The Nexus between Organizational Climate, Collaboratist Leadership and Industry 4.0 Readiness within the Construction Industry [1]

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Abstract

Although Industry 4.0 (4I) is at the heart of global economic dialogues, the lack of readiness for 4I displayed by the construction industry appears to be directly affected by organizational climate (OC) and a lack of collaboratist leadership (CL). This study aimed to determine whether a nexus exists between OC, CL and 4I readiness. To explore this nexus, we sought to establish whether there is a significant relationship between OC, CL and 4I readiness within the construction industry; whether CL and OC predict 4I readiness; whether CL is a mediator between OC and 4I readiness; and the strategic route forward to overcome the lack of 4I readiness. A positivist research paradigm and quantitative research method were used. Questionnaires were distributed to 250 individuals in the construction industry. There are significant relationships between OC, CL and 4I readiness. The results also reveal that CL and OC predict 4I readiness and that CL is a mediator between OC and 4I readiness. This study contributes to ongoing discussions about 4I organizational readiness and suggests that there is a nexus between OC, CL and 4I readiness.

Keywords: Industry 4.0 readiness; organizational climate; collaboratist leadership; information technology; operational technology

Introduction

Industries are adopting Industry 4.0 (4I) technologies at an unprecedented pace in the 21st century, but the construction industry is lagging. There is arguably a nexus between organizational climate (OC), collaboratist leadership (CL) and 4I readiness. Four key aspects affected by the 4I economy are customer expectations, product (and service) enhancement, collaborative innovation and organizational forms (Steyn and Semolic 2020). These aspects affected by the 4I economy speak to OC and CL. It is evident from the above that there is a relationship between OC, CL and 4I readiness in organizations.

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Effective CL role-modelling promotes positive perceptions with followers with respect to creating an OC conducive to high motivation (Steyn and Semolic 2020). The design of production and service processes is largely influenced by technology. These processes constitute 4I organizational forms that are shaped cross-functionally and need to be programme managed (Steyn and Semolic 2018). It is not clear whether there are significant relationships between OC, CL and 4I readiness; whether CL and OC predict 4I readiness; and whether CL is a mediator between OC and 4I readiness in the South African construction industry. This warrants further investigations on the extent of the effect of CL on OC and 4I readiness.

In order to assist with closing this research gap, this paper adopts a theoretical perspective to explore the nexus between OC, CL on 4I readiness. It starts with unpacking construction in the 4I before exploring the nexus above. Thereafter, it seeks to outline the effects of OC and Cl as predictors of 4I readiness. When the prediction theory has been discussed, the paper unpacks CL's mediation capabilities between OC and 4I readiness. Lastly, it outlines strategies to overcome the lack of 4I readiness in the construction industry. The research approach and methods follow the literature review. The results from the empirical study, discussion and conclusions are given as the last sections in this paper.

Literature overview

Construction in the Fourth Industrial Revolution

The risks of 4I are greater than the opportunities in most instances (Dalenogare *et al.* 2018). The long-term effects of 4I on the construction industry will vary depending on responses to questions such as: What are the key barriers to the full application of 4I in emerging countries? When will construction industries adopt these emerging technologies on a large scale? What policies are needed to guide the application of these technologies?

4I is expected to change the global construction industry in four key ways, namely sustainability and enhanced resource use; increased geographical proximity, as well as the integration of customers in design and production processes; mass customization of products and services, enabled by distribution and responsive production through collaborative processes; and people-aligned interfaces and improved work conditions (Stankovic *et al.* 2017).

Despite noticeable growth in South Africa's construction industry, according to the Economic Development Department (2014), it is still fragile and fragmented. The economic and political environment at a given time determine the success of an industry. There is currently a high business failure rate caused by low barriers to entry, which allow unskilled, under-resourced

participants to enter the lower ends of the industry (Weaver and Hyde 2005). In addition, the way that projects are handled in the construction industry in developing countries poses a major challenge to 4I readiness. Fragmentation of views and lack of understanding of projects by designers, builders and suppliers lead to nobody taking ownership of the success of the project as a whole (Datta 2000). According to Samari and Shafiei (2012), the 4I readiness of the construction industry is negatively affected by socio-economic stress, chronic resource shortages, poor building standards and systematic corruption in the developing world.

The lack of 4I readiness and non-adoption of associated technologies causes wastage within the construction industry. According to Datta 2000 as well as Shen *et al.* (2002), wastage is still a great concern in the construction industry. If people and technology are amalgamated, fatigue will be eliminated, which will reduce wastage and thereby boost the pace of operations and profitability. Co-operative Robots in Processes have become important because they assist with the alleviation of fatigue amongst employees. According to Wilkesmann and Wilkesmann (2017), there is a continuum of organizing digital work. The digital architecture of 4I is not an end in itself, but supports people working in and with those structures to make production or service processes smarter and more efficient. The same authors further argue that technology can hasten the pace of migrating organizations from mechanistic to organic systems according to Burns and Stalker's continuum. Darnley *et al.* (2018) argue that financial and legal readiness, technical readiness, communication readiness, cultural and societal readiness, organizational form readiness, and resource readiness are critical for organizations to be ready to implement 4I.

The relationship between OC, CL and 4I readiness

Available literature discusses OC, CL and 4I, but there is not much literature on 4I readiness. This study seeks to establish the connections between these three variables. According to Koys and Decotiis (1991), OC has distinct and enduring characteristics that describe a particular work environment and distinguish it from environments in other organizations. Organizational leadership and structural values at organizational level can be measured through analysing OC. Leaders have the mammoth responsibility to enhance, foster and build OC. Such leadership should be collaboratist in nature. Positive perceptions with followers with respect to creating an OC conducive to high motivation are encouraged by effective CL role-modelling (Steyn and Semolic 2020). From the literature cited above, it can be concluded that there is a connection between OC and CL. The above authors further aver that successful 4I entities are led by collaboratist leaders who are super-transformational with respect to behavioural, operational and structural strategies. These further knits successful 4I readiness, OC and CL together.

OC and CL as predictors of 4I readiness

In the 4I economy, organizations focus on core business and competence, with partners performing non-core tasks while collaborating in virtual networks (Semolic and Steyn 2017). Steyn (2010) avers that an organization's preferred organizational culture and behaviour are informed by its value system. The organization's values, beliefs and guiding principles form the basis for achieving its vision and mission. 4I collaboratist leaders are guardians of the value system mentioned above, requiring them to role-model the preferred organizational culture and behaviour. Based on the authors cited above, it is evident that connections exist between OC and 4I readiness, the latter being the dependent variable. OC can be deemed a predictor of 4I readiness, as it sets the tone for the culture, which determine the extent to which organizations can prepare for 4I.

CL's mediation capabilities between OC and 4I readiness

Steyn and Semolic (2017) state that a 4I approach views leadership as embodying a collaborative and creative journey with people. They define this as CL. According to Steyn and Semolic (2020), CL thrives in open innovation environments where modern business and organizational forms are encouraged. The writers also describe collaboratist leaders as super-transformational. CL acts as an intermediary or mediator between OC and 4I readiness. Based on the above literature, CL can improve 4I readiness because of its super-transformational qualities with respect to behavioural, operational and structural strategy.

Strategies to overcome lack of 4I readiness

The available literature speaks to 4I but not 4I readiness. However, the measures discussed in this section will assist in overcoming the lack of 4I readiness. Steyn and Semolic (2020) state that innovative governance and creative organizational structures and mindsets led by collaboratist leaders ensure high levels of collaboratism and synergy, which translate into 4I readiness. They also argue that, for organizations to achieve ultimate success in the 4I economy, superior CL is of paramount importance. CL enables modern-day organizations to be highly competitive and achieve superior performance through innovative governance, creative organizational structures, collaboratism and synergy.

By aligning and unifying 4I infrastructure, systems and practices, organizations can optimize business processes and greatly reduce operating expenses. Integrating these environments, however, requires businesses to address both technological and organizational requirements. Employing a tiered intelligent system architecture ensures high scalability, availability and security, while Internet of Things gateways efficiently bridge operational technology (OT) and

information technology (IT). Effective converged architectures require cross-functional teams that share knowledge and unify business practices amongst organizations, following a strategic direction that is set at the executive level. By aligning OT and IT, raw data can be transformed into meaningful, actionable information that increases productivity, simplifies decision making and improves business results (Redhat 2016). According to Atos (2012), IT/OT convergence is promoted by two drivers: economic pressures resulting from globalization and intensifying competition, and the benefits and eventual competitive advantages that stem from the integration of these disciplines. It can therefore be concluded that organizations require innovative governance, creative organizational structures, collaboratism and synergy to overcome the lack of 4I readiness.

Research approach and methods

Action research, which is a type of applied research, served as the research type. Zikmund (2003) defines applied research as research undertaken to answer questions about specific problems or to make decisions about a particular course of action or policy decision. According to Watkins (2016), applied research has been designed to apply research findings to solving a specific, existing problem. Furthermore, applied research involves the application of existing knowledge to improve management practices and policies, as in the instance of this research study. According to Collis and Hussey (2009), action research is a type of applied research, designed to find an effective way of bringing about a conscious change in a partly controlled environment. The objective of action research is to enter a situation, attempt to bring about change and monitor the results. Coghlan and Brannick (2002, p. 23) describe the action research cycle as consisting of "diagnosing, planned action, taking action, and evaluating action", which maps the planned research process for this research study. According to Baskerville and Wood-Harper (1996), action research seeks to contribute and propose interventions to the acquisition of scientific knowledge. Action research also assists in real-life problem solving. This method is a paragon of post-positivist research methods: it is empirical, yet interpretive; it is experimental, yet multivariate; it is observational, yet interventionist.

A survey research design was used in this study. While the research was theoretical in nature, the positivistic paradigm served as a basis for the research study. According to Kasi (2009 p. 13), positivistic researchers hold the view that the world is "knowable, fixable, definable, provable and can be described and discovered". As a result, the type of data that is used to support the research findings is quantitative (positivistic). According to Blumberg *et al.* (2011), researchers investigate a research problem by testing whether theoretically derived hypotheses hold for the investigated situations. If the objective facts support the hypotheses, then the underlying fundamental laws are applicable, and their validity is enforced. Quantitative research is used to answer questions relating to relationships amongst measured variables (Leedy and Ormrod 2005). According to Punch

(2003), quantitative research is verifiable in nature and the data is in the form of numbers. Therefore, quantitative data is used to support the research findings in this paper.

Data sources, collection and analysis

Electronically delivered self-administrated questionnaires were used as data collection method to gather data from infrastructure owners, professional teams, contractors and regulatory bodies in the construction industry and elicit their views on the nexus between OC, CL and 4I readiness within organizations. Views on OC and CL attributes that determine organizational readiness for 4I were quantified using a four-point Likert scale. Responses to the questionnaire are reported by summing the values of each selected option and dividing the sum by the number of respondents, creating a mean score for each question. This score is then used to represent specific traits, be they negative or positive OC and CL attributes that determine organizational readiness to receive 4I. The data is quantified by measuring the frequency of responses, as well as descriptive statistics such as measures of central tendency and spread.

Leedy and Ormrod (2001) elaborate that it is not possible in most instances to study the entire population due to its size. Accordingly, researchers usually select a subset or section from the population that is representative of that population. This is known as the sample (Sekeran 2003). In the present study, a sample of 250 individuals in the construction industry affiliated with the industry regulatory bodies were selected. The unit of analysis refers to "the object phenomenon entity, process or event that the researcher is investigating" (Mouton and Marais 2001, p. 33). In the present study, the unit of analysis is individuals. These are infrastructure owners, professional teams, contractors and representatives of regulatory bodies in the construction industry. The present study made use of judgement sampling, which is also known as purposive sampling, where an equal chance of selection cannot be established. The primary researcher created a list of 250 individuals affiliated with regulatory bodies from which were approached to complete the survey and 210 responded (84% response rate).

Measuring instrument

The following questionnaires were distributed electronically and used to measure the three constructs:

OC questionnaire adapted from Koys and DeCotiis (1991).
4I readiness questionnaire adapted from Darnley *et al.* (2018).
CL questionnaire developed based on the research of Steyn and Semolic (2019).

Data capturing and statistical analysis

Data analysis is the process of editing and reducing accumulated data to a manageable size, developing summaries, looking for patterns, and applying statistical techniques (Cooper and Schindler 2006). The data was captured using SPSS version 25. Confirmatory factor analysis (CFA) was also performed using the same software. Descriptive statistics such as frequencies and means were used. In addition, inferential statistics such as correlation analysis and regression analysis were used to analyse the relationship, prediction and mediation between the variables in this study. According to Brown and Moore (2012), the CFA should establish the factors amongst a set of indicators. To asset the fit of the CFA model, the researchers considered Flora and Curran (2004), who state that greater factor determinacy is indicated by higher factor loading values, proving the factor to be valid.

Empirical results

Out of the 210 respondents, 174 (82.90%) were male and 36 (17.10%) were female. The construction industry is still perceived as a masculine industry, as deduced from the characteristics of the respondents. In order to conduct a factor analysis for the three variables, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was utilised. According to Glen (2016), the KMO test measures the quality of data and its readiness for factor analysis, as well as the sampling adequacy for each variable in the model and for the complete model. He further argues that the following rule of thumb is often used to interpret the statistic: KMO values between 0.8 and 1 indicate that the sampling is adequate, while values less than 0.6 indicate that the sampling is not adequate and that remedial action should be taken. However, some authors put this value at 0.5. According to Bartlett (1951), Bartlett's test of sphericity is significant when $p < 0.01$.

To determine the construct validity of the questionnaire, a principal component analysis was used as method of extraction, and varimax rotation was applied to ensure that each variable loaded high on as few factors as possible. This was done to ensure the construct validity of the questionnaire. Anti-image matrices were used as measures of sampling adequacy. The variables with high factor loadings in the rotated component matrix were considered. To determine the reliability of the questionnaire, the Cronbach's alpha was calculated for each of the extracted factors to assess the internal consistency within each factor.

Validity and reliability of CL

CL was measured using 11 statements to which respondents responded using a four-point Likert scale. Four scales of CL were measured, namely collaboration, cognitive ability, change orientation and people orientation. Factor analysis was used to investigate the underlying structure

in the responses to the questions. A KMO value of 0.80 was obtained, and the values for Bartlett's test of sphericity were as follows: approx. chi-square 303.68, df 55 and sig. 0.00.

All questions had significant anti-image covariance and anti-image correlation and were grouped into three factors.

The variables thus did measure the same underlying aspect, and the three factors which were extracted using factor analysis did represent all variables to a satisfactory level. The highest loading, and no more than one per factor, was considered for each factor. The variables that loaded high on the first factor included: "Management demonstrates validity through promoting sincere relationships in own teams", "My manager has systems thinking", "Management supports me to adapt to changing environments", "Management focusses on customer expectations" and "Management encourages decision-making amongst the workers" (eigenvalue of 3.05). The first factor thus indicates that organizations which focus on fostering healthy relationships with stakeholders have cognitive abilities and are change-oriented. Such organizations support their employees to adapt to changing environments and encourage decision-making amongst workers. Given the respective variables that loaded high on the first factor, the factor was called "relationship, cognitive and change orientation".

Variables which loaded high on the second factor included: "Management promotes collaboration between employees", "Management promotes flexible organization forms", "My manager inspires creative thinking" and "Management is committed to the growth of workers beyond their allocated work roles" (eigenvalue of 1.12). Management which promotes flexible organizational forms and collaboration amongst employees inspire creative thinking. Such management is committed to the growth of employees beyond their allocated work roles. The second factor was called "people and change orientation".

"Management effects change through its vision" and "Management provides meaningful vision to me" loaded high on the third factor (eigenvalue of 1.02). Management which effects change through its vision also provides meaningful vision to the employees. As this variable was concerned with transformational and visionary leadership, the third and last factor was called "visionary leadership".

According to Tavakol and Dennick (2011), different reports exist on acceptable alpha values, ranging from 0.70 to 0.95. A low alpha value could be due to a low number of questions, poor inter-relatedness between items or heterogeneous constructs. The Cronbach's alpha values suggested that the internal consistency in all three factors was acceptable; hence, each item measured the same concept as the overall factor. The Cronbach's alpha value for the CL

statements was 0.80. The high Cronbach's alpha value suggested that there was consistency between all the statements that were used to measure the CL.

With regard to the descriptive statistics for CL, the factor "relationship, cognitive and change orientation" had the lowest mean, at less than 0.50. "People and change orientation" had a mean of 0.51, and "visionary leadership" had a mean of 0.61. This suggests that the factor visionary leadership is the main driving factor of CL's impact as a mediator between OC and 4I readiness, while the factor "relationship, cognitive and change orientation" is the factor that least drives this impact.

Validity and reliability of 4I readiness

The overall readiness of a company looking to implement 4I technologies was measured using 20 statements to which respondents responded on a Likert scale. Three dimensions, namely financial and legal readiness, technical readiness, and cultural and societal readiness, were measured. Factor analysis was used to investigate the underlying structure in the responses to the questions. A KMO value of 0.84 was obtained, and the results of Bartlett's test of sphericity were as follows: approx. chi-square 760.74, df 190 and sig. 0.00. These results were significant.

Sixteen of the 20 questions had significant anti-image covariance and anti-image correlation.

The 20 variables thus did measure the same underlying aspect. Six factors which were extracted using factor analysis did represent all variables to a satisfactory level. The variables that loaded high on the first factor included: "My company's infrastructure is digitized and modern", "Existing 4I technologies are relevant in solving the company's operational challenges" and "Management fears that data leaks or system failures could occur as a result of hacking" (eigenvalue of 4.67). The first factor indicates that existing IT and 4I technologies are modern and relevant in solving operational challenges within companies. However, management fears that data leaks or system failures could occur because of hacking. Given the above variables that loaded high on the first factor, the factor was called "technical and cybersecurity readiness".

The variables that loaded high on the second factor included: "Benefits of implementing 4I technologies outweigh associated legal costs (data ownership, updated regulations etc.)", "The infrastructure at my workplace can be modified to integrate with desired 4I technologies", "There are high volumes of data usage at my workplace", "Sufficient IT protection has been provided against hackers and cyber-attacks" and "My company conducts mergers with organizations which offer similar services in the same industry to increase rate of delivery" (eigenvalue of 1.60). Existing infrastructure in companies can be modified to integrate with desired 4I technologies, and because of high volumes of data usage, the benefits of these technologies outweigh the

associated legal and cybersecurity costs. Also, mergers with other organizations which offer similar services in the same industry often take place to increase rate of delivery. The second factor was called "technical, legal and partnership readiness".

The third factor had the following variables with high loadings: "Return on 4I investments is guaranteed", "Investing in 4I technology is beneficial" and "My company engages with other entities in different industries to expedite delivery and production" (eigenvalue of 1.29). Due to the guaranteed benefits and return on investment of 4I technology, IT and 4I infrastructure within companies are digitized and modern. This makes engagements with other entities in different industries easier, thereby expediting delivery and production. The third factor was called "financial and partnership readiness".

Variables which load high on the fourth factor included "Management provides sufficient resources to implement 4I technology", "Management is ready to adopt new processes for future business operations" and "My company collaborates with other businesses across the industry" (eigenvalue of 1.10). Management provides sufficient resources to implement 4I technology and is ready to adopt new processes for future business operations. This enables companies to successfully collaborate with other entities across the industry. Given the various variables with high loadings, the fourth factor was called "financial, change and partnership readiness".

The variables which loaded high on the fifth factor included: "Product integration with existing infrastructure can be complex", "I apply 4I technologies in my working environment" and "Management is afraid and wary of technology replacing jobs" (eigenvalue of 1.07). While applying 4I technologies, the integration of products with existing infrastructure can be complex. In addition, management is afraid and wary that eventually technology will replace jobs. This factor was called "technical and change readiness".

Lastly, the variables which loaded on the sixth factor were: "The cost of implementing 4I technology affects business operations" and "Management is ready to accommodate innovation which comes about with 4I" (eigenvalue of 1.01). Management in companies are ready to embrace innovation which comes about with 4I; however, the associated costs of implementing this technology often affect business operations. This factor was called "financial and change readiness".

The high Cronbach's alpha values suggested internal consistency for all five factors, and hence that each item measured the same concept as the overall factor. The Cronbach's alpha value for all the 4I readiness assessment statements together was 0.73. The high Cronbach's alpha values for all of the variables that were used as proxies for assessing 4I readiness suggested that there

was consistency between all of the statements that were used to gauge the overall readiness of a company looking to implement 4I technologies.

With regard to the descriptive statistics for 4I readiness, the factor "technical and cybersecurity readiness" had the lowest mean, at 0.23. "Financial, change and partnership readiness" had the highest mean, at 0.36. The factor "technical, legal and partnership readiness" had a mean of 0.26, while "financial and change readiness", "financial and partnership readiness" and "technical and change readiness" had means of 0.28, 0.30 and 0.31, respectively. This suggests that the factor "financial, change and partnership readiness" is the main driving factor for the overall readiness of a company looking to implement 4I technologies. The factor "technical and cybersecurity readiness" is the factor that drives this readiness the least.

Validity and reliability of OC

OC was measured based on 40 statements to which respondents responded on a Likert scale. Eight dimensions of OC were measured. Factor analysis was used to investigate the underlying structure in the responses to questions aimed at measuring OC. A KMO value of 0.88 was obtained for OC, and the results of Bartlett's test of sphericity were as follows: approx. chi-square 358.62, df 703 and sig. 0.00. These results were significant.

The variables were grouped into 10 factors. Variables that were included in the analysis had communalities greater than 0.50 and anti-image correlation greater than 0.60. The 34 variables thus did measure the same underlying aspect, and the 10 factors extracted with the factor analysis did represent all variables to a satisfactory level.

The variables that loaded high on the first factor included: "My co-workers are interested in me", "Management trusts me", "Management does not give the wrong advice", "Management helps me whenever I need assistance", "Management is interested in me", "Management supports me whenever I face difficulties", "Management assists me with my errors" and "Management can terminate your service if you deserve it" (eigenvalue of 11.00). The first factor thus indicates that, when management trusts its employees, it does not give wrong advice and helps employees when they need assistance, especially with errors. In addition, co-workers will be interested in each other if management supports employees in the face of difficulties. However, management could terminate employees' services if they deserve it. Given the respective variables that loaded high on the first factor, the factor was called "bilateral trust and support".

The variables that load high on the second factor included: "My co-workers get along", "Management gives me a pat on the back", "My manager lets me know when I'm doing well", "My manager recognizes my good job" and "I receive a fair shake from my manager" (Eigenvalue

of 2.83). Management gives its employees praise, recognizes its employees when they do well and treats them fairly, thereby creating a friendly environment amongst co-workers. The second factor was called "fairness".

The third factor had the following variables with high loadings: "Management keeps its commitments", "Management encourages my ideas", "Management likes new ways of doing things" and "Management does not compromise" (eigenvalue of 1.80). Management promotes new ideas and new ways of doing things, does not compromise and keeps its commitments towards employees. The third factor was called "motivation and innovation".

Variables which loaded high on the fourth factor included: "I make most decisions relating to my work", "I'm allowed to organize my work", "My co-workers help each other" and "We have team spirit" (eigenvalue of 1.53). Management allows employees to make decisions and organize their own work. Employees have team spirit and assist each other. Given the various variables that loaded high on the fourth factor, this factor was called "autonomy and cohesion". Variables that loaded high on the fifth factor included: "I schedule my own work", "My co-workers and I have a lot in common", "Management does not share information", "Management can terminate your service if you deserved it", "I work in a relaxed place" and "Management only calls when there are problems at work" (eigenvalue of 1.37). In general, employees work in a relaxed place. However, they have a great deal in common when it comes to the treatment they receive from management. Management does not share information and only calls when there are problems. Management only terminates the services of employees who deserve it. The fifth factor was called "trust".

On the sixth factor, variables which loaded high included: "I determine my own work", "Management has integrity", "It is easy for me to talk to management" and "Management constantly lobbies for new ideas" (eigenvalue of 1.32). Organizations whose management constantly lobbies for new ideas from employees make it easy for employer–employee dialogue to take place. Such management often has integrity and allows employees to determine their own work. The sixth factor was called "trust and creativity".

On the seventh factor, the only variables that loaded high were: "Management encourages new ways" and "I'm allowed to improve on methods" (eigenvalue of 1.21). Management encourages employees to find new ways of doing things and improve on methods. The seventh factor was called "innovation".

The variables which loaded high on the eighth factor were: "I set my own standards", "My manager uses me as an example" and "Management sets reasonable objectives" (eigenvalue of

1.17). Management uses employees who set their own standards as examples and often set reasonable objectives. In this instance, the eighth factor was called "role modelling and fairness".

The ninth factor had the following variables with high loadings: "I never have a day off" and "I get burned out" (eigenvalue of 1.12). Employees who never have a day off at work are burned out. The ninth factor was called "fatigue".

The 10th and final factor had one variable with a high loading: "There is much work and little time at my workplace" (eigenvalue 1.02). There is a great deal of work and very little time to perform it. The last factor was called "pressure".

All 10 factors had Cronbach's alpha values greater than 0.70. The high Cronbach's alpha values suggested internal consistency in all 10 factors, and hence that each item measured the same concept as the overall factor. The Cronbach's alpha value for the OC statements altogether was 0.93. The high Cronbach's alpha value for all the variables that were used as proxies for OC suggested consistency between all the statements that were used to measure OC.

With regard to the OC descriptive statistics, the factor "pressure" had the lowest mean, at 0.24, while the factor "bilateral trust and support" had the highest mean, at 0.66. This suggests that bilateral trust and support are the main driving factor of OC, while pressure drives OC the least. This is congruent with existing literature.

Mediation of the relationship between CL, OC, and 4I readiness

Although the traditional four-step approach to mediation suggested by Baron and Kenny (1986) is still widely used, it is also criticized. An alternative to this method, which is often used in addition to it, is bootstrapping (MacKinnon *et al.* 2004). The bootstrapping method involves taking a superficially large number of random samples (e.g., 5000) with replacement of the same sample size from one's own data, estimating the indirect effect (the ab path) in each sample, ordering those estimates from lowest to highest, and then defining a confidence interval for the bootstrapped indirect effect within some range of percentiles (e.g., the 2.5th and 97.5th percentile for a 95% confidence interval). However, in this study, the traditional four-step approach to mediation was used.

Baron and Kenny (1986) state that mediation is a hypothesized causal chain in which one variable affects a second variable that, in turn, affects a third variable. Based on the citation above, a mediator can be described as a variable that mediates the relationship between the dependent and independent variable. In this study, multiple regression analysis with mediation was used to determine whether CL was a mediator between OC and 4I readiness. The results of this analysis

are reported below. Tables 1 to 4 show the level to which the investigated variables were related to each other and the level to which the mediator variable mediated the relationship between the independent and dependent variable. Total scores for each of the constructs were calculated for the purposes of the mediation. The details of the mediation process are illustrated in Table 1.

Table 1: Outcome variables.

		Coef.	Std. err.	z	P > z	[95% conf. interval]	
Structural							
4I readiness							
	CL	0.35	0.05	6.79	0.00	0.25	0.45
	OC	0.41	0.06	7.18	0.00	0.29	0.52
CL							
	OC	1.03	0.05	22.83	0.00	0.94	1.12

LR test of model vs. saturated: $chi^2(2142) = 4748.50$, Prob > $chi^2 = 0.00$

The mediation total effects of OC (X) on 4I readiness (Y) are illustrated in Table 2.

Table 2. Total effect(s) of X on Y.

	Coef.	Std. err.	z	P > z	[95% conf. interval]	
Structural						
4I readiness						
CL	0.35	0.05	6.79	0.00	0.25	0.45
OC	0.77	0.04	19.69	0.00	0.69	0.86
CL						
OC	1.03	0.05	22.83	0.00	0.94	1.12

The mediation direct effects of OC (X) on 4I readiness (Y) are illustrated in Table 3.

Table 3. Direct effect(s) of X on Y.

	Coef.	Std. err.	z	P > z	[95% conf. interval]	
Structural						
4I readiness						
CL	0.35	0.05	6.79	0.00	0.25	0.45
OC	0.41	0.06	7.18	0.00	0.29	0.52
CL						
OC	1.03	0.05	22.83	0.00	0.94	1.12

The mediation indirect effects of OC (X) on 4I readiness (Y) are illustrated in Table 4.

Table 4. Indirect effect(s) of X on Y.

	Coef.	Std. err.	z	P > z	[95% conf. interval]	
Structural						
4I readiness						
OC	0.36	0.05	6.68	0.000	0.26	0.47

Figure 1 below illustrates the effect of CL (M) on the relationship between OC (X) and 4I readiness (Y).

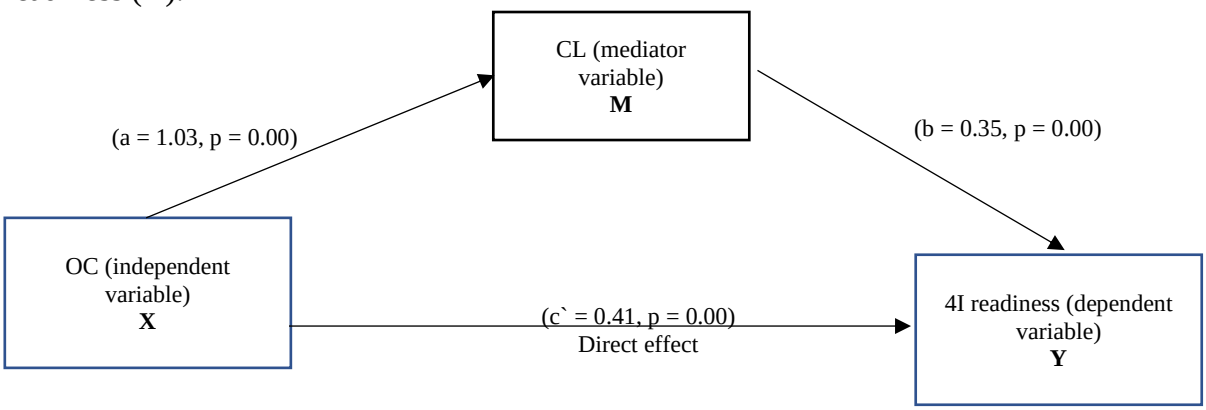

Figure 1. Illustration of a mediation design: X affects Y indirectly through M.

Figure 2 establishes the relationship between OC (X) and 4I readiness (Y).

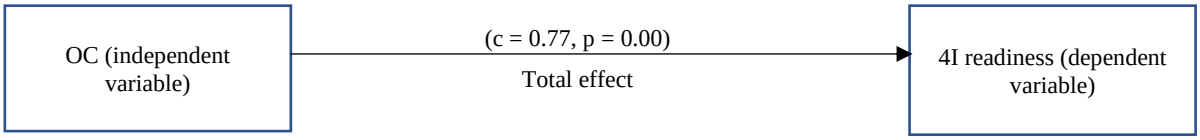

Figure 2. Illustration of a direct effect: X directly affects Y.

Based on Baron and Kenny (1986), mediation consists of four steps as depicted in the two figures above. These four steps in mediation are presented below:

Step 1: This step, illustrated by path (c) of the mediation model shown in Figure 2, established the relationship between OC (X) and 4I readiness (Y). As shown in Table 2, the regression of OC (i.e. independent/predictor variable) on 4I readiness (i.e. dependent/outcome variable) was significant ($\beta = 0.77$, $p = 0.00$). This showed that OC made a positive contribution to 4I readiness.

Step 2: This step, represented by path (a) of the mediation model indicated in Figure 1, showed that the independent variable, namely OC (X), was correlated to the mediator, namely CL

(M). This step essentially involves treating the mediator as if it were an outcome variable and represents the path above. Step 2 showed that the regression of OC on the mediator (CL) was also significant ($\beta = 1.03$, $p = 0.00$). This showed that OC made a positive contribution to CL.

Step 3: This step, represented by path (b) in Figure 1, was used to indicate the relationship between CL (M) and 4I readiness (Y). However, this relationship needed to be controlled for the independent variable. In this case, the relationship between CL (i.e., mediator) on 4I readiness (i.e., dependent variable), controlling for OC, was significant ($\beta = 0.35$, $p = 0.00$). This significant regression showed that CL made a positive contribution to 4I readiness.

Step 4: This step, represented by path (c`) in Figure 1, was used to determine whether CL (M) mediated the relationship between OC (X) and 4I readiness (Y). If the effect of X on Y controlling for M were zero, it would show complete mediation. According to Preacher and Hayes (2004, p. 717), "where the effect of variable X on variable Y is reduced or decreased after the inclusion of the mediator variable, the direct effect is said to have been partially mediated". The analysis revealed that the coefficient was reduced (from $\beta = 0.77$ to $\beta = 0.41$) when the mediator (CL) was included. OC was still a significant predictor of 4I readiness ($\beta = 0.41$, $p = 0.00$), suggesting partial mediation.

In conclusion, as illustrated in Tables 1 to 4, the results from the mediation test relationship indicated that CL mediated the relationship between OC and 4I readiness; therefore, mediation can be assumed. These tables further revealed a positive and significant nexus between OC, CL and the readiness for 4I.

Discussion

Empirical findings of the study are discussed to understand the nexus between OC, Cl and 4I readiness.

The first research question was as follows: "Are there significant relationships between OC, CL and the lack of readiness for 4I displayed by the construction industry". Reviewed literature confirms that there is a positive and significant relationship between OC and leadership, which includes CL (Steyn and Semolic 2017, 2019, Steyn 2019, Rahmana *et al.* 2013). From the citations above, it can be concluded that there is a connection between OC and CL.

OC had a positive significant direct effect on CL, with a coefficient of 1.03. The regression of OC on CL was also significant. This cements the conclusion that there is a significant positive

relationship between OC and CL. A strong relationship was also found between CL and 4I readiness, and mediated the relationship between OC and 4I readiness. These relationships had not been tested before in this manner, and there is no existing reviewed literature which confirms the positive and significant relationship between OC, CL and 4I readiness. However, this study revealed a significantly positive relationship between OC, CL 4I readiness. Based on the conclusions from the research questions and from the individual relationships between OC, CL and 4I readiness, it can be concluded that, firstly, CL is a partial mediator of the relationship between OC and 4I readiness, and secondly, that CL and OC significantly predict 4I readiness.

The second research question was as follows: "Do CL and OC predict 4I readiness?" Not many available studies have tested OC and CL against 4I readiness. However, the reviewed literature agrees that there is a positive and significant relationship between OC and CL, as well as between CL and 4I readiness (Steyn and Semolic 2019, Steyn 2019, Koys and DeCotiis 1991, Rahmana *et al.* 2013, Semolic and Steyn 2017). The data gleaned during this research provided insight into the relationship between OC, CL and 4I readiness. The research findings showed that OC had a significant and positive direct effect on CL, with a coefficient of 1.03. The researchers continued to find a significant and positive direct effect between OC and 4I readiness, with a coefficient of 0.41. There was also a third and final significant and positive direct effect of CL on 4I readiness, with a coefficient of 0.35. The researchers further deduced that OC had a total effect of 0.77 on 4I readiness. These direct effects suggest that, by controlling the mediator (CL), the coefficient is reduced. The above empirical findings and literature review led to the conclusion that CL and OC significantly predict 4I readiness.

The third research question was as follows: "Is CL a mediator between OC and 4I readiness?" There are no precedent studies or existing scientific literature which found CL to be a mediator between OC and 4I readiness. One of the key drivers for conducting this study was to produce new knowledge and address this research gap. Based on the empirical findings above, it can be concluded that CL is a partial mediator of the relationship between OC and 4I readiness. Steyn and Semolic (2017) disagree with the opinions expressed by critiques regarding the negative effect and negative influence of technological innovations, and this concurs with the findings of this study. The research findings are mostly in agreement with existing literature on CL and 4I, but not 4I readiness and OC. The literature (Stiles 1995, Collins and Porras 2002, Kreitner and Kinicki 2004, Semolic 2010, 2012, Rahmana *et al.* 2013, Steyn and Semolic 2016, 2017, Steyn 2019) shows a broad agreement that organizations cannot solely rely on prescriptive strategies but should progressively rely more on emergent approaches to strategy development and implementation.

Data gleaned during this research provided insight into the influence and role of CL on the relationship between OC and 4I readiness. The study and analysis of the mediation results revealed CL was a mediator between OC and 4I readiness. According to Preacher and Hayes (2004), where

the effect of variable X on variable Y is reduced or decreased after the inclusion of the mediator variable, the direct effect is said to have been partially mediated. The analysis also revealed that the coefficient was reduced (from $\beta = 0.77$ to $\beta = 0.41$) when the mediator (CL) was included. OC was still a significant predictor of 4I readiness ($\beta = 0.41$, $p = 0.00$), suggesting partial mediation.

The fourth research question was as follows: "What strategies could be developed and implemented to overcome the 4I readiness problem?" By aligning OT and IT, enterprises can transform unprocessed data into meaningful, actionable information that increases productivity, simplifies decision-making and improves business results (Redhat 2016). According to Atos (2012), IT/OT convergence is promoted by two drivers: economic pressures resulting from globalization and intensifying competition, and the benefits and eventual competitive advantages that stem from the integration of these disciplines. Darnley *et al.* (2018) are of the opinion that innovators promote cultures which view disruptive technologies as opportunities to evolve best practices. Empirical findings from the research revealed significant relationships between OC, CL and 4I readiness.

The study also exposed that CL was a mediator between OC and 4I readiness. The data gleaned from the research further indicated that OC and CL were significant predictors of 4I readiness. Against the above background and with reference to the literature review about OC, CL and 4I readiness, the overall conclusions presented in the next section relate to strategies that can be employed to overcome the lack of 4I readiness within the construction industry. Definite strategies can therefore be developed and implemented to overcome the 4I readiness problem.
The outcome of the research hypotheses were as follows:

H_1: There are significant relationships between OC, CL and 4I readiness: Accept
H_2: CL and OC predict 4I readiness in the construction industry: Accept
H_3: CL is a mediator between OC and 4I readiness: Accept but partial mediation

Conclusions

The current study is the first to establish the nexus between OC, CL and 4I readiness. It can be concluded that organizations which aspire to implement 4I technologies should assess their readiness based on the following factors: based on technical and cybersecurity readiness; technical, legal and partnership readiness; financial and partnership readiness; financial, change and partnership readiness; technical and change readiness; and financial and change readiness. However, 4I readiness is a dependent variable that is predicted by the relationship between OC and CL. It can also be concluded that stronger and improved relationships between OC and CL will enable companies to better prepare themselves to implement 4I technologies. This study has revealed that CL is an arbiter of the nexus between OC and 4I readiness. Based on the findings

presented above, the following overall assertion can be drawn that CL is indeed a good mediator between OC and 4I readiness. The research hypotheses above have been accepted based on the holistic recommendations and the answers to the research questions.

Limitations

According to Collis and Hussey (2009), weaknesses in research are identified by limitations. The following limitations were identified during the research study pertaining to the data collection methods and sample characteristics:

Firstly, the data was collected at a single point in time (cross-sectional). This raises the question of whether the findings would have been the same if the data had been collected over a period (longitudinally), which could be characterized by different emotional states that the employees may have experienced over the period. Secondly, although the primary researcher guaranteed the respondents that their responses would be anonymous, respondents might still have been careful regarding the information they disclosed. Thirdly, the 4I phenomenon is new in South Africa as a whole, and its values are still being debated. Therefore, only a few respondents who understood the concept managed to respond to the questions. Finally, although all nine provinces were targeted for the collection of data required for the study, some provinces like Mpumalanga, Limpopo, Northern Cape and Western Cape were underrepresented. Some respondents chose not to participate in the study for reasons which were not disclosed to the researcher. The data which was finally collected could not be said to be a true reflection of the construction industry within the nine provinces.

While these limitations have not negatively impacted on the findings of the study, they should be noted when future research is considered in the same field of study.

Future research

It will be beneficial if a comparative study could be conducted regarding the collective impact of OC and 4I readiness on CL. The intention of the future research will be, amongst others, to establish whether OC is a moderator of the relationship between CL and 4I readiness. The comparison of CL as a mediator and OC as a moderator will be of vital importance as it will reveal which of the two is more significant and impacts 4I readiness more. Finally, a qualitative study can be conducted to obtain rich data about CL, OC and 4I readiness.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author, [DFZ]. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

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