*. Boston, MA: Harvard Business Review Press.
- Kotter, J. P., & Schlesinger, L. A. (2008). Choosing strategies for change. *Harvard Business Review*, 86(7/8), 130-139.
- Krishnamurthy, K., Radhakrishnan, R., & Ganesan, S. (2024). Digital twin technology in pipeline transportation: Enhancing operational efficiency and safety. *Journal of Natural Gas Science and Engineering*, 112, 104870.
- Kshetri, N., & Voas, J. (2024). Blockchain in the energy sector. *IT Professional*, 26(1), 41-47.
- Kvale, S., & Brinkmann, S. (2015). *InterViews: Learning the craft of qualitative research interviewing* (3rd ed.). Thousand Oaks, CA: Sage Publications.
- Legner, C., Eymann, T., Hess, T., Matt, C., Böhmman, T., Drews, P., . . . Ahlemann, F. (2017). Digitalization: Opportunity and challenge for the business and information systems engineering community. *Business & Information Systems Engineering*, 59(4), 301-308. <https://doi.org/10.1007/s12599-017-0484-2>
- Lewin, K. (1947). Frontiers in group dynamics: Concept, method and reality in social science; social equilibria and social change. *Human Relations*, 1(1), 5-41. <https://doi.org/10.1177/001872674700100103>
- Lewis, L. K. (2019). *Organizational change: Creating change through strategic communication* (2nd ed.). Hoboken, NJ: Wiley-Blackwell.
- Liedtka, J., Salzman, R., & Azer, D. (2017). *Design thinking for the greater good: Innovation in the social sector*. New York: Columbia University Press.
- Magistretti, S., Dell'Era, C., & Petruzzelli, A. M. (2019). How intelligent is Watson? Enabling digital transformation through artificial intelligence. *Business Horizons*, 62(6), 819-829.

- Manworren, N., Letwat, J., & Daily, O. (2023). Cybersecurity in a post-COVID world: Managers' changing priorities. *Business Horizons*, 66(3), 367-380.
- Matt, C., Hess, T., & Benlian, A. (2015). Digital transformation strategies. *Business & Information Systems Engineering*, 57(5), 339-343. <https://doi.org/10.1007/s12599-015-0401-5>
- McKinsey & Company. (2019). *Digital transformation in the energy sector: Leveraging IoT, AI, and analytics for operational efficiency*. New York: McKinsey & Company.
- Mehmood, A., Natgunanathan, I., Xiang, Y., Hua, G., & Guo, S. (2016). Protection of big data privacy. *IEEE Access*, 4, 1821-1834. <https://doi.org/10.1109/ACCESS.2016.2558446>
- Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). San Francisco, CA: Jossey-Bass.
- Meyer, J. P., & Allen, N. J. (1991). A three-component conceptualization of organizational commitment. *Human Resource Management Review*, 1(1), 61-89. [https://doi.org/10.1016/1053-4822\(91\)90011-Z](https://doi.org/10.1016/1053-4822(91)90011-Z)
- Mohamad, M. M., Sulaiman, N. L., Sern, L. C., & Salleh, K. M. (2015). Measuring the validity and reliability of research instruments. *Procedia-Social and Behavioral Sciences*, 204, 164-171. <https://doi.org/10.1016/j.sbspro.2015.08.129>
- Mohammadpoor, M., & Torabi, F. (2020). Big data analytics in oil and gas industry: An emerging trend. *Petroleum*, 6(4), 321-328. <https://doi.org/10.1016/j.petlm.2018.11.001>
- Mohanta, B. K., Jena, D., Panda, S. S., & Sobhanayak, S. (2019). Blockchain technology: A survey on applications and security privacy challenges. *Internet of Things*, 8, 100107. <https://doi.org/10.1016/j.iot.2019.100107>
- Mumford, L. (2006). *The city in history: Its origins, its transformations, and its prospects*. New York: Harcourt.
- Nambisan, S., Lyytinen, K., Majchrzak, A., & Song, M. (2017). Digital Innovation Management: Reinventing Innovation Management Research in a Digital World. *MIS Quarterly*, 41(1), 223-238. <https://doi.org/10.25300/MISQ/2017/41:1.03>
- Nambisan, S., Wright, M., & Feldman, M. (2019). The digital transformation of innovation and entrepreneurship: Progress, challenges and key themes. *Research Policy*, 48(8), 103773. <https://doi.org/10.1016/j.respol.2019.03.018>
- National Hydrocarbons Agency. (2022). *Annual report*. Colombia: National Hydrocarbons Agency.
- Norman, D. A., & Verganti, R. (2014). Incremental and radical innovation: Design research vs. technology and meaning change. *Design Issues*, 30(1), 78-96. https://doi.org/10.1162/DESI_a_00250
- Olsson, L., Folke, C., & Hughes, T. P. (2019). Navigating the anthropocene: Improving earth system governance. *Science*, 347(6223), 1259855.
- Palmarini, R., Erkoyuncu, J. A., & Roy, R. (2024). An innovative framework for industrial augmented reality applications: The case of oil and gas sector. *Computers in Industry*, 155, 104034.
- Pasmore, W., Woodman, R. W., & Shani, A. B. (2019). *Research in organizational change and development* (Vol. 27). Bingley, England: Emerald Publishing Limited.
- Patton, M. Q. (2015). *Qualitative research & evaluation methods: Integrating theory and practice* (4th ed.). Thousand Oaks, CA: Sage Publications.
- Pharris, C. A., & Kolpa, R. L. (2012). *Introduction to health care management* (2nd ed.). Burlington, MA: Jones & Bartlett Learning.
- Pollack, J., & Pollack, R. (2015). Using Kotter's eight stage process to manage an organisational change program: Presentation and practice. *Systemic Practice and Action Research*, 28(1), 51-66. <https://doi.org/10.1007/s11213-014-9317-0>
- Rahman, S. M., Perry, N., Müller, J. M., Siepmann, J., & Klausner, F. (2023). Predictive maintenance in oil and gas pipelines: A machine learning approach. *Reliability Engineering & System Safety*, 230, 108944.
- Ramírez-Mendoza, R., Morales-Menendez, R., Iqbal, H., & Parra-Saldivar, R. (2021). Engineering sustainable smart pipelines: Role of artificial intelligence and industry 4.0. *Sustainability*, 13(9), 4844. <https://doi.org/10.3390/su13094844>
- Rigby, D. K., Sutherland, J., & Takeuchi, H. (2016). Embracing agile. *Harvard Business Review*, 94(5), 40-50.
- Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press.
- Rosenbaum, P. R., Rubin, D. B., & Imbens, G. W. (2021). *Design of observational studies* (2nd ed.). Cham, Switzerland: Springer.
- Rossmann, A. (2018). *Digital maturity: Conceptualization and measurement model*. ResearchGate. Paper presented at the 39th International Conference on Information Systems (ICIS 2018): San Francisco, California, USA, 13-16 December 2018 At: San Francisco.

- Sahin, I. (2006). Detailed review of Rogers' diffusion of innovations theory and educational technology-related studies based on Rogers' theory. *Turkish Online Journal of Educational Technology*, 5(2), 14-23.
- Saldaña, J. (2021). *The coding manual for qualitative researchers* (4th ed.). Thousand Oaks, CA: Sage Publications.
- Sarker, S., Chatterjee, S., Xiao, X., & Elbanna, A. (2019). The sociotechnical axis of cohesion for the IS discipline. *MIS Quarterly*, 43(3), 695-A695. <https://doi.org/10.25300/MISQ/2019/13747>
- Schein, E. H., & Schein, P. A. (2019). *The corporate culture survival guide* (3rd ed.). Hoboken, NJ: Wiley.
- Schmiedgen, J., Rhinow, H., Köppen, E., & Meinel, C. (2016). *Parts without a whole? The current state of design thinking practice in organizations*. Potsdam, Germany: Hasso Plattner Institute for Design Thinking Research.
- Sebastian, I. M., Ross, J. W., Beath, C., Mocker, M., Moloney, K. G., & Fonstad, N. O. (2017). How big old companies navigate digital transformation. *MIS Quarterly Executive*, 16(3), 197-213.
- Sheng, J., Amankwah-Amoah, J., & Wang, X. (2020). Technology in the 21st century: New challenges and opportunities for sustainability. *Technological Forecasting and Social Change*, 161, 120274.
- Shukla, M., Singh, S., & Sharma, R. (2021). *Digital transformation in business and society: Theory and cases*. Cham, Switzerland: Springer.
- Singh, A., Mishra, S., Rusinkiewicz, M., & Katz, G. (2022). Real-time data analytics for intelligent pipeline monitoring: A machine learning approach. *IEEE Transactions on Industrial Informatics*, 18(6), 3867-3876.
- Sirkin, H. L., Keenan, P., & Jackson, A. (2005). The hard side of change management. *Harvard Business Review*, 83(10), 108-118.
- Sousa, M. J., & Rocha, Á. (2019). Skills for disruptive digital business. *Journal of Business Research*, 94, 257-263. <https://doi.org/10.1016/j.jbusres.2017.12.051>
- Stake, R. E. (2010). *Qualitative research: Studying how things work*. New York: Guilford Press.
- Straub, E. T. (2017). Understanding technology adoption: Theory and future directions for informal learning. *Review of Educational Research*, 79(2), 625-649. <https://doi.org/10.3102/0034654308325896>
- Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, 48(6), 1273-1296. <https://doi.org/10.1007/s11165-016-9602-2>
- Tabrizi, B., Lam, E., Girard, K., & Irvin, V. (2019). Digital transformation is not about technology. *Harvard Business Review*, 97(6), 1-6.
- Talukder, A. K. M. M. H. (2019). Supervisor support and organizational commitment: The role of work-family conflict, job satisfaction, and work-life balance. *Journal of Employment Counseling*, 56(3), 98-116. <https://doi.org/10.1002/joec.12125>
- Teece, D., Peteraf, M., & Leih, S. (2016). Dynamic capabilities and organizational agility: Risk, uncertainty, and strategy in the innovation economy. *California Management Review*, 58(4), 13-35. <https://doi.org/10.1525/cm.2016.58.4.13>
- Teichert, R. (2019). Digital transformation maturity: A systematic review of literature. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 67(6), 1673-1687. <https://doi.org/10.11118/actaun201967061673>
- Tracz-Krupa, K., Stachowska, S., & Wziątek-Staśko, A. (2021). Human resource management in the context of digital transformation. *Journal of Organizational Change Management*, 34(6), 1234-1250.
- Tushman, M. L., & O'Reilly, C. A. (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. *California Management Review*, 38(4), 8-29. <https://doi.org/10.2307/41165852>
- Ursachi, G., Horodnic, I. A., & Zait, A. (2015). How reliable are measurement scales? External factors with indirect influence on reliability estimators. *Procedia Economics and Finance*, 20, 679-686. [https://doi.org/10.1016/S2212-5671\(15\)00123-9](https://doi.org/10.1016/S2212-5671(15)00123-9)
- Valdez-De-Leon, O. (2016). A digital maturity model for telecommunications service providers. *Technology Innovation Management Review*, 6(8), 19-32. <http://doi.org/10.22215/timreview/1008>
- Van Eijnatten, F. M., & Van Der Zwaan, A. H. (1998). The Dutch IOR approach to organizational design: An alternative to business process re-engineering? *Human Relations*, 51(3), 289-318. <https://doi.org/10.1177/001872679805100305>
- Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J. Q., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, 122, 889-901. <https://doi.org/10.1016/j.jbusres.2019.09.022>
- Vetterli, C., Uebernickel, F., Brenner, W., Petrie, C., & Stermann, D. (2016). How deutsche bank's IT division used design thinking to achieve customer proximity. *MIS Quarterly Executive*, 15(1), 37-53.

- Vial, G. (2021). Understanding digital transformation: A review and a research agenda. *The Journal of Strategic Information Systems*, 28(2), 118-144. <https://doi.org/10.1016/j.jsis.2019.01.003>
- Warner, K. S., & Wäger, M. (2019). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. *Long Range Planning*, 52(3), 326-349. <https://doi.org/10.1016/j.lrp.2018.12.001>
- Westerman, G., Bonnet, D., & McAfee, A. (2012). The digital capabilities your company needs. *MIT Sloan Management Review*, 28(2), 1-5.
- Westerman, G., Bonnet, D., & McAfee, A. (2019). *Leading digital: Turning technology into business transformation*. Boston, MA: Harvard Business Review Press.
- Wieringa, J., Kannan, P., Ma, X., Reutterer, T., Risselada, H., & Skiera, B. (2021). Data analytics in a privacy-concerned world. *Journal of Business Research*, 122, 915-925. <https://doi.org/10.1016/j.jbusres.2019.05.005>
- Winter, R., Griffiths, M., & Green, C. (2014). Revisiting the foundations of organizational culture: A critical review. *Journal of Organizational Behavior*, 35(1), 1-23.
- Wisdom, J. P., Cavaleri, M. A., Onwuegbuzie, A. J., & Green, C. A. (2014). Methodological reporting in qualitative, quantitative, and mixed methods health services research articles. *Health Services Research*, 49(1), 1-23.
- World Economic Forum. (2017). *Shaping the future of energy and materials: A vision for the next decade*. Geneva, Switzerland: World Economic Forum.
- Worley, C. G., & Mohrman, S. A. (2014). Is change management obsolete? *Organizational Dynamics*, 43(3), 214-224. <https://doi.org/10.1016/j.orgdyn.2014.08.008>
- Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). Thousand Oaks, CA: Sage Publications.
- Yoo, Y., Boland, R. J., Lyytinen, K., & Majchrzak, A. (2006). Organizing for innovation in the digitized world. *Organization Science*, 17(5), 583-596.
- Zhang, L., Wu, Y., & Xu, X. (2023). Blockchain-based traceability system for oil and gas pipeline transportation: Ensuring data integrity and compliance. *Energy*, 264, 126110. <https://doi.org/10.1016/j.energy.2022.126110>

Views and opinions expressed in this article are the views and opinions of the author(s), International Journal of Management and Sustainability shall not be responsible or answerable for any loss, damage or liability etc. caused in relation to/arising out of the use of the content.