

**INFLUENCE OF LEADERSHIP STYLE ON
ORGANIZATIONAL AGILITY TOWARDS
CONSTRUCTION 4.0**

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INFLUENCE OF LEADERSHIP STYLE ON ORGANIZATIONAL AGILITY TOWARDS CONSTRUCTION 4.0

by

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LIST OF ABBREVIATIONS

C4.0	Fourth Construction Revolution
CP	Coercive Pressure
CR	Contingent Reward
DC	Digital Capabilities
DM	Digital Maturity
IA	Idealized Influence (Attributed)
IB	Idealized Influence (Behavior)
IC	Individual Consideration
IM	Inspirational Motivation
IR 4.0	Fourth Industrial Revolution
IS	Intellectual Stimulation
LC	Leadership Capabilities
MEA	Management-By-Exception (Active)
MEP	Management-By-Exception (Passive)
OA	Organizational Agility
SL	Servant Leadership
TFL	Transformational Leadership
TRL	Transactional Leadership

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**PENGARUH GAYA KEPIMPINAN TERHADAP KEBOLEHAN AGIL
ORGANISASI KE ARAH PEMBINAAN 4.0**

ABSTRAK

Industri pembinaan kini sedang mengalami transformasi digital yang pesat, didorong oleh kemunculan era Pembinaan 4.0 (C4.0) yang menekankan automasi, teknologi pintar, dan proses berasaskan data. Dalam landskap yang semakin berkembang ini, kebolehan organisasi tangkas (OA) menjadi elemen penting bagi syarikat untuk menyesuaikan diri secara pantas terhadap gangguan teknologi dan perubahan permintaan pasaran. Dalam konteks ini, kepimpinan memainkan peranan penting dalam memacu organisasi melalui perubahan. Namun, penyelidikan empirikal masih terhad di negara membangun terutama Malaysia, untuk meneliti bagaimana gaya kepimpinan tertentu berinteraksi dengan kematangan digital dalam memacu OA, sekali gus meninggalkan jurang kritikal dalam teori dan amalan. Kajian ini menyelidik pengaruh tiga gaya kepimpinan utama, transformasi, transaksional, dan khidmat, terhadap OA dalam sektor pembinaan di Malaysia, sebuah industri utama yang sedang menjalani transformasi digital. Secara khusus, kajian ini meneliti peranan pengantara kematangan digital, serta kesan moderasi tekanan paksaan. Kajian ini diasaskan kepada Teori Kepimpinan Kompleksiti dan Teori Permainan, yang menyediakan kerangka teori kukuh untuk memahami interaksi dinamik dalam sistem organisasi yang kompleks. Pendekatan kuantitatif telah digunakan dengan membangunkan dan menguji dua puluh hipotesis. Ujian awal bersama pakar industri dan akademik telah dijalankan bagi memastikan kesahihan instrumen kajian. Data telah dikumpul daripada 311 firma pembinaan di Malaysia yang berdaftar dengan CIDB dan terlibat dalam inisiatif pendigitalan, melalui soal selidik berstruktur. Kaedah analisis menggunakan Pemodelan Persamaan Struktur Kuasa Dua Terkecil (PLS-

SEM). Hasil kajian menunjukkan bahawa keupayaan digital memainkan peranan pengantara yang signifikan dalam hubungan antara ketiga-tiga gaya kepimpinan dan OA, manakala keupayaan kepimpinan tidak menunjukkan kesan yang sama. Selain itu, tekanan paksaan didapati memoderasi secara positif hubungan antara kepimpinan transaksional dan OA, namun tiada kesan serupa dikesan bagi kepimpinan transformasi atau khidmat. Dengan memperjelas mekanisme ini, kajian membuktikan bahawa keberkesanan kepimpinan dalam C4.0 bukan sahaja bergantung pada gaya individu tetapi juga pada bagaimana pemimpin menggerakkan kematangan digital di bawah tekanan luaran. Penemuan ini menonjolkan keberkesanan gaya kepimpinan yang berbeza bergantung kepada konteks dalam persekitaran yang sedang mengalami transformasi digital dan dikawal secara institusi. Kajian ini turut menyumbang pandangan baharu dengan secara eksplisit menghubungkan gaya kepimpinan, dimensi kematangan digital, dan tekanan institusi kepada OA, sekali gus memperluas teori kepimpinan sedia ada dalam era transformasi digital. Kajian ini menonjolkan peranan penting kepimpinan berkesan dalam memacu inisiatif digital, meningkatkan agiliti organisasi, dan memastikan kejayaan pelaksanaan prinsip Pembinaan 4.0. Dari segi praktikal, penemuan kajian ini menawarkan panduan yang boleh diambil tindakan oleh firma pembinaan dan pembuat dasar dengan menekankan keperluan penjajaran antara program pembangunan kepimpinan dan pelaksanaan strategi digital, sekali gus mengukuhkan pulangan pelaburan (ROI), daya saing, dan kelestarian jangka panjang. Penjajaran ini penting untuk membina organisasi yang tangkas dan bersedia untuk inovasi dalam persekitaran Industri 4.0. Keterbatasan kajian termasuk tumpuan kepada tiga gaya kepimpinan dalam satu konteks negara sahaja. Kajian masa hadapan disarankan untuk menggunakan pendekatan longitudinal dan meneroka model kepimpinan alternatif merentasi industri bagi mengesahkan serta memperluaskan dapatan ini.

INFLUENCE OF LEADERSHIP STYLE ON ORGANIZATIONAL AGILITY TOWARDS CONSTRUCTION 4.0

ABSTRACT

The construction industry is undergoing a rapid digital transformation, driven by the emergence of Construction 4.0 (C4.0), which emphasizes automation, smart technologies, and data-driven processes. In this evolving landscape, organizational agility (OA) has become essential for firms to adapt swiftly to technological disruptions and shifting market demands. Within this context, leadership plays a pivotal role in steering organizations through change. Yet, limited empirical research in developing countries, particularly Malaysia, has examined how specific leadership styles interact with digital maturity to drive OA, leaving a critical gap in both theory and practice. This study investigates the influence of three prominent leadership styles transformational, transactional, and servant leadership on OA in Malaysia's construction sector, a key industry currently undergoing digital transformation. Specifically, the study examines the mediating roles of digital maturity (digital capabilities and leadership capabilities), and the moderating effect of coercive pressure. The research is grounded in Complexity Leadership Theory and Game Theory, providing a robust theoretical framework for understanding dynamic interactions in complex organizational systems. A quantitative approach was adopted, with twenty hypotheses developed and tested. A pre-test involving industry experts and academics ensured the validity of the research instrument. Data were collected from 311 CIDB-registered Malaysian construction firms engaged in digitalization efforts, using structured surveys. Partial Least Squares Structural Equation Modeling (PLS-SEM) was applied for data analysis. The results reveal that digital capabilities significantly mediate the relationship between all three leadership styles and OA, while

leadership capabilities do not. Additionally, coercive pressure positively moderates the relationship between transactional leadership and OA, but no such effect was found for transformational or servant leadership. By clarifying these mechanisms, the study demonstrates that leadership effectiveness in C4.0 depends not only on individual style but also on how leaders mobilize digital maturity under external pressures. These findings highlight the context-specific effectiveness of leadership styles in digitally transforming and institutionally regulated environments. The study contributes novel insights by explicitly linking leadership styles, digital maturity dimensions, and institutional pressures to OA, extending existing leadership theory into the digital transformation era. Practically, the findings provide actionable guidance for construction firms and policymakers by emphasizing the need to align leadership development programs with digital strategy implementation, thereby strengthening return on investment, competitiveness, and long-term sustainability. This alignment is critical for building agile, innovation-ready organizations capable of thriving in a C4.0 environment. Limitations include the cross-sectional design and focus on three leadership styles within a single national context. Future research should adopt longitudinal approaches and explore alternative leadership models across industries to further validate and extend these findings.

CHAPTER 1

INTRODUCTION

This chapter commences by providing an in-depth background of the focal variable, Leadership style. It also outlines the context of related variables and subsequently addresses the problem statement, research questions, objectives, and significance of the study.

1.1 Background

Leadership refers to the capacity to lead and the act of leading (Gage & Smith, 2016). In addition, leadership as a concept is both complex and contested. Fundamentally, definitions of leadership recognize two synergistic players, viz., a group of followers and a leader that co-exist through a mutual, cooperative, and symbiotic relationship (Rutkauskas & Stasytyte, 2013). The fact that a leader is someone who “makes things better” (Summerfield, 2014, p. 252) reminds one of the old adages that leadership is not just about titles, positions, or flowcharts. Leadership is the position held by a leader, the capacity to lead, and the act of leading (Aksakal & Ulucan, 2024). However, these descriptions limit an understanding of leadership to the mechanics of leadership or observable behavior (Krauter, 2025; Buell, 2012).

The fourth industrial revolution (IR 4.0) requires leaders to be more effective in leading organizations (Alade & Windapo, 2020). According to Lee et al. (2018), IR 4.0 is characterized by increasing digitization, value chains, distribution models, business models, and interconnection of products and services. IR 4.0, a fusion of various technologies, has rendered old techniques, business models, and conventional leadership styles obsolete (Ivanov et al., 2019). Vlasov and Chromjaková (2018) noted

that traditional characteristics were dysfunctional and emphasized the need for new approaches to adapt to IR 4.0. Similarly, Xu et al. (2018) observed the failure of previous leadership in dealing with smart technologies, which have a far-reaching impact beyond the individual level. Consequently, the integration of leadership with the pillars of IR 4.0 is imperative. In this context, leaders must lead their companies by dismantling traditional work processes, redesigning products, and digitizing production to ensure sustainability in the international market (Deloitte, 2015).

In IR 4.0, where technological disruption and rapid changes are the norm, certain leadership styles stand out (Taseer & Ahmed, 2022). Recent studies have provided important evidence that transformational leadership (TFL), transactional leadership (TRL), and servant leadership (SL) styles are widely accepted, becoming topics of interest to many scholars focused on research on adaptive organizational development in leadership contexts characterized by increasing complexity (Bonini et al., 2024; Martinez & Leija, 2023; Abasilim et al., 2018; Rehman et al., 2012). Oyewobi. (2024) and Abasilim et al. (2018) highlighted that leadership significantly influences employees' commitment within organizations. Similarly, Kelta. (2024) and Johnson-Kanda and Yawson (2018) noted that leadership in the 21st century faces unprecedented demands, including navigating rapid technological shifts, overcoming resistance to digital adoption, managing intergenerational workforce expectations, and dealing with fragmented project environments particularly relevant in construction sectors undergoing digital transformation. TFL is vital for fostering innovation and adaptation, enabling organizations to seize opportunities presented by evolving technologies (Cortellazzo et al., 2019). TRL emphasis on structured processes, rewards, and accountability can provide stability within the dynamic IR 4.0 landscape (Javaid et al., 2022). However, it's the agile and adaptable nature of transformational

and TRL that makes them particularly effective (Holst, 2021). On the other hand, the characteristics of servant leaders serve as a fundamental basis for fostering organizational innovativeness. Demonstrating humility in leadership roles is a powerful strategy for cultivating a climate conducive to corporate creativity (Cable, 2018), with servant leaders aligning well with this approach (Sun & Shang, 2019). These leaders exhibit a genuine interest in sharing knowledge with others (Nawaz et al., 2024; Van Dierendonck & Patterson, 2015) and are adept at stepping back to encourage collaboration among team members, fostering an environment conducive to the exploration and exchange of thoughts and ideas (Van Dierendonck & Rook, 2010).

Transformational leaders are seen as inspirational, motivating employees to work with high performance and overcome their previous limits (Abasilim et al., 2019; Burns, 1978). According to Bass and Avolio (1997), the TFL style has five manifestations: idealized attributes, idealized behavior, intellectual stimulation, inspirational motivation, and individualized consideration. Influence is idealized, leadership vision is shared, employees voluntarily follow shared visions, and leaders become role models for employees, always putting collective interests first (Avolio & Bass, 2004). Through inspirational motivation, leaders make employees aware of the urgency of leadership goals, motivate them, and instill in them the desire and confidence to achieve organizational goals and vision as a whole (Majka, 2024; Yukl, 2013).

Jensen et al., (2019) and Kuhnert and Lewis (1987), argue that TRL involves substituting one goal for another to enhance leadership performance. It encourages leadership employees to become ethical leaders of the future by coaching them to recognize the challenges of leadership situations and guiding the organization toward

improved employee performance. Another view is that transactional leaders identify employees' needs and reward them for meeting those needs, thereby enhancing their performance (Arnold et al., 1998).

Transactional leaders prioritize rewards as motivators for subordinates rather than focusing on work goals or addressing mistakes unless there is a significant deviation (Howell & Avolio, 1993). Avolio and Bass (2004) describe two types of rewards and one form of punishment in TRL: contingent reward, contingent positive reinforcement, and contingent negative reinforcement. This leadership approach emphasizes established processes, procedures, and performance expectations, with exceptional performance being rewarded (Akram et al., 2016). On the other hand, management by exception involves close supervision and inspection to ensure tasks are completed (Oswald et al., 2022; Gill, 2012), limiting creativity and innovation among employees. Contingent rewards and management by exception can enhance leadership performance, but they may reduce employee engagement in a flexible work environment (Boyd, 2024; Sosik & Jung, 2009). Passive management by exception occurs when leaders wait for serious issues before taking corrective action (Bass, 1998), while contingency penalties are imposed for underperformance or failure to meet leadership requirements (Yahaya & Ebrahim, 2016). TRL serves as the foundation for the more complex TFL style (Rahman, 2024; James & Ogbonna, 2013).

In digital transformation, SL, particularly within the framework of IR 4.0, emerges as an optimal approach for enhancing organizational agility (OA). OA enables businesses to adapt quickly, innovate, and respond to change, which is essential in the fast-paced, technology-driven landscape of Industry 4.0 (Ononiwu et al., 2024). SL supports this by fostering collaboration, empowering employees, and promoting a culture of adaptability, ensuring organizations remain resilient and competitive in the

face of uncertainty (Batool et al., 2022). This is attributed to its effectiveness in elevating employee performance and fostering a culture that encourages the generation of new ideas and innovative thinking, a principle aligned with upper echelons theory (Hambrick & Mason, 1984). The qualities exhibited by servant leaders serve as fundamental facilitators for the agility of an organization. Emphasizing humility in leadership positions proves to be a valuable strategy for fostering OA (Cable, 2018). Consequently, SL becomes a catalyst for promoting high levels of agility, demonstrating a positive impact on OA. Recent research indicates notable productivity advantages in companies led by humble executives (Brynjolfsson et al., 2017) or those adopting a SL style (Yoshida et al., 2014), highlighting the compatibility of SL with the demands of contemporary digital transformations.

The concept of "Construction 4.0" aims to revolutionize the construction industry by incorporating advanced digital technologies and modern construction techniques among stakeholders. Its objective is to enhance productivity, increase competitiveness with global counterparts, and contribute to the country's economic, social, and cultural growth (Craveiroa et al., 2019). El Jazzer et al. (2021) define IR 4.0 as the use of cyber-physical systems, the Internet of Things, data, and services to link production technologies with smart production processes. The advancements and digitalization brought about by IR 4.0 are driving the transformation of the construction industry into C4.0 (Lee et al., 2022). The term "C4.0" has emerged in 21st-century construction research, driven by the growth of various technologies, evolving investor needs, increasing demand for customization, and the need for green and sustainable buildings (Rastogi, 2017).

IR 4.0 will change the business environment and force construction leaders to embrace disruption. Leaders should create and lead agile organizations that are more

resilient to change and emerging competition. In the early 1990s, the term "organizational agility" originated in the production departments of companies and has since been extended to different departments (Ahammad et al., 2020; Cunha et al., 2020; Doğan & Baloglu, 2018; Lopes, 2009; Mason, 2010; Sağır & Gönülölmez, 2019; Shafer, 1997; Uğurlu et al., 2019; Zhang & Sharifi, 2000). Researchers have emphasized OA as a capability to identify opportunities, change direction, mitigate risks, and leverage change (Jamrog et al., 2006). In the era of C4.0, the integration of mechanical and digital technology is transforming production from machine-dominant to digital- and service-dominant, presenting opportunities for efficient resource utilization and strategic goal achievement (Vaidya et al., 2018; Zhou et al., 2015). However, this transformation requires significant changes in organizational culture, work systems, and operations, providing both challenges and opportunities for C4.0 implementation (Cimini et al., 2020). The wide-ranging adoption of C4.0 across various industries may increase external and competitive uncertainty (Schumacher et al., 2016).

To navigate this uncertain environment, firms require OA, a necessary dynamic capability that can increase business performance in a volatile market. OA provides firms with the capability and guidelines to efficiently configure their C4.0 technologies and manage external uncertainty effectively (Elnagar et al., 2019; Kurniawan & Hamsal, 2019; Walter, 2021). While research on the relationship between OA and C4.0 is still in its early stages, it is gaining momentum as agility is increasingly positioned as a must-have dynamic capability to realize the full potential of adopting the C4.0 ecosystem and gaining and sustaining a competitive advantage (Akkaya, 2019). Additionally, OA enhances resilience, defined as the ability of the organization to bounce back from crises caused by internal or external environmental changes (Tarigan

et al., 2021). The adoption of C4.0 technologies can be driven by firms' motivation to develop resilience, and enhanced agility can also lead to organizational resilience (Miceli et al., 2021).

Petry (2018) mentions several main characteristics of digital leadership or leadership styles that need to be considered in a volatile, uncertain, complex, and ambiguous (VUCA) environment. These include agile, participative, network, open, and trust-based leadership, which describe leaders who think through different scenarios, consider various options, experience distinct ideas, and support internal and external connections. Leadership is crucial for the success of organizations in digital transformation (Oswald, 2017; Rudito, 2017). Previous research has demonstrated the significant impact of digital leadership on digital maturity (Kieser, 2017). Digital maturity (DM) in IR 4.0 refers to the level of advancement and proficiency in utilizing digital technologies for organizational transformation and achieving operational excellence (Polyanska et al., 2022). Digital leadership encompasses a combination of TFL and TRL styles and plays a vital role in enhancing digital capabilities within organizations, ultimately contributing to DM and creating value (Kiron et al., 2016). Leaders who possess technological understanding and stay updated with digital trends contribute to the development of digital insights and foster DM within their organizations (Abbu et al., 2020).

A higher level of DM enables leaders to make data-driven decisions, embrace innovative practices, and respond quickly to changing market conditions, thus enhancing the organization's agility (Wang & Guo, 2022). Leaders who understand and leverage digital technologies effectively can empower their teams to be more adaptable, collaborative, and innovative, ultimately leading to improved OA (Nuryadin et al., 2023). Leadership styles have a significant influence on organizational changes

and the implementation of institutional practices (Akanji et al., 2020). The roles and relationships within organizations can be influenced by various factors such as innovation capability, environmental issues and management commitment (Imran et al., 2019). Building upon institutional theory, which emphasizes the impact of external pressures on firms' operational practices (Dubey et al., 2019), a particular focus is placed on coercive pressure as a potent type of organizational change with profound implications for how firms conduct their business activities (Slack & Hinings, 1994).

Coercive pressure (CP) manifests when stakeholders exert formidable pressures, encompassing rules, regulations, sanctions, and punishments (Ogbanufe et al., 2021). This phenomenon has been examined through the lens of coercive isomorphism, which highlights the convergence of events and occurrences across organizations due to common external demands (Powell & DiMaggio, 2012). In this vein, CP emerges as a catalyst for firms to adopt new technologies and practices to enhance their digital capabilities and agility (Sharma & Daniel, 2016). This compels firms to undergo incremental or radical transformations to align themselves with the demands of Industry 4.0 (Robertson et al., 2012; Zhong et al., 2017). As previously discussed, that CP emerged from requirements, standards, and competitive forces from industry regulatory authority, significantly influences the adoption of Construction 4.0 by convincing organizations to comply with digital transformation mandates and technological advancements (DiMaggio & Powell, 2015; Nawi et al., 2021). While this pressure accelerates digitalization, it can also create challenges for organizations struggling with limited resources, workforce skill gaps, and rigid compliance demands (Rahman et al., 2024). In Malaysia, government-driven policies, such as the Construction Industry Transformation Programme (CITP) and Construction 4.0

Strategic Plan 2021-2025 (CIDB Malaysia, 2024), act as coercive forces that shape the pace and scope of digital transformation in the construction sector.

Digital maturity reflects both technological capabilities and leadership capabilities, shaping an organization's readiness to integrate tools such as BIM, IoT, and automation into its core operations (Westerman et al., 2014; Ghobakhloo, 2020). However, in Malaysia, the progress of digital maturity is heavily influenced by coercive pressure external forces such as government regulations, CIDB requirements, and compliance-driven policies which often compel firms to adopt digital solutions regardless of internal readiness (DiMaggio & Powell, 2015; Jepson et al., 2022). This dual focus highlights a critical tension: while digital maturity enables innovation and agility, coercive pressure can both accelerate adoption and constrain leadership flexibility. Understanding how these two forces interact is therefore central to explaining the dynamics of leadership, organizational agility in Malaysia's construction sector.

Developed countries such as Germany, the United States, and Japan have made significant strides in adopting C4.0 (Ali & Khan, 2024). Many emerging economies like Indonesia, India, and Brazil, are making continuous progress in implementing digital technologies, but facing such as high costs, inadequate infrastructure, limited workforce digital skills, and regulatory constraints continue to slow down widespread adoption (Rahman et al., 2024). Even with these challenges, government-driven initiatives, strategic leadership, and industry collaborations are playing a crucial role in accelerating the transition to digitalized construction practices in developing economies (Sani et al., 2025).

In Malaysia, The Construction Industry Development Board (CIDB) has implemented a series of policies, rules and plan aimed at fostering the advancement of C4.0 within the construction sector (Construction 4.0 Strategic Plan 2021-2025). C4.0 in Malaysia has gained momentum recently, aligned with the global IR 4.0 initiative (Kozlovska et al., 2021). This approach seeks to employ advanced technologies like BIM, IoT, and automation to revolutionize the construction sector. Studies have explored technology adoption barriers and benefits, with government, academia, and industry driving research (Moshood et al., 2020; Shafei et al., 2022; Zabidin et al., 2024). The progression of C4.0 research in Malaysia has not only heightened awareness and generated valuable insights but has also paved the path for embracing advanced technologies in the construction domain, thus steering the nation's construction sector towards a digitally empowered, efficient, and sustainable future (Moshood et al., 2020). Although, regardless of government efforts, the industry still struggles with leadership challenges (Shahrudin et al., 2024), DM gaps (Chia, 2024), and regulatory constraints (Almatari et al., 2024), which affect the successful implementation of C4.0 technologies (Ismail et al., 2024). The transition to digital construction requires strong leadership to drive technological adoption, enhance agility, and navigate compliance-driven environments (Aniebonam et al., 2025). Leadership and digital transformation challenges is crucial for ensuring that Malaysia's construction industry remains competitive, resilient, and aligned with global C4.0 advancements.

1.2 Problem Statement

Leadership styles are widely studied in the context of OA, their effectiveness in highly regulated and technology-driven environments like Construction 4.0 remains

unclear (Ismail et al., 2024; Nawi et al., 2025). Research has extensively examined the influence of diverse leadership styles on fostering innovation and adaptability across industries (Kumari et al., 2022; Madi Odeh et al., 2023; Rizki et al., 2019). Existing research lacks empirical evidence on how leadership approaches facilitate agility amid rapid digital transformation and compliance challenges (Rahman et al., 2024). What is problematic is that these leadership styles transformational, transactional, and servant leadership are celebrated in theory but show mixed effectiveness in practice, particularly in C4.0 settings where firms must balance innovation with compliance. Previous literature consistently underscores the pivotal role of various leadership styles in nurturing innovation and adaptability across industries (Taouil et al., 2023). Salamzadeh et al. (2021) highlighted that TFL, widely recognized for its ability to inspire and stimulate creativity, is frequently associated with fostering a culture of innovation and change within organizations. This leadership style is particularly relevant in navigating the challenges posed by IR 4.0. However, in practice, its visionary and risk-taking orientation can sometimes clash with regulatory demands, reducing its effectiveness in fostering organizational agility under strict compliance regimes. Studies (Madi Odeh et al., 2023; Ndarwa, 2023; Schiuma et al., 2022) have shown that leaders who exhibit transformational qualities such as vision-setting and encouragement of risk-taking tend to motivate employees to embrace change and explore new ideas. Conversely, while TRL's structured approach is effective in clarifying expectations and driving performance, it can be less suited to responding to the dynamic demands of IR 4.0 (Holst, 2021). This means TRL may reinforce compliance but limit flexibility, creating a potential trade-off that undermines agility. SL is essential for fostering organizational innovation, with humility in leadership roles identified as a powerful strategy for cultivating a climate conducive to corporate

creativity (Cable, 2018). Studies by Sun and Shang (2019) further emphasize the alignment of SL with this approach. Leaders exemplified by Van Dierendonck and Patterson (2015) demonstrate a genuine interest in sharing knowledge, and as observed by Van Dierendonck and Rook (2010), excel in promoting collaboration among team members. This creates an environment conducive to the exploration and exchange of innovative thoughts and ideas. Overall, Kara (2022) highlights that balancing transformational, TRL tends to yield the most favorable outcomes in promoting innovation, and adaptability crucial attributes in the IR 4.0 landscape. Yet, the challenge remains that servant leadership's long-term relational focus may not directly resolve urgent digital and compliance pressures in C4.0 environments. Within the broader discourse on leadership styles and OA, prior research (Dare, 2023; Jermisittiparsert, 2020; Le et al., 2021) has illuminated the substantial impact of distinct leadership approaches on organizational outcomes. As IR 4.0 unfolds, organizations need leaders adept at steering them through this transformative era, ensuring they remain agile and responsive to change (Abdelmajied, 2022).

Akkaya and Tabak (2020) argued that current studies have predominantly focused on the technological aspects of construction projects while inadvertently overlooking the role of leadership styles in facilitating OA. The synergy between leadership and innovation is highlighted by research such as that of Akkaya and Tabak (2020), which emphasizes the significant impact of specific leadership styles on OA. Collectively, these insights contribute to a deeper understanding of the relationship between leadership styles and OA across industries (Maskuriy et al., 2019). In Malaysia's construction sector, which is dominated by small and medium-sized enterprises (SMEs), Mustafa and Flanagan (2012), and Shaharuddin et al. (2021) identified a limited demand for innovation among SME players, as well as low

awareness of C4.0 principles, both of which hinder productivity (Osunsanmi et al., 2018). Amid these challenges, the unexplored link between leadership styles and C4.0 agility necessitates a unique leadership approach (Maskuriy et al., 2019). Several researchers (Kelly, 2018; Oberer & Erkollar, 2018; Shafei et al., 2022; Yang et al., 2022) have suggested further exploration of leadership styles that align with C4.0 requirements. However, their application within the Malaysian construction landscape remains an under-researched area. This raises the problem of how leadership styles function in practice under institutional and technological pressures, and whether they are sufficient to drive agility without additional mediating or moderating mechanisms.

The leadership styles and DM is conceptually recognized, but there is limited practical insight into how different leadership styles influence digital adoption and technological integration in construction firms (Ali & Khan, 2024). Many firms struggle with leadership-driven digital transformation due to a lack of structured frameworks guiding DM development (Sani et al., 2025). With the integration of advanced digital technologies, leadership plays a crucial role in guiding and facilitating digital transformation. While the importance of leadership in driving organizational change and adaptation particularly concerning DM is widely recognized (Abbu et al., 2022), research highlights the influence of leadership styles, particularly a blend of transformational and transactional approaches, on DM and organizational value (Effendy & Arquisola, 2022; Jameson et al., 2022; Ruloff & Petko, 2022; Shin et al., 2023). TFL skills such as visionary thinking, risk-taking, and adaptability have been identified as key factors in enhancing DM (AlNuaimi et al., 2022; Cao & Le, 2022; Rofiq et al., 2023). Meanwhile, TRL, with its emphasis on efficiency and performance, must be harmonized with the agility required to navigate rapidly evolving technological landscapes (Samad et al., 2023). Leso et al. (2023) emphasize that DM

equips leaders to guide digital transformations and make informed technology choices. However, aligning this maturity with agile principles requires a balance between structure and flexibility. Similarly, Cortellazzo et al. (2019) highlight that effective leaders can leverage transactional practices to set clear digital transformation goals while using their digital expertise to drive innovation. Previous research underscores the importance of both transformational and TRL styles in fostering DM and integrating technology in the context of IR 4.0 (Niță & Guțu, 2023; Rashidi & Patil, 2023; Türk, 2023). A balanced leadership approach is particularly critical within the unique framework of C4.0, where technological integration, efficiency, and collaboration are key drivers of success (Abbu et al., 2020; Lekan et al., 2021). As the construction industry continues to embrace digitalization to enhance operational efficiency (Salamak & Januszka, 2018), understanding the complex dynamics between leadership style, DM, and effectiveness within C4.0 emerges as an essential area for research (İmamoğlu et al., 2021; Weber-Lewerenz & Traverso, 2023). However, despite these insights, the interplay between leadership styles and DM within the specific context of C4.0 remains an underexplored domain, particularly in Malaysia, where the construction sector faces challenges in aligning leadership-driven digital transformation with regulatory frameworks, workforce readiness, and industry digitalization goals (CIDB Malaysia, 2024). Despite national initiatives such as the Construction Industry Transformation Programme (CITP) and the push for Industry 4.0 adoption, regulatory compliance often creates tensions between innovation and standardization. Construction Firms, particularly in Grades G5–G7, are required to meet stringent CIDB and government-mandated digitalization standards, yet these policies are frequently perceived as top-down and rigid, limiting organizational flexibility (Ismail et al., 2024). Moreover, the regulatory framework emphasizes

compliance and documentation over adaptive learning and innovation, resulting in a gap between policy intent and on-the-ground execution. This mismatch has slowed the pace of Construction 4.0 integration, creating uncertainty among firms about the return on investment in digital tools such as BIM, IoT, and AI. Leadership within firms is therefore caught between fulfilling regulatory requirements and fostering a culture of digital innovation, a dilemma that complicates efforts to build organizational agility and sustainable competitiveness (Desai et al., 2025). This suggests that digital maturity may serve as a critical mediating mechanism that explains why leadership styles succeed or fail in producing organizational agility in C4.0. While government initiatives such as the CITP 2021–2025 promote digital adoption, there is limited research on how leadership influences DM and, in turn, drives Construction 4.0 implementation in Malaysia (Ismail et al., 2024).

DM is often associated with OA (Ononiwu et al., 2024), empirical studies focusing on the construction sector are scarce, particularly in developing economies where digital adoption varies significantly (CIDB Malaysia, 2024; Ismail et al., 2024). The mechanisms through which DM enhances OA in Construction 4.0 remain underexplored (Rahman et al., 2024). As firms navigate the landscape of C4.0, characterized by the convergence of digital technologies and industrial advancements (Kilaso et al., 2023), the interplay between leadership and OA assumes heightened importance. While the influence of leadership style on OA has been acknowledged (Akkaya & Tabak, 2020), the underlying mechanisms driving this relationship warrant closer examination. Attar and Abdul-Kareem, (2022) emphasize that in the context of IR 4.0, marked by technological disruptions and global interconnectivity, there is growing interest in the dynamic interaction between leadership styles and OA (Marcucci et al., 2022). This relationship extends further to firm performance, as noted

by Lokman et al. (2019), who highlight that effective leadership fosters strong customer relationships, significantly enhancing overall business outcomes (Akkaya et al., 2020). Additionally, the emerging prominence of DM as a critical enabler of success in the digitalization era has garnered increasing attention (Musarat et al., 2021). DM plays a multifaceted role in driving transformation Arkhipova and Vaia (2018) highlight its mediation in IT capabilities, innovation, and collaboration, while Khin and Ho (2018) link it to agility and overall performance through active digital engagement. However, Rashidi and Patil (2023) caution that intense digitalization does not necessarily equate to high maturity, reinforcing the need for a strategic approach. Notably, within the construction sector, limited exploration of innovative concepts hinders the development of a strong digital culture (Ciampi et al., 2022). This raises crucial questions about the potential mediating role of DM in the relationship between leadership styles and OA. Studies suggest that DM bridges leadership and OA by enabling firms to effectively implement leadership-driven digital transformation (Khin & Ho, 2019). Research also highlights that without DM, leadership strategies may fail to translate into OA, emphasizing the need for digital competency in leadership models (Rashidi & Patil, 2023; Shahzad, 2024). Therefore, one key problem is understanding whether leadership styles can truly enhance OA directly, or whether their effect depends on the presence of sufficient digital maturity within firms. Understanding this mediation is essential for developing a comprehensive leadership approach that enhances OA within the C4.0 framework, particularly in Malaysia's construction sector.

CP is recognized as a key external force driving digital adoption, its influence on leadership effectiveness in fostering agility within construction firms remains under-researched (DiMaggio & Powell, 2015). There is a lack of practical guidance on

how firms can balance regulatory compliance with leadership-driven agility in Construction 4.0 (CIDB Malaysia, 2024). The majority of research on CP has predominantly focused on its influence on organizational behavior and responses, particularly in the context of regulatory compliance and external demands. CP, a mechanism that drives conformity among entities, has been widely studied; however, its role in construction remains minimally explored (Saka et al., 2016; Yang et al., 2021). Existing studies highlight CP's impact on various aspects, such as Building Information Modeling (BIM) adoption (Saka et al., 2022), eco-friendly practices (Mensah et al., 2020), safety measures (Jepson et al., 2020), and regulatory compliance in the Chinese construction industry (Nawaz & Guribie, 2022). In the Malaysian construction sector, Tagod et al. (2021) examined how CP moderates the relationship between organizational structures and risk management. Their findings indicate that CP significantly influences organizational effectiveness, particularly in achieving shared project goals. Furthermore, Jayashree et al. (2022) assert that external pressures play a moderating role in an organization's ability to survive in a competitive environment, suggesting that organizational productivity and adaptation rely heavily on external forces. Similarly, Yue et al. (2023) recognize that CP can drive positive organizational change and environmental initiatives, yet its intricate relationship with leadership styles and OA remains an uncharted domain. Within the construction industry's compliance landscape, CP is pivotal in enforcing regulations, safety standards, and contractual obligations (Jepson et al., 2022). This enforcement compels the industry to adopt more effective strategies to ensure regulatory adherence and project success. Literature also underscores the significant influence of CP on innovation adoption (Zhou et al., 2019). Given these insights, scholars (Jepson et al., 2020; Mensah et al., 2020; Zhongming et al., 2014) have advocated for further

exploration of the moderating role of CP in the construction sector (Tagod et al., 2021). The problem, however, is that little is known about whether CP enhances or constrains the effectiveness of leadership styles in driving OA, creating uncertainty in both theory and practice. Understanding this moderating dynamic is essential for developing a holistic leadership approach that enhances OA within the C4.0 framework in Malaysia's construction sector.

Accordingly, this study proposes a research model that examines how leadership styles (TFL, TRL, SL) influence OA, with digital maturity as a mediating mechanism and coercive pressure as a moderating factor. This model is directly designed in response to the identified problems, providing a theoretical and practical pathway to address leadership shortcomings in regulated, digitally transforming environments.

1.3 Research Questions (RQ)

- RQ1. How do different leadership styles impact the organization agility of construction firms within the framework of Construction 4.0?
- RQ2. What is the relationship between leadership style and the digital maturity of construction firms operating within the framework of Construction 4.0?
- RQ3. What is the relationship between digital maturity and organization agility of construction firms operating within the framework of Construction 4.0?

RQ4. To what extent does the mediation of digital maturity impact the relationship between leadership style and the agility of construction firms within the framework of Construction 4.0?

RQ5. To what extent does coercive pressure moderate the relationship between leadership style and agility of construction firms within the framework of Construction 4.0?

1.4 Research Objectives (RO)

RO1: To examine the impact of leadership styles on enhancing organizational agility of construction firms in C4.0.

RO2. To assess the influence of leadership style on the digital maturity of construction firms in C4.0.

RO3. To assess the influence of digital maturity on the organizational agility of construction firms in C4.0.

RO4. To investigate the potential mediating role of digital maturity in the relationship between leadership style and organizational agility in C4.0.

RO5. To investigate the capability of moderating role of coercive pressure in the relationship between leadership style and organizational agility in C4.0.

1.5 Significance

1.5.1 Practical Significance

The significance of this study lies in its practical contributions, offering industry-specific insights tailored to Malaysia's construction sector as it transitions to C4.0. By examining how leadership styles impact construction firms' agility within C4.0, this research provides empirical evidence on which leadership approaches transactional, transformational, or servant are most effective in navigating Malaysia's compliance-driven construction environment (Ismail et al., 2024). The findings can help industry practitioners refine leadership frameworks to enhance OA, ensuring firms remain competitive amidst rapid technological disruptions (Akkaya et al., 2020; Hiller & Ozgen, 2023).

Additionally, by investigating the relationship between leadership styles and DM, this study offers guidance on how leadership can accelerate the adoption of digital technologies such as BIM, AI, and automation in Malaysian construction firms. This is crucial given that DM mediates the effectiveness of leadership in driving OA, meaning leadership alone is insufficient without robust digital capabilities (Khin & Ho, 2019; Rashidi & Patil, 2023). The study's insights can inform leadership training programs that integrate digital competency-building to ensure Malaysia's construction sector effectively implements C4.0 technologies (Schiuma et al., 2022; Cortellazzo et al., 2019). Furthermore, examining whether DM mediates the relationship between leadership style and OA can provide insights into the mechanisms through which digital leadership influences OA. This, in turn, can aid in developing comprehensive strategies for C4.0 implementation by equipping leaders with digital transformation strategies that enhance workforce adaptability, innovation, and regulatory alignment

(Khin & Ho, 2018; Phakamach et al., 2023; Rashidi & Patil, 2023; Shahzad, 2024). The findings can support construction leaders in structuring digital transformation initiatives that align leadership development with technology adoption strategies.

Lastly, by investigating the moderating role of CP on the leadership-agility relationship, this study provides critical insights into how regulatory frameworks influence digital leadership effectiveness (Jepson et al., 2022; Yue et al., 2023). Given Malaysia's strict compliance landscape, understanding how leadership can balance regulatory demands with digital transformation efforts is vital for ensuring that CPs do not hinder OA but instead facilitate structured digital adoption (CIDB Malaysia, 2024; DiMaggio & Powell, 2015). This research extends institutional theory by demonstrating how external pressures shape leadership effectiveness in digital transformation environments. Overall, this study provides actionable recommendations for construction firms, policymakers, and industry leaders in Malaysia, ensuring a smoother transition to C4.0 by optimizing leadership strategies, enhancing digital capabilities, and effectively managing regulatory constraints.

1.5.2 Theoretical Significance

The theoretical significance of this study lies in its potential to advance scholarly understanding of digital leadership styles, OA, and C4.0. By investigating the influence of leadership styles on construction OA within C4.0, this study contributes to the development of theoretical models that elucidate the dynamic interplay between leadership approaches and organizational responsiveness in the context of technological transformation (Attar & Abdul-Kareem, 2022; Marcucci et al., 2022). Furthermore, exploring the correlation between leadership style and DM in construction firms within C4.0 strengthens the theoretical foundation of leadership's

role in shaping digital capabilities and technological adoption within the construction sector (Cortellazzo et al., 2019; Schiuma et al., 2022).

Additionally, by examining the mediating role of DM in the relationship between leadership style and OA, this research enhances theoretical frameworks that explain how leadership practices foster OA in an increasingly technologically driven environment (Khin & Ho, 2018; Rashidi & Patil, 2023). Lastly, by investigating how CP moderates the relationship between leadership style and OA in C4.0, this study advances theoretical perspectives on the contextual factors influencing leadership effectiveness under external pressures (DiMaggio & Powell, 2015; Slack & Hinings, 1994). Collectively, this research contributes to the enrichment of existing theoretical models, deepening our comprehension of digital leadership dynamics, DM, and OA within the transformation of the construction industry.

1.6 Research Scope

The scope of this research entails a comprehensive examination of the interplay between digital leadership, DM, OA, and the moderating role of CP within the C4.0 landscape. This study specifically focuses on Malaysian construction Firms in the construction sector, with the primary objective of analyzing their perceptions of digital leadership effectiveness in enhancing OA. Additionally, the study seeks to determine whether DM mediates the relationship between digital leadership and OA, while also assessing the moderating influence of CP on this dynamic. By concentrating on Malaysian construction Firms within C4.0, this research aims to provide an in-depth exploration of the distinct challenges and opportunities arising from their digital transformation journey.

This study targets managerial employees within G5 to G7 construction firms in Malaysia, as these firms exhibit greater efficiency, technological readiness, and adaptability compared to other classifications. The selection of G5 to G7 firms aligns with the study's objectives, enabling a focused analysis of construction digital leadership's impact on OA within C4.0. A quantitative research methodology will be employed, utilizing a robust sample of Malaysian construction Firms to collect empirical data for rigorous statistical analysis. Through this approach, the study aims to produce reliable and generalizable insights into the intricate relationships among digital leadership, DM, OA, and CP. The findings will not only contribute to existing knowledge on digital leadership practices but also provide data-driven insights for construction industry leaders to enhance OA in response to C4.0's transformative forces. However, it is important to acknowledge the scope limitations of this study. Since the research relies solely on quantitative data, it may not capture the nuanced qualitative factors that could provide a more comprehensive understanding of moderator and mediator effects within the observed relationships.

1.7 Definition of Key Terms

4IR- Fourth Industrial Revolution

The Fourth Industrial Revolution (IR 4.0) is a technological transformation characterized by the integration of digital, physical, and biological technologies, reshaping industries and societies through automation, connectivity, and data-driven innovation. (Philbeck, & Davis, 2018).

In this study: IR 4.0 in C4.0 refers to the digital transformation and technological advancements revolutionizing the construction industry through the

integration of AI, IoT, robotics, automation, and data analytics for improved efficiency and innovation.

Construction 4.0 (C4.0)

C4.0 refers to the application of the principles and technologies of the IR 4.0 within the construction industry. It involves the integration of digital technologies, automation, data analytics, artificial intelligence, and other advanced innovations to enhance the efficiency, productivity, and sustainability of construction processes and practices (Begić, & Galić, 2021).

In this study, C4.0 pertains to the implementation of IR 4.0 technologies and concepts within the construction industry in Malaysia. It involves the adoption of digital leadership styles, DM, and OA to effectively navigate the challenges and opportunities presented by technological advancements and changing market dynamics in the construction sector. C4.0 aims to enhance the industry's competitiveness, productivity, and adaptability by leveraging innovative approaches and digital solutions.

Transformational Leadership

TFL is a leadership style that inspires and motivates individuals and teams to achieve exceptional performance by fostering a visionary and collaborative work environment (Manu, 2022).

This study defined, TFL, within the framework of C4.0 in the context of IR 4.0, refers to a leadership style that propels and stimulates individuals and teams towards achieving outstanding performance by cultivating a visionary and