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CULTIVATING A DATA-DRIVEN CULTURE: EXPLORING THE ROLE OF DATA ANALYTIC CAPABILITY, EMPLOYEE EMPOWERMENT, AND TRANSFORMATIONAL LEADERSHIP

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To remain competitive in an increasingly complex business environment, companies are turning to digitalization technologies. To benefit from these technologies, companies need to develop their Data Analytic Capability and Data-Driven Culture. This is a complex socio-technical process that in addition to technical aspects, also involves organizational aspects. The present study examines how two organizational aspects, Transformational Leadership and Employee Empowerment contribute to companies harnessing their Data Analytic Capability to develop a Data Driven Culture. The findings of a cross-sectional survey design show that Transformational Leadership compounds the positive effect of Data Analytic Capability on Data Driven Culture. However, and contrary to what the theory predicts, Employee Empowerment in combination with Transformational Leadership can have a negative impact on DDC. Possible explanations are proposed.

Keywords:

digital transformation, data-driven culture, transformational leadership, employee empowerment, data-driven decision making



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1 Introduction

To compete in an increasingly digital world, companies are embracing digitalization as a way to reduce waste, add value for customers, and improve company performance (Rossi et al., 2022). Digitalization is a broad concept, referring to our society transforming from analog to digital, and the corresponding changes in customer behavior, and within and across communication and collaboration (Vial, 2019). Three distinct processes related to digitalization can be distinguished: (1) digitization as the process of converting analog into digital data, (2) digitalization as the improvement of business processes through the application of digitalization tools, and (3) digital transformation as the changes in the business model to take advantage of new opportunities stemming from digital technologies (Machado et al., 2019). By enabling companies to combine technological tools and data analytics, digitalization allows them to improve their capacities and effectiveness (Garmaki et al., 2016; Gupta & George, 2016; Yu et al., 2021). This is called Data Analytic Capability (DAC) (Mikalef et al., 2018).

For companies, DAC in combination with a Data Driven Culture (DDC), can be an avenue to competitive advantage (Kokkinou et al., 2023d). DAC enables companies to turn data into insights, improving data-driven decision making. DAC can thereby lead to improved supply chain agility (Dubey et al., 2019), supply chain robustness (Kokkinou et al., 2023d), more sustainable supply chain performance (Al-Khatib, 2022) and improved firm performance (Akter et al., 2016). Nevertheless, DAC alone is not sufficient as the generated insights will only be of value if they are used as part of decision-making (Chatterjee et al., 2021). The concept of DDC was therefore introduced. DDC refers to whether the insights developed are actually used by employees and managers in day-to-day decision-making (Yu et al., 2021).

Even though the need to develop DDC is widely recognized (Chatterjee et al., 2021; Kokkinou et al., 2023; Yu et al., 2021), less is known about the factors affecting a company's development of DDC. Previous research has highlighted the role of leadership and employee empowerment in making changes and shifting organizational culture (Cortellazzo et al., 2019; Motamarri et al., 2017). Therefore, the purpose of this study is to examine how leadership and employee empowerment contribute to the development of DAC and DDC, a novel contribution to the digitalization literature.

2 Review of the Literature

2.1 Resource Based View and Dynamic Capability Theory

The Resources Based View (RBV) of the firm and Dynamic Capability Theory (DCT) provide a comprehensive theoretical framework for how companies can orchestrate people, process, and technology resources in such a way as to create competitive advantage (Brandon-Jones et al., 2014; Kokkinou, 2023a; Kokkinou, 2024; Mikalef & Krogstie, 2020; Wu et al., 2006). RBV stipulates that companies possessing resources that are valuable, rare, and cannot be imitated or substituted can generate competitive advantage (Barney, 1991). While RBV is widely embraced, it is criticized for considering assets and capabilities as being static, and ignoring the need for companies to evolve their resources in response to changes in their environment (Eisenhardt & Martin, 2000; Wang & Ahmed, 2007). DCT evolved to address this limitation by introducing the concept of dynamic capabilities, defined as their “*ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments*” (Teece et al., 1997, p. 516).

DAC has been described as both a capability, and an enabler of other capabilities (Helfat & Peteraf, 2009; Kokkinou, 2023b). DAC is designated as a capability as it allows companies to sense their environment (e.g. identify new patterns) (Mikalef et al., 2019), seize opportunities (e.g. making data-driven decisions to assess investment opportunities), and to reconfigure and transform activities in response (Teece, 2012). DAC is also considered an enabler of other dynamic capabilities (Helfat & Peteraf, 2009). These include process innovation capability (Mikalef & Krogstie, 2020), sustainable innovation capability (Al-Khatib, 2022) and supply chain agility (Dubey et al., 2019; Ghasemaghaei et al., 2017).

2.2 Data Analytic Capability and Data Driven Culture

DAC is a company’s ability to use data, technology, and people to quickly generate the insights needed to support complex decision-making (Yu et al., 2021). While this definition is often applied to big data in particular (Akter et al., 2016; Dubey et al., 2019; Singh & Singh, 2019; Yu et al., 2021), the rapid pace of technological developments shifts the definition of big data, broadening the significance and applicability of DAC (Kokkinou et al., 2023b). Grounding themselves in the RBV

and socio-materialism theories, Akter et al. (2016) identified three dimensions of DAC. These were, in order of relative importance: talent capability, management capability, and technology capability. Talent capability refers to the capabilities of analytics professionals, and encompasses technical, business, relational and technology management knowledge (Akter et al., 2016). Management capability refers to decisions being made by applying a proper management framework. Technology capability refers to the flexibility of IT platforms as enabled through connectivity and compatibility of the various applications.

DDC refers to an organizational culture where managers prioritize in their decision-making the insights generated by data over their intuition and gut feeling (Gupta & George, 2016; Kokkinou et al., 2023d). Unlike Akter et al. (2016), who view management capability as a dimension of DAC, we adopt the view of Gupta and George (2016) and Yu et al. (2021) that DAC is an antecedent of DDC. We apply Gupta and George's (2016, p. 1053) definition of DDC as "*the extent to which organizational members (including top-level executives, middle-managers, and lower-level employees) make decisions based on the insights extracted from data.*" From this perspective, DDC is an intangible resource that enables companies to harness the benefits of DAC by facilitating the dissemination of data-driven insights across a company (Chatterjee et al., 2021; Gupta & George, 2016; Karaboga et al., 2023). This is supported by previous research that found the effects of DAC and DDC to synergize (Karaboga et al., 2023; Kokkinou et al., 2023d). Consistent with these findings, we hypothesize that:

H1: DAC has a positive effect on DDC

2.3 Employee Empowerment

The definition of DDC explicitly refers to employees at all levels of the company (Gupta & George, 2016), implying that employee empowerment may be a necessary condition for DDC. Employee empowerment is defined as the "*downward movement of authority and relaxing the boundaries of vertical control*" (Motamarrì et al., 2017). Employee empowerment has been viewed alternatively as the act of granting power to the person being empowered, the process leading to the person experiencing the power, and a psychological state (Menon, 2001). However, Menon (2001) argued

that these views were not mutually exclusive but instead together provided a comprehensive picture of employee empowerment.

By extension, employee empowerment can be seen as the delegation of decision-making authority, in such a way that it remains in line with company values and objectives (Motamarri et al., 2017).

Employee empowerment is a widely embraced strategy, especially in companies embracing Total Quality Management (Ugboro & Obeng, 2000) and has been linked to numerous business outcomes. Employee empowerment positively links to employee and customer satisfaction (Ugboro & Obeng, 2000) and individual and team performance (Chen et al., 2007; Özaralli, 2003). Employee empowerment as an organizational strategy has also been hypothesized to contribute to greater supply chain integration (Shub & Stonebraker, 2009). It has also been found to contribute to supply chain innovativeness by reducing restrictions and enabling employees to conduct operational activities pro-actively (Jaouadi, 2022). As technology has become increasingly part of employees' day-to-day work, the concept of employee empowerment has evolved to encompass new dimensions, including (a) decision-making, (b) discretionary skills, (c) information access, (d) knowledge and skills, (e) tools and technology, and (f) training and development. Motamarri et al. (2020) examined front-line employee empowerment in the context of analytics-driven services and emphasized the importance of training and equipping front-line employees with the knowledge and technology needed to perform their work.

The development of a DDC requires employees at all levels of the company, from top management to front line employees (Gupta & George, 2016; Motamarri et al., 2017) to adopt data-driven decision-making, leading to the second hypothesis:

H2: Employee empowerment has a positive effect on DDC

The company environment, and leadership in particular, play an important role in whether employees feel empowered (Menon, 2001).

2.4 Transformational Leadership

Transformational leadership has been proposed as an enabler of companies' digitalization efforts (McCarthy et al., 2022). Where transactional leadership refers to an exchange relationship between a leader and follower where each seeks to meet their own self-interest; transformational leadership refers to a relationship where the leader moves the follower beyond immediate self-interest (Bass, 1999). This is done through a combination of inspiration (the leader sets the example to be followed), charisma (the leader provides vision, arouses and inspires), intellectual stimulation (the leader provides challenge and stimulates to think in a different way), and individual consideration (the leader provides coaching and feedback) (Bass, 1999; Özaralli, 2003). Transformational leadership is thus characterized by “*raising an awareness of the importance and value of designated outcomes and by developing intellectually stimulating and inspiring followers to transcend their own self-interests for a higher collective purpose, mission, or vision*” (Özaralli, 2003, p. 335).

Leaders and managers play an important role in company's digitalization and development of DAC (Kokkinou et al., 2023c; Kokkinou et al., 2024; McAfee et al., 2012) by orchestrating aspects relevant to developing DAC (Tabesh et al., 2019). To successfully guide the company, leaders and managers need to take a people, process, technology and data perspective (McCarthy et al., 2022). Leaders need to take the role of digital enabler, recognizing the opportunities engendered by technologies, communicating their value, and enabling their implementation (Cortellazzo et al., 2019). Leaders also need to promote the development of knowledge and expertise across the company through hiring new employees, training existing employees, or creating access to outside expertise (Behl et al., 2019; Kokkinou et al., 2021). Leaders also need to demonstrate commitment, give support, and allocate the right resources to the right people (Kokkinou et al., 2023b). Transformational leadership, with its emphasis on providing a vision, coaching, and intellectually stimulating employees is therefore expected to strengthen the impact of implementing DAC on the development of DDC, leading to the following hypothesis:

H3a: Transformational leadership strengthens the positive effect of DAC on DDC

Transformational leaders are also responsible for creating an organizational culture that encourages employee empowerment (Donate & Guadamillas, 2011). In the context of digitalization, data and the insights it enables become easier to share, enabling more autonomy for employees through involvement in real time decision-making (Cortellazzo et al., 2019). A transformational leadership is therefore expected to strengthen the effect of employee empowerment on DDC, leading to the following hypothesis:

H3b: Transformational leadership strengthens the positive effect of employee empowerment on DDC

The full theoretical framework and study hypotheses are shown in Figure 1.

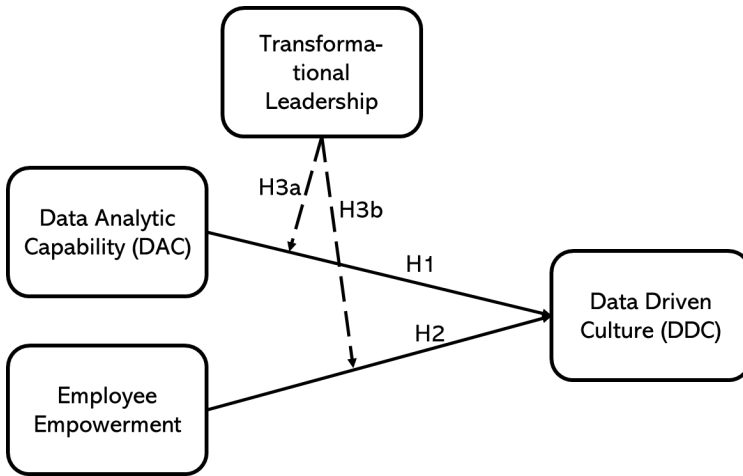


Figure 1: Conceptual Framework

3 Methods

A cross-sectional survey design was used to test the study hypotheses. We describe below the design of the data collection instrument, the sampling method, and the data collection and analysis procedures.

3.1 Sampling and Data Collection

The unit of analysis consisted of companies operating in the Netherlands. To represent these companies, we recruited participants from a database consisting of 322 professionals acting as internship supervisors for students attending a logistics programme at a Dutch university of applied sciences. After one reminder, 120 responses were obtained. 22 responses were eliminated due to excessive missing data. The remaining 98 responses were retained for further analysis (a response rate of 30.4%)¹. Consistent with the nature of the sample, the transportation and logistics sector was over-represented. Third party logistics providers, transportation/warehousing, and wholesale/distribution companies accounted respectively for 24%, 7%, and 10% of the responses obtained. Nevertheless, a wide range of other industries were also represented, including retail (14%), pharmaceuticals (8%), automotive (7%), and professional services (9%). The companies included in the final response set were also diverse in terms of size (28% had fewer than 250 employees while 35% had more than 10,000 employees worldwide) and revenues (31% earned less than 100 million EUR, while 41% earned more than 500 million EUR per year worldwide). The responses were equally divided between Dutch companies operating mostly in the Netherlands (27%), Dutch companies operating internationally (31%), and Dutch subsidiaries of an international company (31%), with the remainder qualifying themselves as “other” (10%). Respondents reported an average tenure at the company of 6.453 years ($SD = 4.757$).

3.2 Survey Design

To collect the data for this study, a survey consisting of four sections was designed in the software Qualtrics. The first section explained the survey objective, confidentiality procedures, and informed consent. The second section was used to collect demographic data about the company. The third section was used to collect data on the constructs of interest to the study. The fourth section consisted of demographic questions about the respondent.

To measure the constructs of interest to this study, previously validated scales were obtained from the literature. The scales for DAC (Srinivasan & Swink, 2018) and

¹ The 98 responses retained for further analysis had less than 5% missing data. However, this missing data explains discrepancies between sample sizes used across the remainder of the paper and percentages not adding to 100%.

DDC (Yu et al., 2021) each consisted of four items measured on a scale from 1 (completely disagree) to 5 (completely agree). The abbreviated scale for transformational leadership, the Global Transformational Leadership scale consisting of seven items developed by Carless et al. (2000) was used and adapted to the perspective of the respondent. Respondents were asked to indicate how frequently they engaged in the behavior described on a scale from 1 (never) to 5 (always). The complete scale to measure employee empowerment consisting of 15 items was used, anchored with 1 (completely disagree) to 5 (completely agree) (Motamarri et al., 2020). A team of native Dutch speakers consisting of the third author and four master students translated the survey to Dutch. Both Dutch and English surveys were pre-tested by individuals of equivalent experience as the intended sample and their feedback was used to revise the wording in the surveys. Two native English speakers including the second author backtranslated the Dutch survey. Any inconsistencies between the two surveys and feedback received from the pre-test were discussed and resolved by the research team (consisting of the three authors) in consultation with the four master students who translated and three industry professionals who pre-tested the survey.

4 Results

For each construct, the internal consistency was first established using Cronbach Alpha (Fornell & Larcker, 1981). For all constructs, Cronbach Alpha ranged from .715 to .878 (see Table 1).

Table 1: Descriptive Statistics

	Cronbach Alpha	Mean	Standard Deviation
Data Analytic Capability (DAC)	.816	3.665	0.896
Data Driven Culture (DDC)	.743	3.840	0.695
Transformational Leadership (TL)	.715	4.284	0.411
Employee Empowerment (EMP)	.878	4.018	0.512

Linear models were subsequently used to examine the relationships between DAC, employee empowerment and DDC, and the moderating role of transformational leadership. The linear regression analysis seen in table 2 showed a statistically significant model ($F(5,83)=15.72$, $p<.001$, $R^2 = .486$, $adj R^2 = .455$). Since the effects of both interaction terms (transformational leadership and DAC, transformational leadership and employee empowerment) on DDC were significant, the main effects will not be interpreted. No conclusions will therefore be drawn regarding H1 and H2.

Table 2: Linear Regression Results

Variable	Estimate	St. Error	t-value	p-value
Constant	-3.008	4.636	-0.649	0.518
DAC	-1.639	0.783	-2.092	0.039*
EMP	3.017	1.429	3.017	0.038*
TL	1.139	1.083	1.052	0.296
DACxTL	0.489	0.181	2.686	0.009*
EMPxTL	-0.683	0.334	-2.048	0.044*

* denotes $p < 0.05$

Transformational leadership was found to significantly impact the relationship between DAC and DDC ($b= 0.489$, $SE = 0.181$, $p<.05$). As the interaction plot in Figure 2 shows, when transformational leadership is high (one standard deviation above the mean), DAC has a stronger positive effect on DDC than when transformational leadership is low (one standard deviation below the mean), supporting H3a.

Against expectations, transformational leadership was found to significantly impact the relationship between employee empowerment and DDC ($b= -0.683$, $SE = 0.334$, $p<.05$) in a negative way. As the interaction plot in Figure 3 shows, when transformational leadership is high (one standard deviation above the mean), employee empowerment has a negative effect on DDC. Conversely, when transformational leadership is low (one standard deviation below the mean), employee empowerment has a positive effect on DDC. This led to the rejection of H3b.

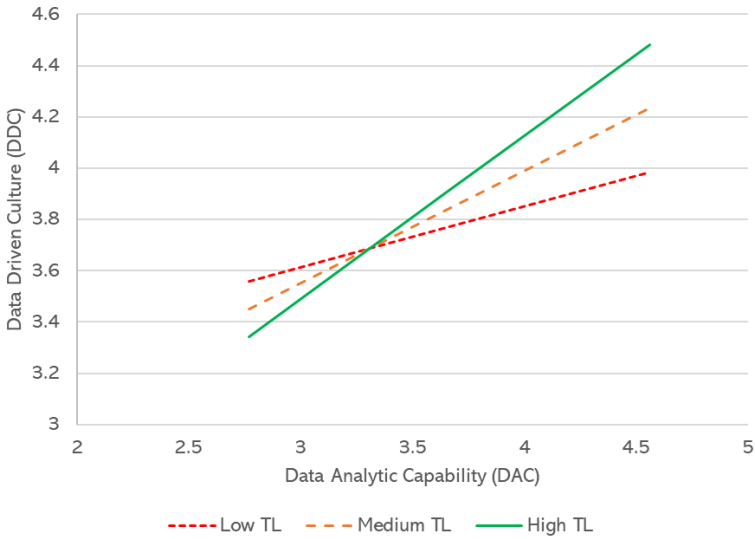


Figure 2: Interaction Effect of Data Analytic Capability and Transformational Leadership on Data Driven Culture

Source: Own

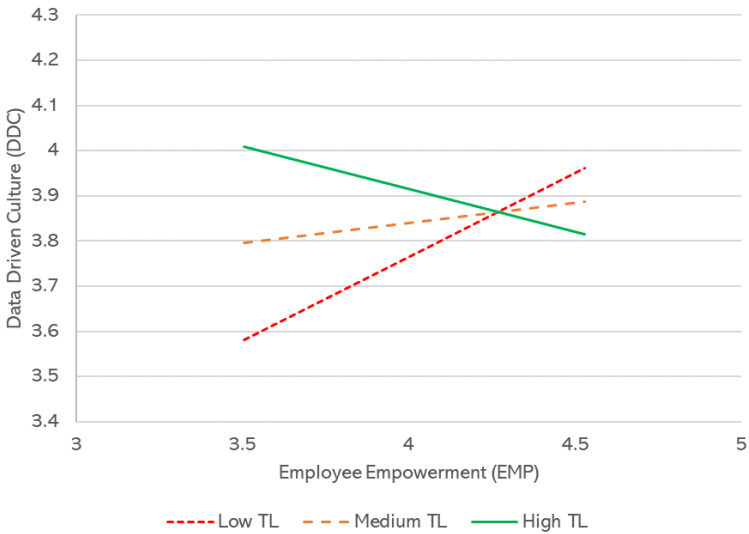


Figure 3: Interaction Effect of Employee Empowerment and Transformational Leadership on Data Driven Culture

Source: Own

5 Discussion

There is increasing attention to the role that employees play in shaping the company's digitalization efforts (Blanka et al., 2022). The purpose of the present study was to examine how companies can develop their organizational culture towards being a DDC, by considering both technical aspects such as the development of DAC, and organizational aspects such as leadership and employee empowerment (Gupta & George, 2016).

Our findings show that the development of DAC, in combination with transformational leadership has the greatest positive impact on the development of a DDC. Developing DAC contributes to turning data into actionable insights (Chatterjee et al., 2021). Leaders leaning towards a more transformational leadership style in turn can inspire employees by sharing their vision of how DAC contributes to the company's strategy and modeling data-driven decision-making (Kokkinou et al., 2023a; McCarthy et al., 2022; Özaralli, 2003).

Unexpectedly, employee empowerment in combination with transformational leadership had a negative impact on DDC. While Cortellazzo et al. (2019), Jaouadi (2022) and Motamarri et al. (2020) advocate for employee empowerment and transformational leadership to promote a DDC (Cortellazzo et al., 2019; Jaouadi, 2022; Motamarri et al., 2017), our findings demonstrate the opposite. In the presence of transformational leadership, employee empowerment had a negative impact on developing a DDC. Several explanations can be proposed based on the literature. First, employee empowerment is a multi-dimensional concept (Motamarri et al., 2017) incorporating people aspects (e.g. discretionary skills), process aspects (e.g. decision-making), and technology aspects (e.g. tools and technology) (Motamarri et al., 2020). As such, transformational leadership only impacts certain aspects of employee empowerment, and could impact those which are unrelated to DDC, wasting precious resources. Second, as Motamarri et al. (2020) demonstrated in the context of frontline employees, employees need to be equipped with the training, knowledge, and technology to be able to perform. It is thus possible that when empowered and inspired by transformational leaders but without being given the necessary data analytic knowledge on a more practical level, employees resort to using their intuition instead of DAC.

5.1 Limitations and Further Research

Further research should delve deeper into processes linking employee empowerment, transformational leadership, and DDC. A qualitative and more in-depth approach, through multiple case studies, should examine the mechanisms underlying these processes, and identify potential mediating variables. These variables could include other people related aspects such as intrapreneurial competency (Blanka et al., 2022; Vargas-Halabí et al., 2017) and technical training, knowledge, and skills (Kokkinou, 2023b).

The present study used a cross-sectional survey design to examine how DAC, employee empowerment and transformational leadership contribute to companies' development of a DDC. The sample was limited to companies operating the Netherlands and was relatively small. The Netherlands is characterized by a low-power-distance culture (Hofstede, 1983), and an affinity for data-driven decision making. To improve the generalizability of the findings, the study should be replicated with a broader and more diverse sample.

5.2 Implications for Practitioners

In their pursuit of competitive advantage, companies need to embrace digitalization and develop their DAC. To realize the advantage of DAC, companies need to invest in developing a DDC, so that these insights are used for decision-making and contribute to improving company performance, supply chain resilience and competitive advantage. To achieve this, companies need to not only focus on technical issues, but also the interlinked aspects of leadership and employee empowerment. Clearly, just promoting transformational leadership and employee empowerment practices is not sufficient. Instead, attention needs to be given to the fit between people, process, and technology, and the adequate provision of training, knowledge, and skills.

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