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The role of leadership in digital transformation – a paradox way to improve operational performance

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Abstract

Purpose – Leadership has been identified as a crucial driver of efficient deployment of any Operations Management (OM) paradigm. Our work focuses on digitalisation, a recent OM paradigm, and analyses the mediating effect of digital transformation (DT) on the relationship between task-oriented and relationship-oriented leadership styles (LSs) and operational performance (OP) improvements in the manufacturing context.
Design/methodology/approach – The authors employed survey data from Hungarian manufacturing firms. Hypotheses are tested using structural equation modelling.
Findings – Task-oriented and relationship-oriented LSs exert distinct influences on DT and OP improvements. The results indicated that task-oriented LS drives OP improvements through its impact on DT. The relationship-oriented LS does not influence DT. Regarding the implications for OP improvements, we revealed a leadership paradox as the indirect positive impact of task-oriented LS may be offset by the direct negative influence of relationship-oriented LS.
Research limitations/implications – The results are most pertinent to manufacturing firms that have already started their digital journey. Further studies must clarify how managers' cultural embeddedness (i.e. general perceptions about efficient leadership in their country or region, national culture) could influence findings. Finally, to learn about the effective long-term behaviours of leaders might require different empirical methods.
Originality/value – To the best of the authors' knowledge, this study represents one of the first survey-based examinations of CEOs on the ways how LSs drive the effective deployment of DT in manufacturing firms. Our findings demonstrate a leadership paradox at the nascent stages of DT in manufacturing firms.

Keywords Digital transformation, Leadership styles, Operational performance improvements, Manufacturing firms
Paper type Research paper

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Quick value overview

Interesting because: As firms engage with technology-driven change it is increasingly necessary to explore factors influencing successful digital transformation (DT). We investigate the role of leadership styles (LSs) in driving DT and improving operational performance (OP) in manufacturing firms. The study uniquely explores how task-oriented and relationship-oriented LS influence DT and OP, revealing a paradoxical relationship.

Theoretical value: The study examines the complex relationships between task- and relationship-oriented LSs, DT and OP. The results show how task-oriented LS exerts a direct and positive influence on DT, which in turn affects the cost efficiency and service flexibility indicators of OP. On the other hand, relationship-oriented leadership has no impact on DT, and it negatively affects OP, particularly in terms of quality and delivery and cost. This deviation challenges conventional wisdom and existing literature, which typically promotes relationship-oriented traits in DT.

Practical value: In order to navigate the digital world and improve OP, leaders must adopt the appropriate LS at each stage of DT. Our findings suggest that task-oriented LS should be emphasised during the early stages of DT. In addition, managers should be cautious of over-reliance on relationship-oriented LS, which may have an adverse effect on OP improvement.

1. Introduction

Over the past decade, a new wave of digitalisation has spread in the manufacturing sector. This phenomenon is referred to as digital manufacturing or Industry 4.0 (I4.0), among others (Culot *et al.*, 2020). As firms engage with this technology-driven change, they usually combine augmented techniques of e-business (e.g. enterprise resource planning, customer relationship management) with advanced technological solutions (e.g. IoT, 3D printing, cloud, artificial intelligence, big data analytics) (Frank *et al.*, 2019).

To realise the potential benefits of digitalisation, firms must approach it as a complex organisational phenomenon (Erboz *et al.*, 2022) that combines both technical and socio elements of organisations. This implies that digital transformation (DT) extends beyond the "pure" adaptation of technological solutions. It also encompasses the elaboration of digital strategy (Gill and VanBoskirk, 2016; Matt *et al.*, 2015), adjustments to the organisational structure and knowledge (Karippur and Balaramachandran, 2022) and changes in cultural traits Ivan *et al.*, 2019; Gill and VanBoskirk, 2016).

Experience related to previous Operation Management's (OM) socio-technical paradigms [e.g. Advanced Manufacturing Technology (AMT), lean production, Total Quality Management (TQM)] has demonstrated that leadership has a critical role in these complex organisational transformations (Beer, 2003). However, studies on previous OM paradigms do not converge towards a clear pattern of supporting leadership behaviour.

One might posit that the rapid expansion of digitalisation in the manufacturing sector would have motivated lively debates on the interplay among leadership (styles) (LSs), DT and operational performance (OP) improvements. Surprisingly, studies rarely focus on the complex web of these concepts (Tortorella *et al.*, 2023). Furthermore, the empirically supported knowledge base on the interplay is incomplete and fragmented. It clearly limits the effective interventions of firms.

Findings on the influence of leadership on DT conclude that leadership fosters DT. It is also highlighted that managers could exhibit traits and behaviours resembling different LSs (Imran *et al.*, 2021; Akçay Kasapoğlu, 2018). However, these studies rarely rely on well-established LSs concepts. To propose viable perspectives on the effective deployment of DT, our study distinguishes task-oriented and relationship-oriented LSs. It is a widely used differentiation in leadership studies (Katz *et al.*, 1950; Fiedler, 1971, 1978) with a footprint in the OM context (van Dun *et al.*, 2017).

Works on performance implications of DT or leadership are mature, but multi-focused. In the OM stream, studies on the performance implications of DT are dominated by OP

improvements (Szász *et al.*, 2021) and less emphasis is given to financial measures (Alkaraan *et al.*, 2022). Literature on leadership is dominated by detailing improvements in soft measures (primarily on the individual and team levels) and business performance indicators (Berman *et al.*, 2020). Our work integrates these fragmented orientations at the OP improvement level.

Although the complex web of links between LSs, DT and performance outcomes is seldom addressed, a common point is that both DT and performance could be influenced by leadership (Dubey *et al.*, 2020; Imran *et al.*, 2021). However, studies rely on different assumptions regarding the "driver" factor in the interplay. For example, authors claim either the moderator role of LSs (Tortorella *et al.*, 2023) or the mediator role of DT (Dubey *et al.*, 2020).

Our empirical study expands current knowledge on the role of leadership in DT. We approach leadership via LSs and assume that it is a key driver of organisations' digital transformation. Relying on the elaborated research question, our main objective is to identify the direct and indirect impacts of LSs on OP improvements via DT:

RQ. How does DT mediate the relationship between LSs and OP improvements?

The paper is structured as follows. In the literature review section, we introduce the task-oriented and relationship-oriented LSs. Subsequently, a multi-pillar approach of DT is described. As the research model is developed, three main hypotheses are formulated. The methodological section starts with the operationalisation and proceeds with explanatory analyses resulting in the elaboration of sub-hypotheses. The result section summarises the analysis of manufacturing firms' data. After discussing the revealed patterns of perceived effective LSs in DT, our work is concluded with a discussion of future research and managerial implications.

2. Literature review

2.1 Leadership styles

LS defines a distinct pattern of skills, capabilities and behaviours that managers apply to influence their subordinates in order to achieve organisational goals (Weber *et al.*, 2022). Researchers typically differentiate a few distinct, and in some cases extreme, patterns in their leadership models such as transactional and transformational leadership styles (Rousseau, 1995; Bass, 1990), relationship- and task-oriented LSs (Katz *et al.*, 1950; Fiedler, 1971, 1978) democratic- and autocratic LSs (White and Lippitt, 1960) or situational leadership (Hersey *et al.*, 1979).

The contingency approach of leadership asserts (Fiedler, 1978) that LS needs to be aligned with the desired organisational trajectory. For instance, *task-oriented leaders* utilise top-down communication and provide clear instructions on how to complete the requisite tasks (Fiedler, 1971). They emphasise short-term planning, personnel efficiency, role and objective clarification and performance monitoring (Mikkelson *et al.*, 2019). *Relationship-oriented leaders* are employee-focused, provide social and emotional support and offer unique attention to their employees (Fiedler, 1971). Such leaders focus on empowering, supporting and motivating followers (Ardi *et al.*, 2020). Their goal is to foster trust, commitment, motivation, collaboration and cohesion within teams (Mikkelson *et al.*, 2019).

As the effectiveness of leadership is considered, studies typically examine the individual (Hater and Bass, 1998) and team level (performance) implications (Imran *et al.*, 2021), concluding that collective performance will be greater when they work under a relationship-oriented leader (Jung and Avolio, 2017). Different levels of performance are also discussed. For example, relationship-orientation positively impacts OP indicators like flexibility, quality, cost and delivery (Tay and Low, 2017) or task-oriented leadership has positive influence on financial performance (He *et al.*, 2023). In general, OP implications of leadership attract less academic attention (Tortorella *et al.*, 2023).

This study examines the effects of task-oriented and relationship-oriented LSs. Our scales are consistent with those employed in other studies (Tortorella *et al.*, 2023; van Dun *et al.*, 2017).

2.2 Key pillars of digital transformation

Successful transformation requires firms to approach DT as a complex organisational phenomenon. In addition to (1) technological developments, digitalisation's organisation-wide changes are marked by (2) digital strategy, (3) organisational resources and structure and (4) corporate culture.

2.2.1 Technology. While firms strive to keep pace with the ever-evolving technological landscape, they need to achieve a balance between exploration and exploitation (Kane *et al.*, 2017; Karippur and Balaramachandran, 2022). Path dependency theory (Teece *et al.*, 1997) or the concept of absorptive capacity (Zahra and George, 2002) posits that firm's current exploitation of technology determines the basis for further advancements. When looking for novel solutions, the exploration of technology helps to reconcile external and internal resources (Csiki *et al.*, 2023). Benchmarking competitors, lead firms and buyers are key aspects of such explorations (Gill and VanBoskirk, 2016). The practical consequence of this balancing effort is that firms eventually combine traditional e-business solutions with recent technological innovations (Frank *et al.*, 2019).

2.2.2 Digital strategy. A digital strategy, aligned with business strategy, is crucial from the early stages of DT (Matt *et al.*, 2015). The digital strategy provides clear directions and defines quantifiable goals (Karippur and Balaramachandran, 2022) that guide individual and team efforts (Alshehab *et al.*, 2022). Elaboration of digital strategy is also a signal of competent management. Its elaboration must be followed by execution (Gill and VanBoskirk, 2016; Heini and Heikki, 2015) which is monitored throughout the DT. Finally, experience gained during the roll-out phase influences strategy renewal (Karippur and Balaramachandran, 2022; Tortorella *et al.*, 2023).

2.2.3 Organisational resources and structure. Once the direction is defined by the strategy, it is assumed that firms possess the necessary financial resources (Ghobakhloo and Iranmanesh, 2021). In this setting, knowledge accumulation and structural adjustments are further prerequisites of the exploitation of technological knowledge and capabilities (Alshehab *et al.*, 2022; Heini and Heikki, 2015). Individuals supporting DT in terms of technological expertise should come from the most capable organisational units (Akçay Kasapoğlu, 2018). Their presence, together with the assignment of formal roles and the provision of training (and new recruitments), ensures that the necessary digital skills are pervading the organisation (Alshehab *et al.*, 2022; Ivan *et al.*, 2019; Karippur and Balaramachandran, 2022).

2.2.4 Culture. A firm cultivating DT reconciles top-down (e.g. supportive management attitude) and bottom-up (e.g. employee involvement and idea generation) directions of cultural development (Karippur and Balaramachandran, 2022). Key actions such as internal and external communication of the digital vision (Karippur and Balaramachandran, 2022; Gill and VanBoskirk, 2016), education and trainings at all levels (Akçay Kasapoğlu, 2018; Tay and Low, 2017), managing beliefs related to risk-taking and willingness to take responsibility (Akçay Kasapoğlu, 2018) support cultural shift (He *et al.*, 2023).

One concludes that these pillars of DT are interdependent, e.g. lack of financial resources constrains digital skill development and hence slow down the digital journey; digital strategy influences effective exploration of new technological solutions etc. Therefore, our research relies on a comprehensive assessment of DT (Szukits, 2022).

2.3 Operational performance

Manufacturing and competitive strategies play a pivotal role in determining how well a company operates and competes in the market (Amoako-Gyampah and Acquaah, 2008). To

achieve strategic goals, OP is a critical aspect of a firm's overall performance with outcomes including cost, reliability, flexibility and services, speed, dependability and quality (Slack *et al.*, 2010). The positive impact of digital technologies on various OP measures has been widely documented (López-Gómez *et al.*, 2018). To grasp a comprehensive assessment of OP implications, we adapted the OP dimension of the firm competitiveness index (Chikán *et al.*, 2022).

2.4 The relationship between leadership styles, digital transformation and operational performance

A limited number of studies investigate the relationship between (leadership) LSs, DT and performance (improvements) (Table 1). These works indicate several vague spots that limit the drawing of practical and specific conclusions.

In relation to DT, some authors adopt a technology-oriented operationalisation (Dubey *et al.*, 2020; He *et al.*, 2023; Imran *et al.*, 2021), whereas others emphasise a comprehensive approach (Berman *et al.*, 2020; Tortorella *et al.*, 2023). Regarding performance implications, authors favour financial indicators (Berman *et al.*, 2020; Dubey *et al.*, 2020; He *et al.*, 2023) and less attention is devoted to traditional OP indicators (Tortorella *et al.*, 2023). Finally, studies describe leadership by different pools of attributes, traits and behaviours. As consistent conceptualisation of leadership is concerned, only entrepreneurial leadership (Dubey *et al.*, 2020; Wu *et al.*, 2021) and the polarised structure of task- and relationship-oriented LSs (Tortorella *et al.*, 2023) appear.

Different assumptions permeate the interplay of concepts. Leadership is either identified as a direct driver of DT and performance (Dubey *et al.*, 2020; Imran *et al.*, 2021; Wu *et al.*, 2021) or as an internal factor inseparable from DT (He *et al.*, 2023; Imran *et al.*, 2021) or as a moderator (Tortorella *et al.*, 2023). Therefore, the role of DT differs also considerably: it is a context (Berman *et al.*, 2020), a mediator (Dubey *et al.*, 2020) or a moderator of mediated influence (Wu *et al.*, 2021).

Studies represent a wide variety of methodological approaches. Relationships are examined by single and multiple cases (Imran *et al.*, 2021; Tay and Low, 2017), single country and international survey-based research (Dubey *et al.*, 2020; He *et al.*, 2023; Tortorella *et al.*, 2023). Narratives reflect the opinions of different managerial levels and even incorporate employee perceptions. Only two studies focused on a larger sample of manufacturing companies (Dubey *et al.*, 2020; Tortorella *et al.*, 2023). Furthermore, some works fall into the category of anecdotal evidence (Berman *et al.*, 2020).

Our review revealed different interpretations of concepts and pointed out their different roles in the interplay. However, conclusions do converge: leadership plays a crucial role as it could enhance both DT and performance. Although, the positive performance implication narrative dominates both in financial (Dubey *et al.*, 2020; Wu *et al.*, 2021; Berman *et al.*, 2020) or operational measures, a recent study claims that relationship-orientation could have a negative moderating influence (Tortorella *et al.*, 2023).

3. Conceptual research model and hypothesis

Our work aims to solve the shortcomings of the current literature. First, we distinguish LSs on a conceptual basis, approach DT in a comprehensive manner and focus on textbook-wise OP measures most probably influenced by DT in manufacturing firms. Second, we target the top decision-maker of manufacturing firms and assume that his/her perception has the greatest influence on the effective deployment of DT. Our research model is presented in Figure 1.

The following sections elaborate on the three main hypotheses of our research.

Table 1. Summary of papers on leadership traits and behaviour, digital transformation and performance outcomes

Authors	Sample	Country	Study objective	Leadership styles, leadership attributes, behaviours, skills		Digital transformation		Performance outcomes	Research method(s)	Results
				Description	Role in the interplay	Description	Role in the interplay			
Berman *et al.* (2020)	1,500 managers (incl. 750 Chief Digital Officers (CDOs))	23 countries	Examines the tasks, skills and behaviour of CDOs and how it contributes to financial performance	CDOs think and act strategically, contribute digital strategy, nurture culture, manage budget; cooperate and monitor; approach digitalisation as an evolutionary process	Influences performance directly	The organisation has launched or is planning to launch a highly strategic, enterprise-wide, cross-functional digital transformation programme	Context	Financial performance: Return on Investment (ROI)	Mixed-method: surveys and regressions and in-depth interviews	The presence of a CDO does appear to indicate a positive impact on an organisation's ROI of their digital investment CDOs' background in business (strategy) is correlated to improved financial performance
Dubey *et al.* (2020)	256 manufacturing firms	India	Develop and test a model that describes the role of EO on the adoption of BDA powered by AI and OP	Entrepreneurial orientation (EO): innovativeness, pro-activeness, risk taking	influences DT and performance directly	Technologies (big data analytics (BDA) powered by artificial intelligence (AI)	Mediates the link between DT and performance	Financial performance: revenue growth, market share, ROI, cash flow, NPD, ROC employed, profit-to-revenue ratio	Cross-sectional survey, PLS-SEM analysis	Leadership contributes to higher level of digitalisation and improves OP

(*continued*)

Table 1. Continued

Authors	Sample	Country	Study objective	Leadership styles, leadership attributes, behaviours, skills		Digital transformation		Performance outcomes	Research method(s)	Results
				Description	Role in the interplay	Description	Role in the interplay			
He *et al.* (2023)	474 employees from service firms	United States	Explores the relationship between DT, organisational resilience (OR) and consequences on organisation and employees and performance	Transformation management intensity (TMI): transformative and shared vision of DT, participation, culture change, digital skills development, coordinated initiatives, clear roles, unified KPI for digital initiatives, IT contribution	interacts with DT; no direct influence on performance	Digital intensity: digital technologies and channels, automated processes, system integration, analytics, support customers, processes and performance	Interacts with TMI, no direct influence on performance	Financial performance: profitability, ROI, sales growth	Structural equation modelling (SEM)	TMI and DI have indirect influence on financial performance via individual contribution and systematic control

(*continued*)

Table 1. Continued

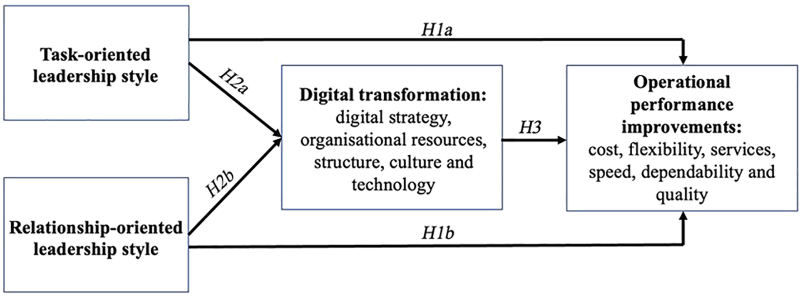
Authors	Sample	Country	Study objective	Leadership styles, leadership attributes, behaviours, skills		Digital transformation		Performance outcomes	Research method(s)	Results
				Description	Role in the interplay	Description	Role in the interplay			
Imran *et al.* (2021)	4 global industrial companies	European Nordic countries	Explores enablers and performance outcomes of digital transformation	Leadership areas: (1) awareness, collaboration, driving digital change and culture, leading by example, mentoring/ coaching-style leadership, transparency, value-driven; (2) adaptability, the right attitude, communication skills, data-driven decision-making, empowerment, failing fast, experimentation, open-mindedness, risk-taking, trust, surface-level technical knowledge and vision	Interacts with DT, influences performance directly	Technical system (implementation of digital technologies)	Interacts with leadership, no direct influence on performance	Agility, customer centricity, collaboration	Multiple case study, in-depth interviews	Leadership, organisational structure and culture are the key enablers of DT. These enablers lead to increased performance outcomes

(*continued*)

Table 1. Continued

Authors	Sample	Country	Study objective	Leadership styles, leadership attributes, behaviours, skills		Digital transformation		Performance outcomes	Research method(s)	Results
				Description	Role in the interplay	Description	Role in the interplay			
Tortorella *et al.* (2023)	189 manufacturing firms	India and Brazil	Examine the moderating role of LSs on the relationship between I4.0 maturity and OP	Task-oriented, relations-oriented and change-oriented LSs	Moderates the link between DT and performance	Strategy, employee and culture, technology	Influences performance directly	OP: productivity, quality, delivery, inventory, safety	Multivariate data techniques	Task-oriented LS positively moderate the relationship between digitalisation and OP. The moderating effects of relations-oriented and change-oriented LSs were negative
Wu *et al.* (2021)	73 CEOs + 377 middle managers	China	Explores the relationships among entrepreneurial leadership, ambidextrous learning and organisational performance in DT	Entrepreneurial leadership: innovativeness, support, ability to flexibly change the environment and credibility	influences learning and no direct influence on performance	A firm-level organisational change that signifies the disruptive implications of digital technology for businesses	moderates the mediator role of learning between leadership and performance; no direct influence on performance	Organisational performance: financial performance: growth of sales revenue, profitability, operational cost efficiency, growth of market share	Questionnaire analysed with hierarchical linear regression	Digital context moderates the mediation effect of ambidextrous learning between entrepreneurial leadership and organisational performance

Source(s): Authors' own work



Source(s): Authors' own work

Figure 1. Research model

3.1 Leadership styles and operational performance improvements

Task-oriented leadership contributes to OP improvements through clear goals, close monitoring, efficient resource allocation, promoting clarity, efficiency, accountability, continuous enhancement of processes and resource management (Fiedler, 1978; Hersey *et al.*, 1979). Empirical evidence on DT underscores that traits related to task-oriented LS such as clear top-down communication and the ability to flexible change bring cost savings and higher quality (Tay and Low, 2017; Wu *et al.*, 2021) and pave the way to productivity, delivery and safety (Tortorella *et al.*, 2023).

Traits resonating with relationship-oriented LS such as people orientation, adaptability, proactiveness and long-term orientation typically support quality orientation and cost-effective operations (Imran *et al.*, 2021) during DT. A similar pool of behaviour such as an emphasis on support, information sharing and relationship management also facilitate DT, which in turn leads to cost saving, better quality and faster information delivery (Tay and Low, 2017). Finally, innovativeness and risk-taking attitudes are associated with improved performance outcomes (Dubey *et al.*, 2020; Berman *et al.*, 2020).

It is postulated that managers with both task-oriented and relations-oriented LSs may facilitate a positive impact on OP improvements.

H1a. Task-oriented LS positively influences the improvement of OP.

H1b. Relationship-oriented LS positively influences the improvement of OP.

3.2 Leadership styles and digital transformation

Task-oriented leaders believe in top-down communication, goal setting and clear instructions, efficient monitoring processes and personnel efficiency (Fiedler, 1971; Mikkelson *et al.*, 2019). These factors can shape both development and execution of DT. For example, He *et al.* (2023) highlight that clear vision and top-down governance positively affect DT. Regarding the process level, timely information sharing, reporting (Tay and Low, 2017) and data-driven approach facilitate DT (Imran *et al.*, 2021). Finally, task completion monitoring contributes to the desired outcome of the transformation (Kretschmer and Khashabi, 2020).

Relationship-oriented style can also have a positive influence on DT, albeit through a different modus operandi. These leaders are more employee-focused, provide emotional support and motivation, prioritise cooperation and put more emphasis on cultural alignment (Ardi *et al.*, 2020; Fiedler, 1971; Mikkelson *et al.*, 2019). Several papers conclude that to engage in a successful DT, leaders should disseminate awareness of DT topics (He *et al.*, 2023) and nurture cultural change (Berman *et al.*, 2020). Focus on employees can be seen when leaders promote empowerment and mentoring/coaching (Imran *et al.*, 2021). In addition, they favour pro-activeness (Dubey *et al.*, 2020) and credibility (Wu *et al.*, 2021) instead of

interventions (Tay and Low, 2017) during DT. To reach the desired goals of DT, they lead digital change by example (Imran *et al.*, 2021) and value coordination of initiatives (Berman *et al.*, 2020; He *et al.*, 2023).

Based on these arguments, we assume that the influence of LSs on DT is positive:

H2a. Task-oriented LS contributes positively to DT.

H2b. Relationship-oriented LS contribute positively to DT.

3.3 Digital transformation and operational performance improvements

Manufacturing firms embark on their digital journey with the expectation of improvements in all dimensions of the triple bottom line (Felsberger *et al.*, 2020). Studies examining different "layers" (e.g. projects, applications, firm level) of digitalisation in a manufacturing context yielded similar results. Quality improvement and better inventory management are the primary means of improving perceived cost efficiency (López-Gómez *et al.*, 2018). DT significantly enhances OP by enabling greater efficiency, flexibility and integration (Akçay Kasapoğlu, 2018; Imran *et al.*, 2021). By adopting advanced technologies and innovative processes enables companies to achieve cost savings, improved quality and faster information delivery (Tay and Low, 2017). Firms' DT can improve firms' operating flexibility enabling quicker response (Tian *et al.*, 2022). To summarise, DT can have a profound positive impact on OP.

H3. The DT positively influences improvements in OP.

4. Research methodology

4.1 The survey and the sample

Our research draws upon the survey data of the Competitiveness Research Center at Corvinus University of Budapest. The sampling frame was derived from the Hungarian Statistical Office's enterprise database, which contained 4,295 domestic firms. The sample was stratified according to size (50–99, 100–249 and > 250 employees), industries and regional dimensions. Data collection was completed in July 2019. Altogether, 2,062 firms were approached, and 234 companies completed the questionnaires. The financial data of sample companies was obtained from Bisnode, a financial service firm. After data cleaning, the final sample comprised 209 companies, 113 of them represented the manufacturing sector.

The survey programme utilises five distinct questionnaires. A general questionnaire, completed by the CEO, encompasses the primary characteristics of the company, institutional context and items of performance measures organised into a firm competitiveness index (FCI) (Chikán *et al.*, 2022). The CEO questionnaire addresses topics pertaining to strategy, organisational structure and human resources. It was also completed by the CEO. Three questionnaires are linked to functional areas namely production (production manager), trade/marketing (sales/marketing manager) and finance (financial manager). The dependent and independent variables were in different questionnaires, thus ensuring a level of methodological and psychological separation (Craighead *et al.*, 2011).

Our research sample comprises 94 manufacturing firms of the 113 due to missing data at the construct level. A 50% threshold limit was set for missing data in each construct. In the final sample ($N = 94$), there were 16 large (>250 employees) and 78 middle-sized firms (50–249 employees). The size and industry categories of the final sample accurately represent the national economy (Szukits, 2022). The nonresponse bias (Armstrong and Overton, 1977) was tested by comparing the variable means of the first and the last registered thirty responses via a *t*-test. At the 1% significance level, no differences were confirmed.

4.2 Research techniques

To explore the data, we employed partial least squares structural equation modelling (PLS-SEM) analysis (Hair *et al*., 2017). Within the SEM family of methods PLS aims to maximise explained variance and is one of the most widely used methods (Hair *et al.*, 2019). PLS-SEM does not require a normal distribution of manifest variables and can be used with relatively small samples (Hair *et al.*, 2019; Henseler *et al.*, 2009). The sample size of 94 companies and a significance level of 5% permit the model to have 5–10 inner or outer model links pointing at any latent variable, depending on effect sizes (Cohen, 1992) which limit we did not exceed. Additionally, the post hoc power analysis (Faul *et al.*, 2008) indicates that, given our $N = 94$ sample size at a 5% statistical significance level the power of the analysis is 0.919, which is acceptable.

The PLS-SEM algorithm initially estimates the latent variables as linear combinations of the manifest variables. Subsequently, the structural equations describing the relationships between the latent variables are estimated (Hair *et al.*, 2022). Our model comprises eight latent variables measured in a reflective manner, based on 29 manifest variables (Table 2). While some researchers suggest that a latent variable should be calculated based on a minimum of three variables (Sarstedt *et al.*, 2020), others conclude that even one or two indicators are sufficient (Hayduk and Littvay, 2012). In our model three of the latent variables are expressed via two manifest variables, while the other five latent constructs are based on three to seven indicators. The PLS algorithm is iterative, estimating the parameters of the model by repeating a fixed number of times up to a target value. The SmartPLS 4 software (Ringle *et al.*, 2022) was used to run the model with 1,000 iterations (Hair *et al*., 2019).

4.3 Measures

In our confirmatory analysis we differentiated task-oriented and relationship-oriented LSs which is a common distinction in management (Northouse, 2021) and even in OM (van Dun *et al*., 2017). DT framework (Szukits, 2022) is derived from the works of Kane *et al*. (2017), Gill and VanBoskirk (2016) and a research report (IWI-HSG and Crosswalk AG, 2015). Finally, we assessed performance improvements based on the firm competitiveness index' (Chikán *et al.*, 2022) OP dimension. Table 2 summarises our main concepts and the corresponding manifest variables.

5. Data analysis and results

5.1 Measurement model

We assessed reliability and validity with several tests. As shown in Table 2, factor loadings are all above 0.5 and most above 0.7. Cronbach's α and Composite Reliability (CR) coefficients were employed to assess the reliability of the model and for all latent variables they are above or close to the minimum value of 0.7. The AVE values, employed as an indicator of convergent validity, are all above the minimum threshold of 0.5.

The Fornell and Larcker (1981) criterion, that AVE values should exceed the covariance between the latent variables, is met considering most constructs. Although the AVE value for task-oriented LS (0.664) is very close to the covariance between the two LSs (0.666), the cross-loading values concerning these two latent constructs provide compelling evidence for discriminant validity. Furthermore, confirming healthy discriminant validity, all HTMT (Heterotrait-monotrait ratio) values are under the cut-off of 0.9. In conclusion, the outer structural model is sound from a reliability and validity perspective.

Confirmatory analyses indicate that the two LSs proposed are relevant. Regarding DT, we distinguish between two constructs. The "digital strategy" construct covers environment analysis and elaboration of formal digital strategy. The other digital construct combines organisational, cultural and technological elements, named as "digital organisation and technology".

Table 2. Descriptive statistics, factor loadings and tests

Measurement of main concepts	Latent variable	Manifest variable	Mean	Factor loadings	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Digital transformation To what extent does the following statement apply to your company? 1 – not at all 3 – medium 5 – fully	*Digital strategy*	The management of our organisation has clearly defined the digital business strategy of the organisation	3.936	0.935	0.875	0.884	0.941	0.888
		Corporate management understands the digital challenges and opportunities facing the company	3.404	0.950				
	Digital organisation and technology	We have allocated adequate financial resources to plan and implement the digital business transformation	3.553	0.894	0.965	0.965	0.971	0.825
		Our organisation has the technological knowledge and skills for the DT	3.532	0.893				
		In our organisation, we can come up with and embrace digitisation by bottom-up ideas	3.543	0.924				
		We can quickly adjust our digital solutions to meet business challenges	3.404	0.900				
		We are willing to take risks compared to our current practice by introducing innovative digital solutions	3.628	0.928				
		We monitor cutting-edge digital solutions in our industry	3.585	0.897				
		We are consciously testing new digital technologies to investigate their applicability	3.415	0.921				

(*continued*)

Table 2. Continued

Measurement of main concepts	Latent variable	Manifest variable	Mean	Factor loadings	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
LS How important do you think the following patterns of behaviour and thinking are for an ideal leader? 1 – not at all 3 – medium 5 – very typical	*Relationship-oriented LS*	Leader communicates goals clearly and convincingly, jointly discusses tasks and entrusts implementation to colleagues, who can turn to him/her, if they feel the need	4.223	0.696	0.825	0.829	0.877	0.589
		Key performance indicators (KPI) are only part of the leadership toolkit, it is necessary that leaders and employees feel that the goals are their own	3.851	0.762				
		The task of the leader is to make the goals personal, to set an example and to mobilise the organisation in the direction of their implementation	4.106	0.758				
		The leader's duties include emotional and professional support and development of the colleagues	3.947	0.796				
		Building trust is an important leadership task because it is the way to achieve innovative solutions	4.011	0.818				
	Task-oriented LS	Key performance indicators (KPIs) convey the agreed goals to leaders and subordinates	3.372	0.727	0.743	0.752	0.855	0.664
		The leader's tasks are largely aimed at ensuring that his/her colleagues perform their tasks as best as possible	3.915	0.831				
		Because of the great responsibility in the work organisation, trust is based on control and follow-up	3.830	0.878				

(*continued*)

Table 2. Continued

Measurement of main concepts	Latent variable	Manifest variable	Mean	Factor loadings	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
OP	*Cost*	Cost effectiveness	3.617	0.887	0.694	0.698	0.867	0.765
Our performance,	*improvement*	Competitive prices	3.606	0.862				
compared to our	*Quality and*	Product/service quality	3.851	0.847	0.802	0.846	0.865	0.618
competitors, between	*delivery*	Quality of manufacturing activity	3.766	0.831				
2016 and 2018 in the		Quality of materials	3.596	0.762				
selected dimension		Delivery time/service time	3.755	0.695				
was	*Flexible*	Flexibility of the logistics system	3.819	0.601	0.779	0.809	0.848	0.587
1 – much worse	*servicing*	Product/ service assortment	3.809	0.764				
3 – about the same		Quality of production/customer service	3.936	0.827				
5 – much better		Organisation of distribution channels	3.745	0.849				

Note(s): All items are measured on a 1–5 Likert scale and represent the perception of the CEO
Source(s): Authors' own work

In the case of performance improvements, our results confirm the validity of three operations-related constructs: "cost improvement", "quality and delivery" and "flexible servicing".

Building upon the aforementioned constructs, sub-hypotheses were developed (Table 3). As for H1 (LSs → OP), we compiled three sub-hypotheses for each performance construct in relation to each LS. Regarding H2 (LSs → DT), our four sub-hypotheses assume links between two LSs and two DT constructs. In H3 (DT → OP), we examine six sub-hypotheses on the links between the two DT and three OP constructs.

Finally, the explorative analysis of DT led to the conclusion that digital strategy is a prerequisite for the execution of initiatives (H4) (Hess *et al.*, 2016).

Table 3. Sub-hypotheses elaboration

Core concepts and their link	Main hypotheses	Sub-hypotheses
LSs → OP	H1a: Task-oriented LS positively influences the improvement of OP	H1aa: *Task-oriented LS positively influences the improvement of cost improvement* H1ab: *Task-oriented LS positively influences the improvement of flexible servicing* H1ac: *Task-oriented LS positively influences the improvement of quality and delivery*
	H1b: Relationship-oriented LS positively influences the improvement of OP	H1ba: *Relationship-oriented LS positively influences the improvement of cost improvement* H1bb: *Relationship-oriented LS positively influences the improvement of flexible servicing* H1bc: *Relationship-oriented LS positively influences the improvement of quality and delivery*
LSs → DT	H2a: Task-oriented LS contributes positively to DT	H2aa: *Task-oriented LS contributes positively to digital strategy* H2ab: *Task-oriented LS contributes positively to digital organisation and technology*
	H2b: Relationship-oriented LS contributes positively to DT	H2ba: *Relationship-oriented LS contributes positively to digital strategy* H2bb: *Relationship-oriented LS contributes positively to digital organisation and technology*
DT → OP	H3: The DT positively influences improvements in OP	H3a: *The digital strategy positively influences the improvement of cost improvement* H3b: *The digital strategy positively influences the improvement of flexible servicing* H3c: *The digital strategy positively influences the improvement of quality and delivery* H3d: *The digital organisation and technology positively influences the improvement of cost improvement* H3e: *The digital organisation and technology positively influences the improvement of flexible servicing* H3f: *The digital organisation and technology positively influences the improvement of quality and delivery*
DT	H4: The digital strategy positively influences digital organisation and technology	–

Source(s): Authors' own work

5.2 The structural model

The R^2 values (Table 4) of the dependent variables – reflecting the predictive accuracy of the model – vary between 0.098 and 0.656, meaning that 9.8%–65.6% of the variance of these constructs can be explained by the model. The explanatory power concerning the focal dependent constructs are considered significant in this research field and among the circumstances of the model.

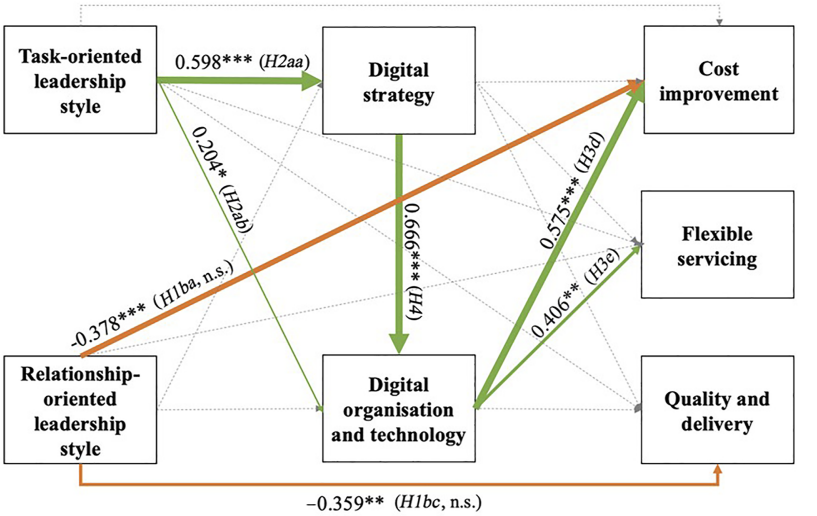
Bootstrapping has been employed to assess the path coefficients (see Figure 2 and Table 5).

Regarding other model fit measures, SRMR is below the generally accepted upper limit of 0.1 (and equal to the more conservative one, see also (Hu and Bentler, 1998)) with a value of 0.080, while the d-G measure demonstrates good model fit, as the upper bound of the 95% confidence interval = 1.342 is larger than the original value of the d_G = 1.193 (Dijkstra and Henseler, 2015).

Table 4. Explanatory power of the model (R^2)

	R^2	R^2 adjusted
Cost improvement	0.255	0.222
Digital strategy	0.381	0.367
Digital organisation and technology	0.656	0.645
Flexible servicing	0.203	0.168
Quality and delivery	0.098	0.058

Source(s): Authors' own work



Note(s): Path coefficients displayed above the arrows; significant path and related sub-hypothesis is supported (*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$) (green path); n.s – significant path, but sub-hypothesis is not supported (orange path); dashed grey arrows: non-significant paths

Source(s): Authors' own work

Figure 2. Research model and PLS path coefficients

Table 5. Structural model (direct effects) and hypotheses testing

Hypotheses and sub-hypotheses		Supported (Y)/not supported (N)	Direct effects	Path coefficient	Bootstrapping sample mean	Bootstrapping standard deviation	T statistics	*p* Values	Result
H1a: Task-oriented LS positively influences the improvement of OP	H1aa	N	Task-oriented LS → Cost improvement	0.044	0.047	0.153	0.287	0.774	Not supported
	H1ab	N	Task-oriented LS → Flexible servicing	0.110	0.111	0.144	0.764	0.445	
	H1ac	N	Task-oriented LS → Quality and delivery	0.111	0.123	0.186	0.599	0.549	
H1b: Relationship-oriented LS positively influences the improvement of OP	H1ba	N	Relationship-oriented LS → Cost improvement	−0.378	−0.382	0.117	3.236	0.001	Not supported (relationship-oriented LS has a negative influence)
	H1bb	N	Relationship-oriented LS → Flexible servicing	−0.185	−0.189	0.146	1.270	0.205	
	H1bc	N	Relationship-oriented LS → Quality and delivery	−0.359	−0.367	0.143	2.506	0.012	
H2a: Task-oriented LS contributes positively to DT	H2aa	Y	Task-oriented LS → Digital strategy	0.598	0.591	0.117	5.113	0.000	Supported
	H2ab	Y	Task-oriented LS → DT organisation and technology	0.204	0.204	0.109	1.873	0.061	
H2b: Relationship-oriented LS contributes positively to DT	H2ba	N	Relationship-oriented LS → Digital strategy	0.029	0.046	0.121	0.240	0.810	Not supported
	H2bb	N	Relationship-oriented LS → DT organisation and technology	0.004	0.004	0.084	0.051	0.959	

(*continued*)

Table 5. Continued

Hypotheses and sub-hypotheses		Supported (Y)/not supported (N)	Direct effects	Path coefficient	Bootstrapping sample mean	Bootstrapping standard deviation	T statistics	*p* Values	Result
H3: The DT positively influences improvements in OP	H3a	N	Digital strategy → Cost improvement	−0.079	−0.081	0.162	0.488	0.626	Not supported
	H3b	N	Digital strategy → Flexible servicing	0.042	0.049	0.200	0.211	0.833	
	H3c	N	Digital strategy → Quality and delivery	−0.139	−0.146	0.250	0.559	0.577	
	H3d	Y	DT organisation and technology → Cost improvement	0.575	0.588	0.152	3.789	0.000	Partially supported
	H3e	Y	DT organisation and technology → Flexible servicing	0.406	0.415	0.195	2.082	0.038	
	H3f	N	DT organisation and technology → Quality and delivery	0.265	0.264	0.235	1.128	0.260	
H4: The digital strategy positively influences digital organisation and technology	H4	Y	Digital strategy → Digital organisation and technology	0.666	0.668	0.077	8.700	0.000	Supported

Source(s): Authors' own work

5.3 Research question and hypothesis evaluation

Regarding H1, task-oriented LS does not have a direct effect on OP improvements (*H1aa*, *H1ab* and *H1ac* are not supported). However, relationship-oriented LS exerts weak yet statistically significant ($p < 0.05$) negative influence on OP constructs like quality and delivery and cost improvement ($f^2 = 0.079$ and 0.107 respectively) (*H1ba*, *H1bb* and *H1bc* are not supported). In conclusion, LSs do not exert a direct positive influence on OP (*H1a* and *H1b* are not supported).

As for H2, task-oriented LS has a significant direct impact on digital strategy with a medium-level positive effect ($\beta = 0.598$, $p = 0.000$, $f^2 = 0.321$) (*H2aa* is supported). Furthermore, it exerts a direct positive influence on digital organisation and technology ($\beta = 204$, $p = 0.061$, $f^2 = 0.051$). This *p*-value (0.061) with our sample size indicates that H2ab may also be supported. Relationship-oriented LS exerts no significant influence on DT (*H2ba* and *H2ab* are not supported). The study highlights the pivotal role of task-oriented LS in DT (*H2a* is supported) and finds no evidence for the influence of relationship-oriented LS in DT (*H2b* is not supported).

Looking at H3 while digital strategy does not directly influence any of the three OP improvement constructs (*H3a*, *H3b* and *H3c* are not supported), digital organisation and technology have a significant positive effect on cost improvement ($\beta = 0.575$, $p = 0.000$, $f^2 = 0.153$, *H3d* is supported) and flexible servicing ($\beta = 0.406$, $p = 0.038$, $f^2 = 0.071$, *H3e* is supported). However, quality and delivery construct is unaffected (*H3f* is not supported). Altogether, digital organisation and technology are the only construct of DT with a direct positive effect on OP.

While testing H4, digital strategy exerts a strong positive effect on digital organisation and technology ($\beta = 0.666$, $p = 0.000$, $f^2 = 0.798$, *H4 is supported*). It indicates that digital strategy can also exert an indirect influence on certain OP measures through its positive impact on digital organisation and technology.

The results indicate that while a direct positive effect from LSs to OP improvements is undetectable, task-oriented LS indirectly influences OP improvements via DT. The chain of significant positive effects ($p < 0.05$) appears to originate from task-oriented LS through digital strategy (medium effect $f^2 = 0.321$) to digital organisation and technology (strong effect $f^2 = 0.798$) and finally to OP (cost improvement $f^2 = 0.153$, flexible servicing $f^2 = 0.071$, medium and weak effect). The quality and delivery constructs are not influenced by task-oriented style or by DT. This indirect mechanism of action is not observable concerning the relationship-oriented LS.

6. Discussion

Our research uncovered novel insights on the interplay of LSs, DT and OP improvements.

Regarding DT, similarly to Tortorella *et al.* (2023) and Berman *et al.* (2020), we confirm that DT is an organisation-wide phenomenon. Although we presented only two main pillars of DT, namely digital strategy and digital organisation and technology, the latter encompasses decisions related to organisation, resources, culture and technology. Our finding implies that digital strategy is a vital and distinct pillar of DT (Matt *et al.*, 2015). As middle-sized firms dominate our final sample, our findings also underline the critical importance of a strategic approach to digitalisation in this size category (Ghobakhloo and Iranmanesh, 2021).

Our study explored the direct influence of leadership on DT. We concluded that task-oriented LS is the sole driver of DT. This is primarily due to its positive influence on digital strategy, but it also has a weak positive impact on organisational and technological aspects. Our work contradicts studies suggesting positive impacts of relationship-oriented traits and behaviours of leaders on DT (Berman *et al.*, 2020; He *et al.*, 2023). The results highlight the importance of goal setting (He *et al.*, 2023), efficient processes (Tay and Low, 2017) and monitoring (Kretschmer and Khashabi, 2020).

Regarding the performance implications of LSs, a leadership paradox is revealed as the two LSs exert different influences on OP improvements. The positive and indirect effects of task-oriented LS via DT on OP improvements are complemented by the negative and direct influence of relationship-oriented LS on OP improvements. So, our work challenges the very positive performance implication narratives of leadership during DT (Berman *et al.*, 2020; Dubey *et al.*, 2020). Our findings are closer to Tortorella *et al.*'s (2023) results who also emphasised the positive influence of task-orientation and negative effect of relationship-orientation. The main difference is that we proved the direct negative influence of relationship-orientation on performance and found that it has no impact on DT.

Focusing solely on OP improvements, our model revealed a tricky situation in which managers are locked in. In some dimensions, LSs and DT are conflicting.

The tension between the two LSs is most striking in the cost improvement construct, which is of key importance in the region (Chanal *et al.*, 2020). On one hand, the positive influence of DT on cost improvement is supported indirectly by task-oriented LS. DT can reduce labour costs and increase efficiency, leading to significant cost savings and can also provide insight into operational inefficiencies. Task-oriented leadership indirectly supports these improvements by ensuring that processes are optimised, resources are managed efficiently and performance is continuously monitored. On the other hand, relationship-oriented leaders are detached from the strong focus on task completion and cost efficiency. They prioritise building strong interpersonal relationships and team cohesion. While this is beneficial for team morale and collaboration, it has consequences on performance. To some extent, this difference might be linked to the manufacturing context. It is pervaded by strict standards and rules that could favour a task-oriented approach.

Regarding flexible services, our findings underline the positive direct influence of DT and the positive indirect of task-oriented LS. While DT provides the tools for data-driven decision-making, task-oriented leadership ensures that these tools are used effectively to continuously improve processes and adapt services by maintaining a balance between flexibility and operational discipline.

Contrary to the literature (Szász *et al.*, 2021), quality and delivery are not (positively) affected by DT. Moreover, relationship-oriented LS has a negative influence on it. DT involves integrating advanced technologies into business processes, which can be complex and time-consuming. If not managed well, the initial stages of DT can disrupt existing processes, causing delays and affecting quality. In addition, relationship-oriented leaders might allocate resources based on team dynamics rather than on the basis of DT efforts. This can lead to sub-optimal use of resources, affecting both quality and delivery.

Many considerations bridge the revealed contradictions.

For example, different phases of the digital journey might require different approaches from leaders. Our findings could resonate with the challenges of the early phases of DT. At this stage, the primary driver is task-orientated LS that effectively sets directions and goals and monitors them. However, in the long-term managers can achieve more favourable results with relationship-oriented LS traits such as people-orientation or mentoring. Consequently, our findings could signal a limitation for the long-term success of DT because the transition from one LS (task) to another LS (relations) is unlikely at the individual level.

One must also consider the influence of organisational and contextual factors. Januszek *et al.* (2024) presented different perceptions of an OM paradigm (i.e. lean) between top (e.g. guiding through vision) and middle management (e.g. applying standards and defining tasks) of a large firm. The characteristic of our sample of having many medium-sized companies and the internal focus of DT strengthen the viability of effective task-oriented LS. Additionally, the results may reflect the Hungarian socio-cultural context. Earlier evidence suggests that micromanagement contributes to successful lean deployment in Hungary (Gelei *et al.*, 2015), which indicates that less human-centred managerial behaviour is an enduring contextual characteristic there.

Finally, our findings deviate from previous experience of OM paradigms. For example, works on TQM emphasised skills linked to relationship-oriented LS (Beer, 2003). Later, lean transitions were related to both task-oriented and relationship-oriented traits (Gelei *et al.*, 2015; van Dun *et al.*, 2017). We only underscore the positive influence of task-orientated LS. One might speculate that this evolution from relationship-oriented to task-oriented LS could be associated with the immense nature of the paradigm.

7. Conclusion

Our research design is based on the experience of OM: leadership is the primary initiator of effective deployment of any OM paradigm, among them digitalisation. We explored the interplay among LSs, DT and OP improvements.

Our findings identified two pillars of DT. Digital strategy, as one of the pillars, guides a comprehensive "execution" pillar of digital organisation and technology. Our investigation indicates that "one-fits-all" LS is effective for the deployment of DT. Namely, task-oriented LS is the only potential driver of DT and OP improvements. Furthermore, we urge that managers must consider unique interdependences. The revealed leadership paradox implies a potential offset effect between relationship-oriented LS and task-oriented LS. A striking tension is evident in the cost improvement dimension of OP improvements.

Our study has limitations that offer avenues for future research.

We exclusively focused on measures of OP improvements. However, both LSs and DT could influence other layers of performance (He *et al.*, 2023). To depict a more comprehensive performance implication, future studies could analyse a broader set of indicators including individual- or team-level indicators or financial measures.

The research model was conceptualised on the assumption that LSs are "sticky" in the short run. It is also possible that, on the long run, DT could influence LSs or lead to appointments of new managers with new traits. Further studies, employing alternative methodologies, may also elucidate the direction of causal relations.

The cross-sectional analysis relies on data collected before COVID-19. The pandemic may have provided a significant impetus for numerous companies to adjust managerial attitudes to a more human-centric approach.

Our work relied on confirmatory analysis of extremely different LSs (i.e. task vs relation). Successful deployment of DT might require a mix of traits and ambidextrous behaviours of leaders.

Finally, one should compile an international survey to reveal how the embeddedness of leadership and organisational culture into national culture impacts the examined relations.

Altogether, we speculate that since behavioural and cultural traits alter slowly, our findings could guide efforts of firms engaged with DT in similar socio-cultural context.

References

Akçay Kasapoğlu, Ö. (2018), "Leadership and organization for the companies in the process of industry 4.0 transformation", *International Journal of Organizational Leadership*, Vol. 7 No. 3, pp. 300-308, doi: 10.33844/ijol.2018.60217.

Alkaraan, F., Albitar, K., Hussainey, K. and Venkatesh, V. (2022), "Corporate transformation toward Industry 4.0 and financial performance: the influence of environmental, social and governance (ESG)", *Technological Forecasting and Social Change*, Vol. 175, 121423, doi: 10.1016/j.techfore.2021.121423.

Alshehab, A., Alfozan, T., Gadarrab, H.F., Alahmad, M.A. and Alkandari, A. (2022), "Identifying significant elements of the digital transformation of organizations in Kuwait", *Indonesian Journal of Electrical Engineering and Computer Science*, Vol. 26 No. 1, pp. 318-325.

Amoako-Gyampah, K. and Acquaah, M. (2008), "Manufacturing strategy, competitive strategy and firm performance: an empirical study in a developing economy environment", *International Journal of Production Economics*, Vol. 111 No. 2, pp. 575-592, doi: 10.1016/j.ijpe.2007.02.030.

Ardi, D.S.P., Bernarto, I., Sudibjo, N., Yulianeu, A., A.Nanda, H. and A.Nanda, K. (2020), "The relationship between digital transformational leadership styles and knowledge-based empowering interaction for increasing organisational innovativeness", *International Journal of Innovation, Creativity and Change*, Vol. 11 No. 3, pp. 259-277.

Armstrong, J. and Overton, T. (1977), "Estimating nonresponse bias in mail surveys", *Journal of Marketing Research*, Vol. 14 No. 3, pp. 396-402, doi: 10.2307/3150783.

Bass, B.M. (1990), "From transactional to transformational leadership: learning to share the vision", *Organizational Dynamics*, Vol. 18 No. 3, pp. 19-31, doi: 10.1016/0090-2616(90)90061-S.

Beer, M. (2003), "Why total quality management programs do not persist: the role of management quality and implications for leading a TQM transformation", *Decision Sciences*, Vol. 34 No. 4, pp. 623-642, doi: 10.1111/j.1540-5414.2003.02640.x.

Berman, S., Heller Baird, C., Eagan, K. and Marshall, A. (2020), "What makes a chief digital officer successful?", *Strategy and Leadership*, Vol. 48 No. 2, pp. 32-38, doi: 10.1108/SL-12-2019-0180.

Chanal, H., Gupta, M., Bhan, N. and Cheng, T. (2020), "Operations management research grounded in the resource-based view: a meta-analysis", *International Journal of Production Economics*, Vol. 230 No. 1, 107805, doi: 10.1016/j.ijpe.2020.107805.

Chikán, A., Czakó, E., Kiss-Dobronyi, B. and Losonci, D. (2022), "Firm competitiveness: a general model and a manufacturing application", *International Journal of Production Economics*, Vol. 243, 108316, pp. 1-13, doi: 10.1016/j.ijpe.2021.108316.

Cohen, J. (1992), "A power primer", *Psychological Bulletin*, Vol. 112 No. 1, pp. 155-159, doi: 10.1037/0033-2909.112.1.155.

Craighead, C., Ketchen, D., Dunn, K. and Hult, G. (2011), "Addressing common method variance: guidelines for survey research on information technology, operations and supply chain management", *IEEE Transactions on Engineering Management*, Vol. 58 No. 3, pp. 578-588, doi: 10.1109/TEM.2011.2136437.

Csiki, O., Demeter, K. and Losonci, D. (2023), "How to improve firm performance? – The role of production capabilities and routines", *International Journal of Operations and Production Management*, Vol. 43 No. 12, pp. 1-26, doi: 10.1108/IJOPM-03-2022-0221.

Culot, G., Nassimbeni, G., Orzes, G. and Sartor, M. (2020), "Behind the definition of Industry 4.0: analysis and open questions", *International Journal of Production Economics*, Vol. 226 Nos 4-5, 107617, doi: 10.1016/j.ijpe.2020.107617.

Dijkstra, T. and Henseler, J. (2015), "Consistent and asymptotically normal PLS estimators for linear structural equations", *Computational Statistics and Data Analysis*, Vol. 81 No. 1, pp. 10-23, doi: 10.1016/j.csda.2014.07.008.

Dubey, R., Gunasekaran, A., Childe, S., Bryde, D., Giannakis, M., Foropon, C., Roubaud, D. and Hazen, B. (2020), "Big data analytics and artificial intelligence pathway to operational performance under the effects of entrepreneurial orientation and environmental dynamism: a study of manufacturing organisations", *International Journal of Production Economics*, Vol. 226, 107599, doi: 10.1016/j.ijpe.2019.107599.

Erboz, G., Hüseyinoğlu, I.Ö. and Szegedi, Z. (2022), "The partial mediating role of supply chain integration between Industry 4.0 and supply chain performance", *Supply Chain Management*, Vol. 27 No. 4, pp. 538-559, doi: 10.1108/SCM-09-2020-0485.

Faul, F., Erdfelder, E., Lang, A. and Buchner, A. (2008), "G*Power 3: a flexible statistical power analysis program for the social, behavioral and biomedical sciences", *Behavior Research Methods*, Vol. 39 No. 2, pp. 175-191, doi: 10.3758/BF03193146.

Felsberger, A., Qaiser, F.H., Choudhary, A. and Reiner, G. (2020), "The impact of Industry 4.0 on the reconciliation of dynamic capabilities: evidence from the European manufacturing industries", *Production Planning and Control*, Vol. 33 Nos 2-3, pp. 277-300, doi: 10.1080/09537287.2020.1810765.

Fiedler, F.E. (1971), "Validation and extension of the contingency model of leadership effectiveness: a review of empirical findings", *Psychological Bulletin*, Vol. 76 No. 2, pp. 128-148, doi: 10.1037/h0031454.

Fiedler, F.E. (1978), "The contingency model and the dynamics of the leadership process", *Advances in Experimental Social Psychology*, Vol. 11, pp. 59-112, doi: 10.1016/S0065-2601(08)60005-2.

Fornell, C. and Larcker, D. (1981), "Evaluating structural equation models with unobservable variables and measurement error", *Journal of Marketing Research*, Vol. 18 No. 1, pp. 39-50, doi: 10.1177/002224378101800104.

Frank, A.G., Dalenogare, L.S. and Ayala, N.F. (2019), "Industry 4.0 technologies: implementation patterns in manufacturing companies", *International Journal of Production Economics*, Vol. 210, pp. 15-26, doi: 10.1016/j.ijpe.2019.01.004.

Gelei, A., Losonci, D. and Matyusz, Z. (2015), "Lean production and leadership attributes – the case of Hungarian production managers", *Journal of Manufacturing Technology Management*, Vol. 26 No. 4, pp. 477-500, doi: 10.1108/JMTM-05-2013-0059.

Ghobakhloo, M. and Iranmanesh, M. (2021), "Digital transformation success under Industry 4.0: a strategic guideline for manufacturing SMEs", *Journal of Manufacturing Technology Management*, Vol. 32 No. 8, pp. 1533-1556, doi: 10.1108/JMTM-11-2020-0455.

Gill, M. and VanBoskirk, S. (2016), *The Digital Maturity Model 4.0 Benchmarks: Digital Business Transformation Playbook*, Forrester Research, Cambridge.

Hair, J.F., Hult, G.T., Ringle, C.M. and Sarstedt, M. (2017), *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, Sage Publications, Washington DC.

Hair, J.F., Risher, J.J., Sarstedt, M. and Ringle, C.M. (2019), "When to use and how to report the results of PLS-SEM", *European Business Review*, Vol. 31 No. 1, pp. 2-24, doi: 10.1108/EBR-11-2018-020.

Hair, J.F., Hult, G.T., Ringle, C.M. and Sarstedt, M. (2022), *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, 3rd ed., Sage Publications, Thousand Oaks, CA.

Hater, J.J. and Bass, B.M. (1998), "Superiors' evaluations and subordinate perceptions of transformation and transactional leadership", *Journal of Applied Psychology*, Vol. 73 No. 4, pp. 695-702, doi: 10.1037//0021-9010.73.4.695.

Hayduk, L. and Littvay, L. (2012), "Should researchers use single indicators, best indicators, or multiple indicators in structural equation models?", *BMC Medical Research Methodology*, Vol. 12 No. 159, pp. 1-17, doi: 10.1186/1471-2288-12-159.

He, Z., Huang, H., Choi, H. and Bilgihan, A. (2023), "Building organizational resilience with digital transformation", *Journal of Service Management*, Vol. 34 No. 1, pp. 147-171, doi: 10.1108/JOSM-06-2021-0216.

Heini, M.T. and Heikki, K. (2015), "The usage of digital marketing channels in SMEs", *Journal of Small Business and Enterprise Development*, Vol. 22 No. 4, pp. 633-651, doi: 10.1108/JSBED-05-2013-0073.

Henseler, J., Ringle, C.M. and Sinkovics, R.R. (2009), "The use of partial least squares path modeling in international marketing", *Advances in International Marketing*, Vol. 20, pp. 277-319, doi: 10.1108/S1474-7979(2009)0000020014.

Hersey, P., Blanchard, K. and Natemeyer, W. (1979), "Situational leadership, perception and the impact of power", *Group and Organization Studies*, Vol. 4, pp. 418-428, doi: 10.1177/105960117900400404.

Hess, T., Matt, C., Benlian, A. and Wiesböck, F. (2016), "Options for formulating a digital transformation strategy", *MIS Quarterly Executive*, Vol. 15 No. 2, pp. 123-139.

Hu, L. and Bentler, P. (1998), "Fit indices in covariance structure modeling: sensitivity to underparameterized model misspecification", *Psychological Methods*, Vol. 3 No. 4, pp. 424-453, doi: 10.1037/1082-989X.3.4.424.

Imran, F., Shahzad, K., Butt, A. and Kantola, J. (2021), "Digital transformation of industrial organizations: toward an integrated framework", *Journal of Change Management*, Vol. 21 No. 4, pp. 451-479, doi: 10.1080/14697017.2021.1929406.

Ivan, L., Vuk, V.B. and Spremic, M. (2019), "Mastering the digital transformation process", *Business Practices and Lessons Learned Technology Innovation Management Review*, Vol. 9 No. 2, pp. 36-50.

IWI-HSG and Crosswalk AG (2015), "Digital maturity and transformation study 2015-2016 questionnaire", available at: https://aback.iwi.unisg.ch/fileadmin/projects/aback/web/images/swiss%20digital%20transformation%20initiative/questionnaire_english.pdf (accessed 20 May 2023).

Januszek, S., Netland, T.H. and Furlan, A. (2024), "The role of managerial perceptions and behaviors across hierarchical levels during lean implementation", *International Journal of Operations and Production Management*, Vol. 44 No. 1, pp. 54-74, doi: 10.1108/IJOPM-07-2022-0417.

Jung, D.I. and Avolio, B.J. (2017), "Effects of leadership style and followers' cultural orientation on performance in group and individual task conditions", *Academy of Management Journal*, Vol. 42 No. 2, pp. 208-218, doi: 10.5465/257093.

Kane, G.C., Palmer, D., Phillips, A., Kiron, D. and Buckley, N. (2017), *Achieving Digital Maturity*, 14 ed, MIT Sloan Management Review and Deloitte University Press, Cambridge, MA.

Karippur, N.K. and Balaramachandran, P.R. (2022), "Antecedents of effective digital leadership of enterprises in Asia Pacific", *Australasian Journal of Information Systems*, Vol. 26, pp. 1-35, doi: 10.3127/ajis.v26i0.2525.

Katz, D., Macoby, N. and Morse, N. (1950), *Productivity, Supervision and Morale in an Office Situation*, Institute for Social Research, Ann Arbor, MI.

Kretschmer, T. and Khashabi, P. (2020), "Digital transformation and organization design: an integrated approach", *California Management Review*, Vol. 62 No. 4, pp. 86-104, doi: 10.1177/0008125620940296.

López-Gómez, C., McFarlane, D., O'Sullivan, E. and Velu, C. (2018), *The Practical Impact of Digital Manufacturing: Results from Recent International Experience. Interim Report. Policy Links, Institute for Manufacturing (IfM)*, University of Cambridge, Cambridge, United Kingdom, available at: https://www.ifm.eng.cam.ac.uk/uploads/Content_Images/IfM_IUK_Interim_revised.PDF (accessed 15 September 2022).

Matt, C., Hess, T. and Benlian, A. (2015), "Digital transformation strategies", *Business and Information Systems Engineering*, Vol. 57 No. 5, pp. 339-343, doi: 10.1007/s12599-015-0401-5.

Mikkelson, A.C., Sloan, D. and Hesse, C. (2019), "Relational communication messages and leadership styles in supervisor/employee relationships", *International Journal of Business Communication*, Vol. 56 No. 4, pp. 586-604, doi: 10.1177/2329488416687267.

Northouse, P.G. (2021), *Leadership: Theory and Practice*, Sage Publications, London.

Ringle, C.M., Wende, S. and Becker, J.-M. (2022), "SmartPLS 4. Oststeinbek: SmartPLS", available at: https://www.smartpls.com

Rousseau, D.M. (1995), *Psychological Contracts in Organizations: Understanding Written and Unwritten Agreements*, Sage Publications, London.

Sarstedt, M., Ringle, C. and Hair, J. (2020), "Partial least squares structural equation modeling", in Homburg, C., Klarmann, M. and Vomberg, A. (Eds), *Handbook of Market Research*, Springer Cham, Switzerland, pp.1-47, doi:10.1007/978-3-319-05542-8.

Slack, N., Chambers, S. and Johnston, R. (2010), *Operations Management*, Pearson education, Essex.

Szász, L., Demeter, K., Rácz, B.G. and Losonci, D. (2021), "Industry 4.0: a review and analysis of contingency and performance effects", *Journal of Manufacturing Technology Management*, Vol. 32 No. 3, pp. 667-694, doi: 10.1108/JMTM-10-2019-0371.

Szukits, Á. (2022), "The illusion of data-driven decision making – the mediating effect of digital orientation and controllers' added value in explaining organizational implications of advanced analytics", *Journal of Management Control*, Vol. 33 No. 3, pp. 403-446, doi: 10.1007/s00187-022-00343-w.

Tay, H.L. and Low, S. (2017), "Digitalization of learning resources in a HEI – a lean management perspective", *International Journal of Productivity and Performance Management*, Vol. 66 No. 5, pp. 680-694, doi: 10.1108/IJPPM-09-2016-0193.

Teece, D., Pisano, G. and Shuen, A. (1997), "Dynamic capabilities and strategic management", *Strategic Management Journal*, Vol. 18 No. 7, pp. 509-533, doi: 10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z.

Tian, G., Li, B. and Cheng, Y. (2022), "Does digital transformation matter for corporate risk-taking?", *Finance Research Letters*, Vol. 49, 103107, doi: 10.1016/j.frl.2022.103107.

Tortorella, G., Prashar, A., Antony, J., Cawley, A., Vassolo, R. and Sony, M. (2023), "Role of leadership in the digitalisation of manufacturing organisations", *Journal of Manufacturing Technology Management*, Vol. 34 No. 2, pp. 315-336, doi: 10.1108/JMTM-09-2022-0312.

van Dun, D.H., Hicks, J.N. and Wilderom, C.P. (2017), "Values and behaviors of effective lean managers: mixed-methods exploratory research", *European Management Journal*, Vol. 35 No. 2, pp. 174-186, doi: 10.1016/j.emj.2016.05.001.

Weber, E., Büttgen, M. and Bartsch, S. (2022), "How to take employees on the digital transformation journey: an experimental study on complementary leadership behaviors in managing organizational change", *Journal of Business Research*, Vol. 143, pp. 225-238, doi: 10.1016/j.jbusres.2022.01.036.

White, R. and Lippitt, R. (1960), *Autocracy and Democracy: An Experimental Inquiry*, Harper and Brothers, New York, NY.

Wu, T., Chen, B., Shao, Y. and Lu, H. (2021), "Enable digital transformation: entrepreneurial leadership, ambidextrous learning and organisational performance", *Technology Analysis and Strategic Management*, Vol. 33 No. 12, pp. 1-15, doi: 10.1080/09537325.2021.1876220.

Zahra, S.A. and George, G. (2002), "Absorptive capacity: a review, reconceptualization and extension", *Academy of Management Review*, Vol. 27 No. 2, pp. 185-203, doi: 10.2307/4134351.

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