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Challenges and Solutions for Organizational Change in the Software Industry: A Tertiary Study

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Abstract Organizational Change (OC) in the software industry is essential for maintaining competitiveness in dynamic environments. However, OC initiatives often face inefficiencies due to the lack of structured methodologies and reliance on ad hoc practices. This tertiary study analyzes 17 secondary studies related to the OC theme and its instances affecting key organizational pillars, such as technology, processes, and people. The results reveal limited adoption of OC models in software organizations. In response, it synthesizes 41 OC models, 14 critical success factors, and 6 key characteristics, offering a synthesized overview of structured OC frameworks and their relevance to the software industry context, supporting future adaptation efforts by practitioners.

Keywords: *Organizational Change, Episodic Change, Innovation in Software Industry*

1 Introduction

The software industry operates in a fast-paced, innovation-driven environment where organizational agility and continuous adaptation to external and internal demands are essential for maintaining competitiveness (Agazu and Kero, 2024). However, the successful implementation of large-scale changes—such as cultural shifts, digital transformation, software process improvement, and process automation—remains a significant challenge (Lima et al., 2024). Despite the critical role of these initiatives, they are often not recognized as forms of Organizational Change (OC), a well-established field with decades of consolidated knowledge and best practices (Orieno et al., 2024). This lack of recognition limits the ability of software organizations to benefit from proven OC models, frameworks, and tools.

The absence of awareness and adoption of OC management theories and instruments in the software industry leads to reliance on ad hoc, experience-driven approaches (Beer and Nohria, 2000). These unstructured methods, typically carried out by operational professionals without formal training in OC management, result in recurrent inefficiencies, such as resistance to change, insufficient organizational support, resource constraints, and low stakeholder engagement (Lima et al., 2024). These challenges compromise the success of change initiatives and hinder their alignment with organizational strategies and goals, reducing the potential for long-term impact.

While some organizations employ external consultants for specialized transformations—such as implementing CMMI (Capability Maturity Model Integration), adopting Industry 4.0, or integrating agile practices—most OC initiatives implemented in software industry companies are led by internal teams or volunteer groups strongly committed to improving current practices. However, these groups often lack the formal expertise needed to effectively plan, execute, and sustain organizational change (Edison et al., 2018).

This paper addresses this gap by providing a tertiary review of secondary studies (Kitchenham et al., 2010) on OC in the software industry. By synthesizing 22 processual models, 24 descriptive models, 14 critical factors, and 6 key characteristics, it organizes evidence to guide practitioners and researchers in managing episodic organizational change (EOC) initiatives. In addition to mapping and categorizing these elements, the study explores their interconnections, showing how activities, characteristics, and critical factors are related and mutually reinforcing. This integrated perspective highlights trends, gaps, and underexplored areas, offering a consolidated view of how the software industry can better leverage OC theory to increase the success of transformation efforts.

Tertiary reviews differ from systematic literature reviews (SLRs) based on primary studies (Kitchenham et al., 2009) by enabling a higher-level synthesis across existing SLRs. This meta-perspective is especially relevant in multidisciplinary and evolving domains such as organizational change, as it allows assessing the maturity of the field while revealing methodological patterns and directions for future research.

The remainder of the paper is organized as follows: Section 2 presents the background, Section 3 describes the research method, Section 4 details the results, Section 5 discusses the findings, Section 6 outlines threats to validity and limitations, and Section 7 concludes the paper.

2 Background

OC is a formal approach to transitioning from the current state to a desired future, focusing the organization's efforts on this change (Lewin, 1947). It refers to planned or unplanned initiatives that may make changes in the elements of an organization, such as structure, culture, processes, and technology aiming to enhance performance, efficiency, effectiveness (Beer and Walton, 1987) to respond to internal ou external demands (Agazu and Kero, 2024). Still, the lack of an empirical basis to support theoretical findings Cummings and Worley (2016) has been a recurring critique, emphasiz-

ing the need for more robust evidence to validate OC theories and practices.

Even using other nomenclatures (Lima et al., 2022), in the software and information technology industry, implementing OCs has been a way of life (Miller, 2001). It is a strategic mechanism for companies to establish robust competitive advantages (Davenport and Stoddard, 1994), particularly in highly dynamic business environments. These initiatives often implement the steps of the change as three steps (CATS) model: unfreeze, change, refreeze (Lewin, 1947).

Despite its significance, various studies (Dikert et al., 2016; Orieno et al., 2024; Beer and Nohria, 2000) have shown that the failure or neglect of implementing the knowledge of the management of OC can complicate the implementation of OC in the software industry, making it more susceptible to inefficiency or failure. Consequently, the evolution of many companies relies on individual efforts, leading to unpredictable outcomes. An analysis of 82 cases of OC initiatives implemented in a large software development company, revealed critical challenges, including low familiarity with structured methodologies and minimal adoption of OC management practices due to lack of awareness of this field of knowledge (Lima et al., 2024).

Many studies highlight alternative approaches for managing such initiatives, including PMBoK, Scrum, and CMMI (Zahra et al., 2017; Dikert et al., 2016). Although PMBoK and Scrum support project management, they do not cover the whole EOC lifecycle, which extends beyond traditional project phases. EOCs require evaluating organizational readiness, aligning with long-term goals, and sustaining outcomes post-implementation.

Previous versions of CMMI-SW focused primarily on process maturity in software organizations and did not address broader organizational changes involving technology and people—key pillars in EOC initiatives. However, the most recent version, CMMI 3.0 (CMMI Institute / ISACA, 2023), has expanded its scope, incorporating governance practices and being applicable to multiple domains, including product development, service management, and data management. Despite this evolution, evidence from the selected secondary studies shows that in practice the adoption of CMMI in software companies remains mostly restricted to process maturity perspectives, with limited support for holistic organizational change initiatives.

Given the strategic importance of OC initiatives in fostering competitiveness and adaptability, particularly in the dynamic software industry, it is evident that a lack of structured methodologies and the neglect of established OC practices significantly hinder the success of such initiatives. Therefore, beyond recognizing these challenges, it becomes necessary to consolidate and connect existing knowledge. This study responds to this need by synthesizing processual and descriptive models, critical factors, and key characteristics, and by examining their interconnections. Such integration provides a comprehensive foundation to guide practitioners in overcoming barriers and to support researchers in advancing the field of organizational change in software engineering.

3 Method

This study aims to provide an overview of current research on OC management focusing on available knowledge in the literature applicable to OC initiatives implemented in the software industry context. To consolidate the state-of-the-art from existing literature reviews, a tertiary study (Kitchenham et al., 2010) was conducted to answer three research questions: RQ1. What are the main OC characteristics? RQ2. What existing models could assist in the OC process? RQ3. What are the critical factors for OC initiatives? While RQ1 identifies key aspects that influence management, RQ2 explores models that offer practical support for implementation, and RQ3 reveals critical factors that affect the success and failure of OC initiatives.

The decision to conduct a tertiary study arose from challenges in identifying relevant primary studies (Da Silva et al., 2011) on OC within the software industry context. Initial searches using the term 'Organizational Change' yielded limited results, with only 2% of reviews providing data relevant to this context. Expanding the scope to include terms like "digital transformation", "agile adoption", and "software process improvement" increased the pool from 500 to over 18,000 candidate papers, but the volume and diversity made this approach unfeasible. Consequently, this study focused on identifying and analyzing secondary studies that synthesize the state-of-the-art of organizational change (OC) initiatives, providing a comprehensive analysis of frameworks, critical factors, and essential elements that corroborate effective organizational changes addressed by these studies.

As the interest was to identify literature reviews on the OC field, a Search String as "Organizational Change" AND "Review" was tested. Although 52 articles were returned, only two addressed interventions implemented in the software industry (Acharya and Colomo-Palacios, 2019; Armenakis and Bedeian, 1999). The others addressed the healthcare, construction, public, industrial, and services sectors. To resolve this issue, additional synonyms were incorporated for OC proposed by Lima et al. (2022) such as transition, transformation, adaptation, redesign, migration, improvement, adoption, and restructure.

To refine the Search String, terms related to specific examples of OC initiatives implemented in the software industry that affect the three pillars of companies proposed by Taylor (1914) (people, process, and technology) were added. For the people pillar, the term "team" (Dikert et al., 2016; Lima et al., 2022) was added. For the process pillar, the terms "process improvement" and its acronym "SPI" (Bayona et al., 2012) were added. Within the technology pillar, emphasis was placed on two additional terms and their variations: "digital transformation" and "Robotic process automation" their acronyms "DT" and "RPA" (Zaoui and Souissi, 2020; Ribeiro et al., 2021). In addition, the operator OR was used among alternative spellings and synonyms, and the operator AND was applied to obtain the intersection of these results.

After several runs to reduce the noise in the results while ensuring that the reference set, composed of Lima et al. (2022); Errida and Lotfi (2021); Dikert et al. (2016), was returned, the final Search String was defined as *("Orga-*

nizational change" OR "transition" OR "transformation" OR "adaptation" OR "redesign" OR "migration" OR "improvement" OR "adoption" OR "restructure" OR "SPI" OR "Software process improvement" OR "DT" OR "digital transformation" OR "RPA" OR "robotic process automation") AND "Review". Applied in the Scopus digital library[1] in October 2024, the search returned 190 candidate secondary studies after applying a publication year filter from 2014 to 2024.

The study selection process involved two filtering steps, each applying the inclusion and exclusion criteria. To be included in the selected list, the candidate secondary study must: (i) address OC initiatives, (ii) be a Systematic or Mapping Literature Review, (iii) be published between 2014 and 2024, (iv) be peer-reviewed and published in a journal or conference, and (v) be written in English. In contrast, candidate study must be excluded if it: (i) does not provide any answer to the research questions of this study, (ii) lacks support for their findings with academic studies, or (iii) scored below 11.2 points (70% of adherence) in the quality assessment.

In Filter 1, the result of the analysis of the title and abstract of the retrieved secondary studies generated a set of 25 candidate studies (13% of the total). To ensure consistency in paper selection, statistical tests were applied to evaluate inter-rater agreement. Two independent reviewers screened articles based on predefined criteria, and any discrepancies were resolved through a reconciliation meeting with an additional researcher serving as mediator. Cohen's Kappa coefficient was calculated to quantify agreement, with a threshold of 0.73 indicating substantial consistency (Landis and Koch, 1977).

In Filter 2, a full read of each selected study in the previous step was conducted, identifying 8 publications (32%) that must be excluded. Table 1 presents a checklist of nine questions (Ivarsson and Gorschek, 2011) used to conduct a quality assessment (Kitchenham et al., 2023), ensuring rigor and reliability of the selected secondary studies while addressing potential biases and validity concerns.

During the Filter 2 step, two researchers independently evaluated each secondary study selected in Filter 1 using a three-point scale: 'Yes' (score of 2, indicating full compliance), 'Partially' (score of 1, indicating partial compliance), and 'No' (score of 0, indicating the criterion is not addressed). The scores were then reviewed in a new reconciliation meeting using a third researcher as mediator. The maximum possible score for a study was 16, reflecting complete adherence to quality criteria, while secondary studies scoring below 11.2 (70% of adherence) were excluded. This process resulted in the final selection of 17 secondary studies, coded from P1 to P17.

Beyond the quality analysis of the secondary studies (*Quality Score*), data extraction was conducted for the following elements, each selected to support a comprehensive understanding of how organizational change (OC) has been investigated in the literature:

- **Main OC subject**: to distinguish whether the focus of the reviewed studies was on people, processes, or technology, which are the foundational pillars of organizational change as proposed by Taylor (1914).
- **Domain**: to categorize the disciplinary perspective from which the change initiatives were analyzed (e.g., Software Engineering, Business Management, or Social Sciences), enabling a better understanding of epistemological diversity.
- **Industry**: to observe the context of application (software, non-software, or unspecified), which contributes to assessing the generalizability and specificity of the reported results.
- **OC characteristics**: referring to how the change initiatives were described in terms of scope, structure, and organizational impact.
- **OC Models**: to identify whether theoretical frameworks or reference models were adopted to guide the analysis or implementation of change.
- **Critical factors**: to map the main challenges, enablers, and barriers to successful change initiatives reported in the studies.
- **Primary Studies (PS) Time Span**: The period in which the selected secondary studies defined in their inclusion criteria reflect the historical breadth of the literature synthesis and provide insights into the temporal evolution and relevance of the studied phenomena.
- **Number of PS**: this data was extracted to indicate how many primary studies were synthesized by each secondary study, serving as an indicator of the empirical foundation supporting their findings. While the absolute number of primary studies is not, by itself, a proxy for review quality, since it depends on the availability of literature in each domain, it helps contextualize the breadth of evidence considered. It is important to clarify that the primary studies were not directly accessed or reviewed in this tertiary study; all information regarding quantity and time span was based solely on what was reported in the secondary studies.

Table 1. Quality Assessment Questions

Category	Question
Research Design	1. Is the research aim clear and justified? 2. Is the methodology well-described and aligned with the objectives?
Data Collection	3. Are the data collection methods and sources clearly described?
Data Analysis	4. For qualitative studies: Are the interpretations clear and logical? For quantitative studies: Are statistical analyses well-documented? For quali-quanti studies: use their average score. 5. Are synthesis methods adequately explained?
Context	6. Is the study context (e.g., industry and scope) sufficiently detailed?
Limitations	7. Are the limitations and threats to validity presented?
Results/Conclusions	8. Are the results supported by empirical data?

Afterward, data analysis was conducted, involving content analysis (Hsieh and Shannon, 2005), synthesis using thematic analysis (Cruzes and Dyba, 2011), and critical evaluation of selected secondary studies to derive meaningful insights and results. The thematic synthesis approach involved extracting key data from each secondary study and grouping similar elements into preliminary categories. These categories were iteratively refined by two researchers through

[1] `http://www.digitallibrary.edu.pk/scopus.html`

discussions and validation against the study objectives. A third researcher reviewed the final categories to ensure consistency and minimize bias. This process ensured that the synthesized factors were representative and aligned with the research questions.

4 Results

Table 2 presents the distributions of the selected secondary studies among the following perspectives: Evidence on research questions (RQ1, RQ2, RQ3), Main explored subject, Field of knowledge, Industry where the OC was applied, and Quality Score.

The main explored subjects in the selected literature reviews were OC in general (41%), OC in people, which are interventions that affect team dynamics and maturity (18%), (iii) OC in the process, which are interventions that generate software process improvement (12%), and OC in technology, which are interventions that involve adoption or creation of new technologies (29%). Since the search was not limited exclusively to studies within the field of Software Engineering, 47% of the reviews pertained to the Software Engineering field, another 47% were related to Management and Business, and 6% of the secondary studies addressed changes in the context of Social Sciences, Psychology, and Human Resource Management. Furthermore, although 24% of the studies did not target a specific industry, 59% were directly associated with the software development sector, while 18% addressed contexts such as healthcare, civil construction, public administration, and various service industries.

Although all selected studies were based on the 'Organizational Change' theme, these studies had different focuses. Several studies were found to address organizational change efforts centered on the implementation of new management models in software development teams (P08, P10), improving software process (P12), analyzing the reactions of change agents and individuals affected by the change (P04), analyzing the readiness of the company and its employees to implement an EOC (P02), analyzing the impact of training and the presence of coaching in the EOC process (P01), analyzing EOC as a tool for promoting environmental, social, and financial sustainability (P05), analyzing aspects such as leadership, organizational culture, and change management (P07). In addition, studies were found that focused on reviewing OC theories in general and proposing future research agendas (P06), identifying the most important factors influencing change management success in the construction field (P03), employees' attitudes toward OC initiatives (P09), applying robotic process automation as a tool to apply OC (P14), and the digital transformation as an instance of OC in companies (P13).

Table 2 shows that most of the selected studies were interested in providing evidence on critical factors that can boost or hinder OC iniciatives (76%), others discussed the characteristics of OCs implemented in each context (35%), and few presented processual and descriptive models (18%). In addition, the quality scores presented in Table 2 indicate that the selected studies adhere well to the established quality criteria. Most studies scored highly across key categories, such as clarity of research aims, well-described methodologies, and robust data collection processes. However, only 40% addressed limitations and threats to validity, while 76% explicitly detailed the synthesis methodologies employed, including meta-analysis, thematic analysis, and narrative review.

In addition to the discussed aspects, Table 2 also presents the time span and number of primary studies (PS) analyzed in each secondary study. These two indicators help contextualize the historical breadth and empirical density of the reviewed evidence. The distribution reveals a wide temporal coverage, with primary studies spanning from 1951 to 2022. This suggests that the selected reviews capture both foundational and contemporary insights into Organizational Change (OC), enabling the identification of long-term trends and shifts in focus. Moreover, the number of primary studies analyzed per review varies considerably, from 18 to 279. Although a higher number of PS does not necessarily imply greater quality or comprehensiveness, it does suggest the extent of empirical material synthesized in each review. This diversity reinforces the importance of triangulating findings across studies with distinct scopes and levels of detail.

4.1 RQ1. What are the main OC characteristics?

RQ1 examines the main characteristics of OC initiatives that should be considered when implementing effective change management. Among the selected secondary studies, 39% reported on OC characteristics. The analysis of their content revealed six recurring characteristics that capture the nature and scope of these initiatives. These interrelated dimensions highlight the need for integrated approaches to managing organizational change.

To ensure comparability, the data were consolidated across studies, harmonizing variations in terminology and levels of abstraction into a unified set of characteristics. Table 3 summarizes the six characteristics and indicates the secondary studies in which they were reported (source).

Characteristic #1: OC initiatives respond to internal and external factors. Organizational change is driven by external pressures, such as market dynamics or regulatory requirements, and internal factors like inefficiencies or cultural shifts. These initiatives can originate from the strategic level (top-down), aligning the organization with long-term goals, or from the tactical and operational levels (bottom-up), addressing practical challenges or opportunities. "Organizations are required to make significant investments for implementing various changes to adapt to the changing context" (P03) "These change initiatives are driven by the need to respond to organizational needs and external environmental pressures, such as consumer trends, regulatory influences, and global competitiveness." (P05)

Characteristic #2: Large-scale or high-impact OC initiatives exhibit the characteristics of episodic organizational change (EOC). Unlike continuous organizational change (COC), which evolves incrementally with lower risks and resource requirements, EOC initiatives are marked by intermittent, intentional transformations that demand greater complexity, authority, and resource allocation (Weick and Quinn, 1999). These large-scale changes can significantly

Table 2. Distribution of the selected literature reviews

Code	Publication	Main OC subject				Domain			Industry			Questions			PS Time Span	Number of PS	Quality Score
		OC in General	OC in People	OC in Process	OC in Technology	SW Engineering	Mgmt. & Business	Soc. Science & Psych.	Software	Non-Software	Not Specified	RQ1 Character.	RQ2 Models	RQ3 Factors			
P1	Umut and Aslan (2019)	X						X			X			X	1999-2018	18	13
P2	Miake-Lye et al. (2020)	X					X			X			X	X	1988-2016	26	14
P3	Errida and Lotfi (2021)	X					X			X			X	X	1958-2020	29	13
P4	Khaw et al. (2023)	X					X			X		X		X	1970-2021	79	16
P5	Tipu (2022)	X					X				X		X		2000-2019	62	14
P6	Supriharyanti and Sukoco (2023)	X					X				X			X	2005-2020	48	13
P7	Orieno et al. (2024)	X					X				X	X			1958-2020	37	13
P8	Dikert et al. (2016)		X			X			X					X	1958-2015	52	16
P9	Acharya and Colomo-Palacios (2019)		X			X			X					X	1951-2019	23	12
P10	Lima et al. (2022)		X			X			X					X	2016-2022	28	16
P11	Khan and Keung (2016)			X		X			X					X	1995-2016	33	16
P12	Zahra et al. (2017)			X		X			X					X	2009-2016	40	16
P13	Zaoui and Souissi (2020)				X		X		X			X			2009-2019	32	13
P14	Enríquez et al. (2020)				X		X		X			X			2012-2020	54	16
P15	Hanelt et al. (2021)				X	X			X			X		X	2000-2020	279	12
P16	Moreira et al. (2024)				X	X			X					X	2019-2022	40	14
P17	Plekhanov et al. (2023)				X	X			X			X		X	2009-2016	40	14
Totals		7	3	2	5	8	8	1	10	3	4	6	3		72	920	x=
%		41	18	12	29	47	47	6	59	18	24	35	18		years	studies	14.2

Table 3. Main OC characteristics identified in the selected secondary studies

Characteristic	Source
C1. OC initiatives respond to internal and external factors	P03, P05, P07-P08, P13, P15
C2. Large-scale or high-impact OC initiatives exhibit the characteristics of episodic organizational change (EOC)	P02-P04, P07-P08, P13-P15
C3. OC initiatives must be implemented without disrupting daily operations	P03-P04, P07, P10
C4. Many OC initiatives are implemented without sponsoring support or OC management knowledge	P03, P05, P07, P09-P12, P15-P16
C5. OC initiatives must be aligned with governance structures	P10-P05, P07, P12, P17
C6. OC initiatives should be integrated with organizational learning	P03, P05, P11-P12

impact one or more fundamental pillars of an organization, including people, processes, and technology (Taylor, 1914), necessitating structured planning and governance to ensure successful implementation and long-term sustainability. ”EOC are driven by the need to implement planned interventions that address specific organizational challenges, contrasting with incremental adaptation processes” (P03)

Characteristic #3: OC initiatives must be implemented without disrupting daily operations, requiring a balance between continuity and transformation. For example, ”to sustain change, it is not sufficient for organizations to be ready for implementing single change initiatives, but they must also have the capacity to maintain daily operations and manage and implement multiple changes” (P03) Another study complement that ”Effective change management involves the need to balance operational stability with innovative approaches, ensuring that transitions occur without compromising day-to-day operations” (P07). These perspectives underline that achieving the desired future state requires careful operational continuity management.

Characteristic #4: Many OC initiatives are implemented without sponsoring support or OC management knowledge. However, active sponsorship and reinforcement of changes are vital for sustainability (Lima et al., 2024). ”Visible support from executives ensures alignment and resource allocation, while reinforcement mechanisms solidify the long-term gains of OCs” (P03). ”Organizational support and leadership are highlighted as essential elements for successful change, especially in initiatives that require strategic and cultural alignment.” (P05). ”lack of formal SPI implementation methodology” is an important obstacle” (P11).

Characteristic #5: OC initiatives must be aligned with governance structures. Misalignment between OC initiatives and organizational governance structures can lead to resistance, resource inefficiencies, and dissatisfaction among change agents, particularly in bottom-up initiatives without management approval. Impacting key pillars such as technology, people, and processes, ”aligning initiatives with organizational’s strategic objectives” (P07) ”enhances oversight, fosters coordination, and ensures long-term sustainability” (P05). ”It can enhance and constrain value creation” (P17).

Characteristic #6: OC initiatives should be integrated with organizational learning. One study observed that ”lack of systematic knowledge sharing prevents organizations from learning from past OC initiatives, leading to repeated mistakes” (P15). Another emphasized, ”establishing frameworks for capturing lessons learned is essential for fostering continuous improvement and minimizing risks in future initiatives” (P16). These findings highlight the importance of embedding learning mechanisms within the organization to sustain long-term benefits.

The findings underline the interconnected nature of these characteristics. Effective OC management requires an integrated approach, combining strategic planning, leadership, team engagement, and continuous learning. Understanding

these elements helps navigate the complexities of OCs and achieve sustainable organizational transformation.

4.2 RQ2. What existing models could assist in OC process?

RQ2 examines the organizational change (OC) models that can support the design and implementation of change initiatives. Among the selected secondary studies, 17% addressed OC models stratified in descriptive and processual models (Errida and Lotfi, 2021). While the descriptive models explain the dynamics and characteristics of OC without prescribing specific actions, focusing on understanding existing conditions and contextual factors influencing change (Powell Jr, 2002), the processual models provide structured frameworks outlining specific steps and actions for implementing change, guiding organizations toward a desired future state (Dawson, 2019). Following the analysis and review of the 41 identified models, a categorization was established comprising 24 descriptive models (see Table 4) and 17 processual models (see Table 5).

Table 4. Descriptive Models identified in the selected secondary studies

Model	Source
1. Cummings's change management model (Cummings and Worley, 2016)	P02, P03
2. Burke and Litwin's model of OC (Burke and Litwin, 1992)	P04, P06
3. Congruence model (Bezboruah, 2008)	P02, P07
4. Change formula of Beckhard and Harris (Beckhard and Harris, 1987)	P01, P03
5. Carnall's change management model (Carnall, 2018)	P06
6. Knoster's change model (Knoster, 1991)	P01
7. GE's change acceleration (Tichy and Sherman, 1993)	P02, P09
8. Prosci's change management methodology - ADKAR (Hiatt, 2006)	P02, P07
9. Change Management Body of Knowledge (CMBoK) (CMI, 2022)	P07
10. BCG's change delta (Boston Consulting Group, 2000)	P03, P06
11. McKinsey's 7-S (Waterman et al., 1980)	P05, P06
12. Armenakis et al.'s model (Armenakis et al., 1993)	P01, P11
13. Cawsey et al.'s model (Cawsey et al., 2020)	P02
14. CMI's Change Management Maturity Model (Cameron and Green, 2015)	P06, P08
15. Fernandez and Rainey's model (Fernandez and Rainey, 2006)	P11
16. Change First's model (ChangeFirst Ltd., 2014)	P10, P13
17. Integrative Model of Planned Change (Bullock and Batten, 1985)	P06, P09
18. Bridges' model of transition (Bridges and Bridges, 2016)	P10, P13
19. The change leader's roadmap (Anderson and Anderson, 2010)	P13
20. Whelan-Berry and Somerville's model (Whelan-Berry and Somerville, 2010)	P02
21. Kanter et al.'s model (Kanter et al., 1992)	P03, P06
22. General strategies for effecting changes in human systems (Chin and Benne, 1969)	P11, P14
23. Integrative Framework for corporate sustainability tensions (Hahn et al., 2015)	P13
24. Processes of change in organizations (Van de Ven and Poole, 1995)	P07, P14

Descriptive models of organizational change emerged as an attempt to explain the underlying dynamics and contextual factors that shape transformations. Rather than prescribing sequential steps, these frameworks emphasize diagnosis, alignment, and the interaction of variables across the system. The Burke–Litwin model (Burke and Litwin, 1992) and the Congruence model (Bezboruah, 2008) illustrate this diagnostic tradition by mapping causal linkages between external environment, organizational components, and performance. Complementarily, McKinsey's 7-S framework (Waterman et al., 1980) highlights the interdependence of strategy, structure, systems, and softer dimensions such as skills and shared values, establishing one of the most enduring lenses for organizational analysis. In parallel, Beckhard and Harris's change formula (Beckhard and Harris, 1987) distilled the motivational conditions required for change, while Armenakis et al. (1993) advanced the role of readiness as a precursor to commitment. More practice-oriented contributions, such as GE's Change Acceleration Process (Tichy and Sherman, 1993), BCG's Delta (Boston Consulting Group, 2000), and Prosci's ADKAR methodology (Hiatt, 2006), translated these ideas into actionable consulting tools. Later syntheses, including Kanter et al.'s commandments (Kanter et al., 1992) and Van de Ven and Poole's process theories (Van de Ven and Poole, 1995), reinforced the view of change as multifaceted, contingent, and deeply embedded in organizational systems.

Table 5. processual Models identified in the selected secondary studies

Model	Source
1. Lewin's three-step change model (Lewin, 1947)	P01, P02, P03
2. Lippitt et al.'s change theory (Lippitt, 1958)	P01, P05
3. PDCA Model (Deming, 1986)	P11, P12
4. Judson's five-phase model (Judson, 1991)	P03, P06
5. Jick's 10 steps model (Jick, 1993)	P06
6. PDSA Model (Deming, 1993)	P11
7. Kotter's 8-Step Change Model (Kotter, 1995)	P02, P04, P06
8. Galpin's wheel of nine wedges (Galpin, 1996)	P03
9. Lean Six Sigma (Harry and Schroeder, 2000)	P12, P15, P17
10. Mento et al.'s change model (Mento et al., 2002)	P01
11. Luecke's seven steps (Luecke, 2003)	P03, P07
12. Model of Fernandez and Rainey (Fernandez and Rainey, 2006)	P02, P11
13. Kickert (Kickert, 2010)	P01
14. Business Process Management (BPM) (Weske, 2012)	P13, P16
15. ACMP's Standard for Change Management (ACMP, 2014)	P07, P10
16. Model for improvement (Crowl et al., 2015)	P12, P15
17. Dawson's Accelerating Implementation Methodology (Dawson, 2020)	P05, P13

processual models of organizational change emerged from the need to provide *structured pathways* to reduce uncertainty in transformation processes. The foundation was laid by Lewin's three-step model (Lewin, 1947), which conceptualized change as a sequence of unfreezing, moving, and refreezing. Building on this logic, Lippitt (1958) and Judson (1991) added stages that detail diagnosis, mobilization, and institutionalization, while more prescriptive frameworks such as Jick's ten steps (Jick, 1993) and Kotter's eight steps (Kotter, 2012) gained prominence in practice for their clarity and managerial appeal. In parallel, cycles of continuous improvement, such as PDCA (Deming, 1986), PDSA (Deming, 1993), and the Model for Improve-

ment (Crowl et al., 2015), emphasized experimentation and learning. Other contributions include Galpin's nine wedges (Galpin, 1996), Luecke's seven steps (Luecke, 2003), and approaches that integrate performance and process logic, such as Lean Six Sigma (Harry and Schroeder, 2000) and BPM (Dumas et al., 2018). More recent institutional frameworks, including the ACMP Standard (ACMP, 2014) and Dawson's methodology (Dawson, 2020), illustrate the ongoing effort to systematize change into a *replicable and action-oriented process*.

According to the models identified in the literature review and with the objective of analyzing what each processual model suggests as activities in the three stages of the CATS model (Unfreeze, Change, and Refreeze), we expanded the framework originally published by Cummings and Worley (2016), which was limited to studies from 1947 to 2010. In this research, we incorporate additional processual models identified in the selected secondary studies and published up to 2020, totaling 22 representative models. Table 6 presents these models, their main phases and activities to guide organizational change initiatives.

Models marked with an asterisk (e.g., (*) Kolb & Frohman (1970)) were included in the original list by Cummings and Worley (2016) but were not mentioned in the selected secondary studies. To ensure an expanded and comprehensive list, we retained these preexisting models, which explains why the expanded list includes more models than those presented in Table 5.

Inspired by the Change as Three Steps (CATS) Model Lewin (1947), we examined the activities mapped by the processual models presented in Table 5. This analysis revealed variations both in terminology and in the level of granularity: while some models were more concise, grouping several actions into a single activity, others decomposed them into more detailed steps. To ensure a coherent representation, the researchers conducted a thematic analysis and synthesis process, harmonizing the nomenclature and aligning the level of granularity across models. As a result, we consolidated a unified list of 15 activities distributed across the three stages of the CATS model — Unfreeze, Change, and Refreeze — as summarized in Table 7.

By structuring the activities across these three stages, organizations can navigate the complexities of change more effectively, ensuring both the smooth implementation and long-term sustainability of organizational change initiatives.

4.3 RQ3. What are the critical success and failure factors for OC initiatives?

RQ3 examines the critical factors that influence the outcomes of OC initiatives, either enabling their success or contributing to their failure. Among the selected secondary studies, 94% mentioned critical factors that influence the success or failure of the OC initiatives in the form of opportunities or challenges. These factors were compiled and categorized based on their relevance and frequency in the literature. Table 8 presents a list of 14 critical factors that can boost or hinder the implementation of OC.

A **clear change vision and strategy (CF1)** is crucial for success. This involves aligning the change with the organization's mission, setting clear objectives, and ensuring stakeholders understand the impacts. A lack of clarity was noted as a major barrier. For instance, "defining a clear vision and aligning it with organizational goals ensures a unified direction" (P14), while "without a clearly communicated vision, stakeholders struggle to connect with the change purpose" (P01). Additionally, "ambiguous or misaligned goals create confusion and resistance" (P16).

The performance of the change team (CF2) emerged as another critical factor. High-performing, skilled teams with clear roles and responsibilities are essential for driving OC. However, restrictions on autonomy or insufficient team preparation can undermine their effectiveness. As noted, "high-performing teams with well-defined roles are vital for operationalizing the change strategy" (P13). Similarly, "insufficient autonomy or limited decision-making authority hampers the team's ability to respond dynamically to challenges" (P02). Another study highlighted that "Several studies stated that training improved the chances of succeeding in the transformation" (P08).

Employee motivation (CF10) and stakeholder engagement (CF3) are key to OC success. Recognizing contributions, celebrating small wins, and aligning initiatives with employees' values foster commitment and morale. Engaging supervisors, managers, and external stakeholders ensures aligned support. As noted, "recognizing employees' contributions and celebrating small wins increases morale and commitment" (P15), and "stakeholder engagement, including supervisors and external partners, ensures aligned support across all levels" (P13). Additionally, "aligning change initiatives with employees' values fosters a deeper connection and motivation" (P10). Most models stress that "motivation mobilizes employees to actively participate in change" (P03).

Resistance management (CF4) is frequently discussed, including addressing resistance at individual, team, and organizational levels Dikert et al. (2016). "Cultural factors, inadequate transition management, and cynicism were highlighted as barriers that require careful attention and strategic interventions" (P15). "Strategic interventions, such as involving resistant individuals in the planning process, can mitigate opposition" (P13). "People's resistance is considered as the biggest barrier that can make change difficult, if not impossible" (P03).

Leadership (CF5) and structured approaches to change (CF12), such as governance, planning, and risk management, were identified as key enablers. Effective leadership supports alignment and resource allocation, while structured approaches ensure that change is methodically implemented and monitored. For instance, "strong leadership provides direction and ensures alignment of resources with strategic goals" (P12). Another study highlighted that "structured governance frameworks help monitor progress and address risks proactively" (P08). Furthermore, "methodical planning increases the likelihood of success by reducing ambiguity and streamlining the change process" (P16).

Sustaining change and reinforcing new behaviors (CF6) are vital for long-term success. Cultural integration, reinforcement, and lessons learned prevent regression and foster continuous improvement. "Reinforcement strategies (e.g.

Table 6. Activities proposed by the identified processual OC models

Model (Year)	**Unfreeze**	**Change**	**Refreeze**
Lewin (1947/1951)	Unfreeze	Change	Refreeze
Lippitt et al. (1958)	Develop need for change	Work toward change	Stabilize change
(*) Kolb & Frohman (1970)	Assess need; Diagnosis; Develop plan	Action	Evaluate; Terminate
PDCA (1980)	Define problem; Measure; Analyze	Improve the process	Control
Judson (1991)	Analyze organization; Plan for change; Communicate	Implementation	Reinforce; Institutionalize
Jick (1993)	Analysis; Vision; Sense of urgency; Sponsorship; Implementation plan	Communication; Involvement; Structures; Leadership	Strengthen and institutionalize
PDSA Model (1993)	Plan	Do	Study; Act
Kotter's 8-Step Change Model (1995)	Urgency; Guiding coalition; Vision; Short-term wins	Communicate; Empower action	Consolidate; Institutionalize
Galpin's wheel of nine wedges (1996)	Vision; Diagnose current situation; Recommendations	Pilot test; Rollout	Measure; Reinforce; Refine
Lean Six Sigma (2000s)	Define; Measure	Analyze; Improve	Control
Mento et al. (2002)	Establish sense of urgency; Form vision	Create and communicate plan; Empower employees	Reinforce results; Institutionalize change
Luecke (2003)	Mobilize energy; Develop shared vision; Identify leadership	Start at periphery; Monitor; Adjust strategies	Institutionalize success
Fernandez & Rainey (2006)	Ensure need; Plan; Build internal/external support	Implementation; Provide resources	Pursue comprehensive change
Kickert (2010)	Urgency; Vision; Guiding coalition; Plan; Support	Communicate; Empower action	Institutionalize; Comprehensive change
(*) Sullivan et al. (2011)	Motivation; Analyze status quo; Establish core team; Secure support; Readiness	Pilot; Full implementation	Institutionalize; Measure sustainability
Business Process Management (BPM) (2012)	Process identification; Modelling	Implementation; Monitoring	Optimization; Institutionalization
(*) Kotter (2014) – Accelerating Change	Urgency; Guiding coalition; Strategic vision	Communicate; Empower; Short-term wins	Sustain acceleration; Incorporate in culture
ACMP (2014)	Evaluate impact; Define change; Assess readiness; Risk assessment	Execute and monitor change plan	Evaluate outcome; Lessons learned; Sustainability
Model for Improvement (2015)	Set aims; Establish measures	Test changes using PDSA cycles	Implement and sustain improvement
(*) Accelerating Implementation Methodology (AIM) (2018)	Define change; Build agent capacity; Assess climate; Sponsorship; Readiness	Develop communication plan; Prioritize action	Reinforcement strategy; Cultural fit
Dawson's Accelerating Implementation Methodology (2020)	Assess readiness; Define change need; Build sponsorship	Execute implementation steps; Engage stakeholders; Monitor adoption	Reinforce outcomes; Institutionalize best practices

Table 7. Activities proposed by processual OC models according to the CATS stages

Stage	**Activities**
Unfreeze	A1. Define the motivation for change A2. Ensure leadership and stakeholder support for the change A3. Assemble a dedicated change agent team A4. Establish a clear vision of the desired future state A5. Analyze the organization's readiness for change A6. Implement a risk management strategy A7. Develop a comprehensive change plan
Change	A8. Prepare the organization and its stakeholders for the change A9. Implement the change plan as designed A10. Monitor and control the change process to address any emerging issues A11. Ensure the sustainability of the change through ongoing reinforcement
Refreeze	A12. Institutionalize the change as part of the organization's standard practices A13. Consolidate the change to ensure it is fully integrated A14. Evaluate the results and the overall process of the OC initiative A15. Formalize the completion of the change process

Table 8. Critical Factors (CFs) for Organizational Change identified in the selected secondary studies

Critical Factor	Source (Secondary Studies ID)
CF1. Clear change vision and strategy	P01, P03, P05, P14, P16
CF2. Change team performance	P02, P03, P08, P09, P13
CF3. Stakeholder engagement	P03, P10, P13, P15
CF4. Resistance management	P03-P04, P07, P13, P15
CF5. Leadership	P03, P05-P06, P08-P09, P12, P16
CF6. Support and sponsorship	P03, P05, P11, P14-P15
CF7. Choosing adequate approach	P03-P04, P07, P17
CF8. Change readiness and capacity for change	P02-P03, P12, P15
CF9. Effective communication	P03-P04, P08, P10, P14, P16
CF10. Motivation of change agents	P03, P10, P13, P15
CF11. Training, coaching, and empowerment	P03, P08, P11-P12, P14, P16
CF12. Structured approach for change	P03, P05, P08, P12, P16
CF13. Learning and knowledge sharing	P03, P06, P08, P10, P14
CF14. Evaluation and measurement	P06, P08, P10, P14

recognition and formalization) embed changes into the culture" (P15). "Learning from past OCs ensures continuous improvement" (P14). "Integrating new behaviors promotes sustainability" (P05).

Change readiness and capacity (CF8) emphasize urgency, structural and cultural preparation, and adequate resources and skills. Without these, change efforts risk resistance and low engagement. "Readiness assessments are critical to gauge capacity and identify barriers" (P02). "Establishing urgency through targeted communication fosters awareness and reduces inertia" (P12). Moreover, "lack of preparation, especially cultural and structural, leads to disengagement and prolonged resistance" (P15).

Selecting the appropriate methodology (CF7) impacts OC successful. "There is no consensus on the most appropriate change management model, as a single model may not fully address different OC situations. Therefore, combining multiple models may be the best approach to fit an organization's particular needs" (P03). Using an unsuitable methodology "can lead to resource wastage and poor outcomes" (P04).

Effective communication (CF9) affects successful OC, requiring constant updates, transparency about the process, and monitoring communication strategies. Failures can foster distrust and resistance. "Continuous communication ensures stakeholders are informed and engaged, reducing resistance" (P10). Transparency "builds employee trust by conveying the rationale and steps of the change process" (P14). Monitoring channels "helps identify gaps and improve message delivery" (P16). Additionally, "effective and constant communication creates readiness, reduces resistance, and secures buy-in" (P03).

Training, coaching, and empowerment (CF11) are essential to equip employees with the skills and confidence to cope with OC initiatives. Poor training or lack of empowerment hinders adoption of new practices. "Training programs tailored to required skills ensure employees feel prepared and confident" (P12). "Empowering employees with decision-making authority fosters ownership and commitment" (P16). Moreover, "continuous learning and coaching enable effective adaptation to new practices" (P14).

Learning and knowledge sharing (CF13) build institutional knowledge, while **evaluation and measurement (CF14)** monitor and refine change efforts. "Knowledge sharing enhances collective understanding and prevents repeated mistakes" (P03). "Tracking progress with clear metrics and periodic reviews ensures accountability and informed decisions" (P14). Additionally, "knowledge sharing was essential in successful agile transformations" (P08).

The characteristics, activities, and critical factors of OC initiatives are interconnected. While key aspects influence management, existing models provide structured support for implementation and managing factors that determine success or failure.

4.4 Interconnections among activities, characteristics, and critical factors

Beyond identifying models, activities, characteristics, and critical factors in isolation, this study also examined their interconnections to provide a more integrated view of organizational change. The analysis focused on how the activities proposed by processual models and the key characteristics of OC initiatives relate to the critical factors that determine success or failure. This mapping enables a clearer understanding of which activities and characteristics exert greater influence on critical factors, thereby highlighting leverage points that can guide practitioners and researchers in designing and evaluating change initiatives.

Table 9 offers a practical analysis, enabling practitioners to understand which activities are most impactful in mitigating specific challenges and enhancing positive elements of OC. We noted that most activities are focused on stakeholder engagement (CF3), resistance management (CF4), and effective communication (CF9), which reflects the importance of these factors for change success.

1. Activities with the Greatest Impact on Critical Factors: A1. Define the motivation for change and A7. Develop a comprehensive change plan are the activities that impact the highest number of CFs (64% each). Both are strongly related to factors such as clear change vision (CF1), stakeholder engagement (CF3), resistance management (CF4), and structured approach (CF12). A8. Prepare stakeholders for the change and A10. Monitor and control the change process also have a significant impact (57% each), highlighting the importance of effective communication (CF9) and continuous stakeholder involvement (CF3).

2. Critical Factors Most Impacted by Activities: CF9. Effective communication and CF10. Motivation of change agents are the most impacted factors (93% each), indicating that communication and the motivation of the change team are essential for the success of OC. CF3. Stakeholder engagement and CF4. Resistance management also are highly impacted, with 73% of activities contributing to them. This reinforces the importance of engaging stakeholders and managing resistance throughout the change process.

Table 9. Interconnection between activities (A1–A15) and critical factors (CF1–CF14)

A x CF	CF1	CF2	CF3	CF4	CF5	CF6	CF7	CF8	**CF9**	**CF10**	CF11	CF12	CF13	CF14	% CF that impact A
A1	X	X	X	X		X	X		X	X				X	**64**
A2		X	X	X	X	X			X	X	X				57
A3		X	X	X	X			X	X	X					50
A4	X		X	X					X	X					36
A5				X				X							14
A6		X		X					X	X		X		X	43
A7	X	X	X	X			X		X	X		X		X	**64**
A8		X	X	X	X				X	X	X	X			57
A9		X	X			X			X	X	X	X			50
A10		X	X	X	X	X			X	X				X	57
A11			X	X			X	X	X	X		X			50
A12			X			X	X		X	X			X	X	50
A13			X	X					X	X	X			X	43
A14									X	X			X	X	29
A15									X	X			X	X	29
% A that impact CF	20	53	73	73	27	33	27	20	**93**	**93**	33	33	20	47	

3. Critical Factors Least Impacted by Activities: CF5. Leadership, CF7. Choosing adequate approach, CF8. Change readiness and capacity, and CF12. Structured approach for change are the least impacted factors (27% each). This suggests a gap in leadership involvement and the selection of adequate approaches, which may compromise the effectiveness of the change. CF13. Learning and knowledge sharing and CF14. Evaluation and measurement also have low impact (20% and 47%, respectively), indicating that organizational learning and results evaluation are areas that require greater attention.

4. Activities with the Least Impact on Critical Factors: A5. Analyze organizational readiness for change and A14. Evaluate the results of the change process are the activities that impact the fewest CFs (14% and 29%, respectively). This suggests that organizational readiness analysis and results evaluation are underutilized or not effectively integrated into the change process.

Table 10 shows how the Characteristics (C) of OC initiatives impact the need for attention and management of Critical Factors (CFs). The characteristics of OC initiatives have a varied impact on critical factors attention needed, with a greater focus on change readiness and results evaluation.

The results reveal both strong and weak connections, with some characteristics demanding broader attention while others remain underexplored. These patterns set the stage for the following analysis, where we detail which characteristics exert the greatest and least impact, and which critical factors are most frequently addressed or overlooked.

1. Characteristics with the Greatest Impact on Critical Factors: C2. Large-scale or high-impact OC initiatives exhibit the characteristics of episodic Organizational change (EOC). In this context, EOCs, due to their disruptive and strategic nature, amplify the challenges of change management. This makes attention to all Critical Factors presented in the Table 10, which is essential to minimizing risks, maximizing engagement, and ensuring the success of organizational transformation. C3. OC initiatives must balance continuity and transformation is the characteristic that most impacts CFs (71%). It is strongly related to factors such as clear change vision (CF1), stakeholder engagement (CF3), resistance management (CF4), leadership (CF5), support and sponsorship (CF6), structured approach (CF12), and evaluation and measurement (CF14). This indicates that balancing continuity and transformation requires attention to multiple critical aspects C1. OC initiatives respond to internal and external factors also has a significant impact (50%), highlighting the importance of factors such as clear vision (CF1), change readiness (CF8), and structured approach (CF12).

2. Characteristics with the Least Impact on Critical Factors: C6. OC initiatives should integrate organizational learning is the characteristic that least impacts CFs (21%), being related only to learning and knowledge sharing (CF13) and evaluation and measurement (CF14). This suggests that the integration of organizational learning is undervalued or not adequately connected to other critical factors. C4. Lack of sponsorship or OC knowledge impacts OC success and C4. OC initiatives must be aligned with governance structures also have low impact (29% each), indicating that the lack of sponsorship, OC knowledge, and alignment with governance are areas that need greater attention.

3. Critical Factors Most Addressed by Characteristics: CF8. Change readiness and capacity and CF14. Evaluation and measurement are the most addressed factors, with 83% of the characteristics calling attention to them. This reinforces the importance of ensuring change readiness and continuously measuring results. CF1. Clear change vision and strategy, CF7. Choosing adequate approach, and CF11. Training, coaching, and empowerment are also highly relevant (60% each), indicating that a clear vision, adequate approaches, and team training are essential for OC success.

4. Critical Factors Least Addressed by Characteristics: CF2. Change team performance and CF3. Stakeholder engagement are not directly impacted only by C2. This suggests a gap in the analysis, as team performance and stakeholder engagement are fundamental to the success of change. CF4.

Table 10. Interconnection between characteristics (C1–C6) and critical factors (CF1–CF14)

C x CF	CF1	CF2	CF3	CF4	CF5	CF6	CF7	CF8	CF9	CF10	CF11	CF12	CF13	CF14	% CF that impact C
C1	X			X		X	X	X				X		X	50
C2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	**100**
C3	X			X	X	X	X	X	X	X	X			X	71
C4								X			X		X	X	29
C5	X						X					X		X	29
C6								X			X		X		21
% C that impact CF	67	17	17	50	33	50	67	**83**	33	33	67	50	50	**83**	

Resistance management, CF5. Leadership, CF6. Support and sponsorship, CF9. Effective communication, CF10. Motivation of change agents, and CF12. Structured approach for change have moderate impact (20% to 40%), indicating that these factors need greater integration into the characteristics of OC initiatives.

5. Overall Impact of Characteristics on the Management of Critical Factors: The characteristics of OC initiatives highlight the need for a holistic approach, especially regarding change readiness (CF8) and results evaluation (CF14). However, there is an undervaluation of factors such as change team performance (CF2), stakeholder engagement (CF3), and leadership (CF5), which are critical to the success of change.

To improve the effectiveness of OC initiatives, it is necessary to: 1. Better integrate team performance (CF2) and stakeholder engagement (CF3) into the OC initiatives. 2. Strengthen the role of leadership (CF5) and resistance management (CF4). 3. Ensure that organizational learning (CF13) and continuous evaluation (CF14) are prioritized at all stages of the process.

5 Discussion

The findings of the study highlight that OC initiatives in the software industry face persistent challenges, with ad hoc, experience-driven practices often prevailing over proven methodologies (Beer and Nohria, 2000). Although practitioners often adopt familiar frameworks such as PMBoK, Scrum framework, and CMMI, these models fail to address critical aspects of EOC initiatives, such as organizational readiness, alignment with organizational governance, and long-term sustainability (Lima et al., 2024). Furthermore, the low adoption of classical OC models (Kotter, 2007; Lewin, 1947) further reinforces the need to investigate how existing frameworks can be adapted to better suit the software industry context. To improve effectiveness, software industry companies must increase awareness of OC methodologies and adapt existing models to their specific challenges and characteristics. The synthesized models, factors, and interconnections presented in this study offer a practical foundation for replacing improvised strategies with evidence-based practices.

Integrating descriptive and processual models to address the ”why” and ”how” of OC offers a promising avenue to improve the efficiency and sustainability of change initiatives in the software industry. Despite expanding Errida and Lotfi (2021)’s list of OC models from 37 to 41 (17 processual and 24 descriptive), most of the primary studies cited in the selected literature reviews do not reference these models, particularly in software industry contexts (Lima et al., 2024). While descriptive models help clarify the motivations and contextual factors that drive change, processual models provide step-by-step guidance for execution. This dual perspective enables organizations not only to understand the underlying rationale for change but also to structure their initiatives in a systematic and goal-oriented manner. Practitioners can use this integration as a basis for developing OC roadmaps that align strategic intent with concrete actions, particularly in scenarios such as agile transformations, digital modernization, or process restructuring. Moreover, by examining how activities, characteristics, and critical factors interconnect, this study demonstrates that OC success depends less on isolated elements and more on the combined effect of practices that reinforce one another.

The results of Sections 4.1, 4.2, and 4.3 complement each other, offering a holistic understanding of OC in the software industry. While Section 4.1 explores broader characteristics shaping OC management, Section 4.2 categorizes OC models into processual and descriptive types, providing structured frameworks and theoretical insights. Section 4.3 then identifies critical factors influencing the success or failure of OC initiatives. Finally, Section 4.4 extends these findings by analyzing their interconnections, showing which characteristics and activities are most strongly associated with specific critical factors. These results create a stronger foundation for connecting practical strategies to conceptual principles, supporting practitioners in designing context-aware change strategies that consider both organizational dynamics and technical complexity.

Conducting a tertiary review based on secondary studies enabled this work to leverage a consolidated body of empirical evidence comprising over 900 primary studies, covering a period of more than 70 years (see Table 2). Although the primary studies were not directly analyzed, the strength of this approach lies in synthesizing knowledge from systematic reviews, which have already evaluated and interpreted results across diverse contexts. This strategy expands the temporal and methodological coverage of the investigation, allowing access to longitudinal trends and cross-industry insights.

Moreover, it helps address recurrent limitations in the Organizational Change (OC) literature, such as the prevalence of theoretical contributions with limited empirical grounding (Cummings and Worley, 2016) and the scarcity of software industry-specific evidence (Lima et al., 2024).

These findings advocate for a dual focus on theory and practice. Practitioners must embrace proven OC models, adapting them to the software industry's unique demands, while researchers should aim to fill theoretical gaps. For practitioners, the consolidated set of models, activities, critical factors, and their interconnections can serve as a practical reference to plan, monitor, and adapt OC efforts more effectively. For researchers, the identification of underexplored links between activities, characteristics, and critical factors opens opportunities for further empirical investigation on how these dimensions interact to influence change outcomes.

6 Threats to Validity and Limitations

Despite the adoption of a well-defined protocol and the application of rigorous methodological practices (Kitchenham et al., 2010), some threats to validity remain, along with associated limitations (Zhou et al., 2016).

Internal Validity refers to the reliability of the methods and data used in this study. As the analysis relies on secondary sources, interpretation biases from original authors may persist. To mitigate this, predefined inclusion and exclusion criteria were applied, and independent reviews were conducted by multiple coders. Despite these measures, subjective interpretations during thematic synthesis remain a potential limitation. **External Validity** concerns the generalizability of findings to other contexts. The results are tailored to the software industry, characterized by its rapid technological evolution and volatility. Future studies should investigate cross-industry comparisons to validate the transferability of these findings.

Construct Validity examines whether the study accurately captured its intended constructs. While "critical factors" and "OC models" were derived from established literature (Lewin, 1947; Errida and Lotfi, 2021; Weick and Quinn, 1999), the inclusion of synonyms to address the limited use of "Organizational Change" in software-focused studies may have introduced minor misalignments. Furthermore, synthesizing activities from diverse models, each with distinct contexts and purposes, risks conceptual inconsistency. This mapping provides a starting framework, not a definitive guide. Future research should validate these constructs empirically. **Conclusion Validity** relates to the strength of the evidence supporting the study's conclusions. Synthesizing data from multiple studies added robustness but risked overgeneralization due to variations in study quality and focus. Additionally, excluding non-English secondary studies and those outside the 2014–2024 timeframe might have overlooked relevant insights. Nonetheless, Scopus's comprehensive indexing likely minimized omissions.

Researcher bias remains a concern in qualitative studies. Predefined protocols, peer reviews, and reconciliation meetings minimized subjectivity, with a third researcher ensuring consistency. However, the inclusion of only 17 secondary studies may limit generalizability, and the thematic synthesis process relies on subjective judgment. Expanding the dataset in future research could enhance applicability and impact.

A key limitation of this tertiary review lies in its exclusive reliance on data extracted from secondary studies. While this approach enables the aggregation of insights across a broad and diverse body of literature, it does not involve the direct analysis of the primary studies cited by those reviews. As such, our interpretations and categorizations depend on how these primary sources were originally analyzed and reported in each secondary study. This may lead to the propagation of any bias or methodological limitations present in the original reviews.

7 Conclusion

This study presented a comprehensive tertiary review of Organizational Change (OC) initiatives implemented in the software industry, focusing on identifying models, critical factors, and key characteristics of OC initiatives. By synthesizing insights from diverse secondary studies, this paper organized and consolidated knowledge that bridges theory and practice, providing a structured understanding of how OC can be effectively implemented in dynamic and complex environments. In addition to mapping and categorizing these elements, the study examined their interconnections, showing how activities, characteristics, and critical factors are mutually reinforcing. To ensure study quality, a self-assessment based on the defined Quality Assessment Criteria (Table 1) confirmed the rigor of the methodology and the findings.

The study revealed critical insights. First, while many well-established OC models exist, their application in the software industry remains limited, often overshadowed by informal, ad hoc approaches. Second, the success of OC initiatives hinges on aligning change efforts with organizational strategy, fostering stakeholder engagement, and investing in clear communication and training. Third, the analysis of interconnections demonstrated that certain characteristics (e.g., large-scale initiatives and balance between continuity and transformation) have stronger influence across multiple factors, while specific factors such as change readiness (CF8) and evaluation and measurement (CF14) consistently emerged as central to successful change. These insights underscore the importance of integrating descriptive and processual models while also considering the systemic nature of OC, where the interaction among elements plays a decisive role.

This paper contributes to academia and industry by advancing the understanding of OC in software companies. For academia, the study highlights gaps in the current research landscape, particularly in the development and contextual adaptation of OC models for technology-driven environments. For industry, the paper offers actionable recommendations to improve the planning, execution, and evaluation of OC initiatives. The inclusion of interconnections provides practitioners with a more integrated perspective, helping them prioritize efforts on activities and factors that are most critical to organizational change success.

Future work could expand this research by applying the snowballing technique (Wohlin, 2014) to the selected sec-

ondary studies, potentially uncovering additional relevant studies. Empirical research is also necessary to validate the applicability of the reviewed models and to test the robustness of the identified interconnections in real-world contexts. Moreover, developing tailored frameworks specifically for the software industry could improve the efficiency of OC initiatives. Finally, adapting processual and descriptive models to the dynamic and high-volatility environments characteristic of the software industry represents another promising direction for future exploration.

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