This paper was presented at the XXXVII ISPIM Innovation Conference, held in Granada, Spain on 07 June to 10 June 2026. ISBN 978-952-65771-2-8.

Linking Digital Leadership to LMX Dimensions: A Quantitative Study

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Abstract:

This study examines how digital leadership behaviors shape relational exchange quality (LMX) and, through these relational conditions, influence innovation-relevant outcomes in German companies. Drawing on the Leader–Member Exchange (LMX) framework and innovation research that distinguishes creativity (idea generation) from innovation (idea promotion and implementation), this study develops and tests hypotheses linking perceived digital leadership to LMX quality. Using a deductive quantitative design, data were collected via an online survey of 140 employees working under digitally oriented leaders

across multiple German industries. Results show a strong positive association between perceived digital leadership and LMX quality, supporting a relational mechanism through which digital leadership enables innovation-relevant employee behavior. Practically, organizations pursuing innovation through digital transformation should develop digital leadership as a relational capability that cultivates trust, professional respect, and reciprocal contribution—conditions innovation-management research consistently identifies as critical for transforming ideas into implemented change.

Keywords: Digital Leadership; Employee Satisfaction; Leadership Satisfaction; Transformational Leadership; Digital Work Culture; Quantitative Research

1. Introduction

Digital transformation has expanded the scope and speed of innovation while simultaneously making innovation coordination more complex. Innovation increasingly occurs in distributed teams, digital platforms, and hybrid environments characterized by technological change and reduced physical interaction. As a result, innovation management challenges extend beyond technology adoption to sustaining employee engagement in idea generation, experimentation, knowledge sharing, and implementation under uncertainty. Innovation research highlights that relationship quality is essential for innovation outcomes, as trust and psychological safety shape whether employees are willing to take risks and persist through implementation stages. Mascareño et al. (2020) show that LMX often influences innovation indirectly via creativity rather than through direct effects. Similarly, Son et al. (2017) demonstrate that leadership behaviors affect creativity and knowledge sharing through relational exchange quality.

Digital leadership has therefore emerged as a critical capability in contemporary organizations. While digital tools enable flexibility and efficiency, leadership practices must balance autonomy, control, and relational support. Despite growing interest, empirical research connecting digital leadership behaviors to relational exchange mechanisms such as LMX remains limited, particularly within innovation management contexts. This study addresses this gap by empirically examining how perceived digital leadership relates to LMX quality and positioning this relationship as a relational entry point for innovation processes.

2. Literature Review & Theoretical Framework

LMX Theory

The LMX theory describes leadership as a differentiated relationship process between managers and employees. At its core is the assumption that managers establish different levels of exchange relationships with individual employees. In an organizational context, these differences lead to the formation of in-group and out-group relationships, the quality of which has a decisive influence on motivation, commitment and performance. The in-group comprises employees with whom the manager has developed a high-quality, trusting and often informal partnership-based relationship. These employees often take on additional responsibility, show a high level of ownership, are intrinsically motivated and

identify strongly with the manager and the organization. In return, they receive more support, scope for decision-making and access to resources. The exchange is not only task-related, but is increasingly based on mutual trust, loyalty and reciprocal commitment. This contrasts with the out-group, whose members act primarily within the framework of their formal role. The relationship with the manager remains objective, structured and limited to minimal performance expectations. Characteristics such as low frequency of interaction, low trust and a rather transactional management relationship characterize these exchange relationships. In this constellation, employees usually show less commitment and less willingness to take on additional responsibility, as the relationship offers little development-oriented stimulus (Dansereau et al., 1975).

Classification into an in-group or out-group is not a static state, but rather a process that develops based on behavior, performance, and mutual perception. Under certain conditions, employees can move from a low to a high-quality relationship. LMX therefore offers not only a descriptive, but also a development-oriented understanding of leadership: through targeted interaction and support, managers can actively contribute to the expansion of the in-group and thus make more effective use of their team's potential (Dansereau et al., 1975).

LMX theory posits that leaders form differentiated exchange relationships with employees, and that high-quality exchanges are characterized by trust, respect, and mutual obligation (Graen & Uhl-Bien, 1995). In innovation management, LMX matters because it can provide social and instrumental resources—autonomy, support, legitimacy, and informational access—needed for creative exploration and later implementation stages. Crucially, relational exchange quality is a mechanism that can enable innovation processes rather than merely an HR outcome. Mascareño et al. (2020) provide a key innovation-management insight by testing competing hypotheses: LMX may (a) directly predict innovation or (b) predict innovation indirectly through creativity. Their results support the indirect pathway more strongly: LMX primarily fosters creativity, which then predicts innovation; moreover, LMX dimensions differ in relevance, with professional respect standing out as a key predictor through creativity.

Other innovation-oriented studies further clarify which relational exchanges are innovation-relevant. van Assen and Caniëls (2022) distinguish social LMX (trust-based, long-term oriented) from economic LMX (transactional, short-term oriented) and find that social LMX is associated with innovative work behavior, whereas economic LMX is not. This supports an innovation-management view that socio-relational exchange is more conducive to extra-role innovation behavior than transactional exchange. Ye, Liu, and Tan (2022) show that creative leadership and innovation climate predict innovation behavior and emphasize knowledge sharing as a critical component shaping innovation outcomes. Al-Husseini (2024) demonstrates that top management support amplifies employee creativity via knowledge acquisition/sharing and absorptive capacity—highlighting that leadership support must translate into learning and knowledge processes to yield creativity. Son et al. (2017) show that “close monitoring” reduces creativity and knowledge sharing via lowered LMX, suggesting that leadership behaviors that signal distrust can suppress innovation inputs by damaging relational exchange.

Despite these advances, empirical research explicitly connecting digital leadership to LMX and to innovation-relevant outcomes remains limited, particularly in Germany and across

multiple industries. This gap is problematic because digital leadership is often framed in terms of tools and competencies, while innovation outcomes depend heavily on the relational and learning mechanisms these leadership behaviors produce.

Digital Leadership

Digital leadership encompasses the competencies and relational behaviors required to lead effectively in digitally mediated environments. Munsamy et al. (2023) identify six core competencies including embracing digitalization, facilitating the digital drive, adaptability and resilience, cultivating digital culture, digital skills, and digital competitive intelligence. Emotional intelligence and trust-building capabilities further strengthen relational effectiveness (Goleman et al., 2013). Digital leadership therefore aligns conceptually with LMX theory, suggesting that digital leadership behaviors influence innovation outcomes indirectly by shaping relational exchange quality.

Table 1 Digital Leadership Competency Framework

Competencies	*Description*
Digital competitive intelligence	*Systemic thinking, external focus,risks in digital, market and business intelligence, networking, social dynamic understanding*
Digital skills	*Digital tools and system knowledge, digital process understanding, digital tech skills, digital focus offering, active listening, data analytic skills*
Cultivating a digital culture	*Creativity and innovation, communication, continuous improvement, potential in digital, relationship-based, generational theory, levels of management*
Embracing digital	*Continuous learning mindset, leading self, collaboration, digital adoption, technology driven, ownership and commitment requirement, positive attitude toward digital*
Leadership facilitating the digital drive	*Business acumen, care for employees, enable decision-making, value-creation or solutions-based approach, digital knowledge sharing, demonstrate integrity, complexity leadership, flexible work practice*
Digital adaptiveness and resilience	*Adaptability, change management ability, self-awareness, customer driving digital, compeon driving digital, covid impact*

3 Research Method

Research Question

To better understand the effects of digital leadership in today's work environments, this study investigates the following research question:

"*To what extent does digital leadership influence the quality of leadership relationships according to the Leadership Exchange Model (LXM) in German companies?".*

Hypotheses were formulated-explicitly reflecting the "competing mechanisms" approach from Mascareño et al. (2020). Because our dataset contains relational outcomes (LMX and its dimensions) and an innovation-relevant behavioral proxy (LMX contribution), we test whether digital leadership predicts innovation-relevant behavior directly or primarily through relational quality. Thus, the following hypotheses following a deductive approach using correlational analysis based on the outlined theoretical frameworks were derived:

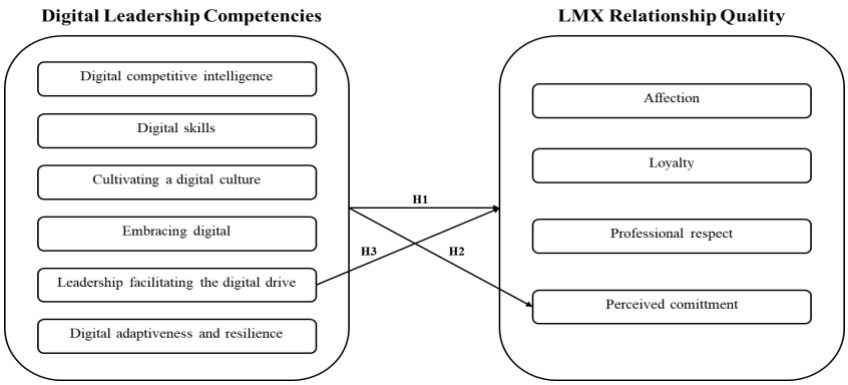
H1: *Employees who perceive their leaders as digital leader tend to report a higher quality in the leader-member relationship.*

H2: *A higher perceived level of digital competence in leaders is associated with stronger employee commitment.*

H3: *There is an association between how actively leaders are perceived to communicate digital changes and how satisfied employees are with their leadership.*

The following graph illustrates the conceptual research framework and the connection to the formulated hypotheses:

Figure 1 Conceptual Research Framework



Research Design and Data Collection

A deductive quantitative research design was employed. Data were collected through an online survey administered via LimeSurvey. Respondents were required to work in German companies and have reported to a digitally oriented leader for at least one year. The final sample consisted of 140 valid responses. Validated LMX items and theoretically

grounded digital leadership items were measured on six-point Likert scales. Data analysis was conducted in JASP using descriptive statistics and Spearman correlation analysis due to non-normal distributions.

4. Research Findings

The following section presents the analysis of the survey results. The evaluation is carried out in several steps: First, descriptive statistics are examined, this is followed by an analysis of the reliability of the applied scales. Then the distribution analysis is evaluated with a focus on key indicators such as skewness, kurtosis, and the Shapiro-Wilk test to assess normality. Finally, correlations between the main variables in the hypothesis are explored to identify potential relationships among the investigated factors.

Descriptive Statistics

The data sample includes responses from a heterogeneous population of participants, providing data about demographic characteristics, employment types, and industry representation. There were originally 205 participants. This was reduced due to the strict exclusion criteria. The overall sample size is comprised of responses from 140 participants, with a small majority of male respondents (n = 95, 67.86%) compared to female respondents (n = 44, 31.43%), and one respondent who did not disclose their gender (0.71%). In terms of the age range, most of the participants were in the age group 36–45 (n = 45, 32.14%), followed by the age range 26–35 (n = 41, 29.29%).

The 46–55 age group consisted of 19.29% of the sample (n = 27), while younger respondents in the 18–25 age group represented 11.43% (n = 16). Respondents aged 56–65 years were fewer (n = 8, 5.71%), and only 2.14% (n = 3) were older than 65 years. Regarding the education level, most participants had a master's degree (n = 44, 31.43%) or a bachelor's degree (n = 43, 30.71%). A large section had pursued Doctorate or Ph.D. studies (n = 32, 22.86%), whereas some reported vocational training (n = 13, 9.29%), high school education (n = 7, 5%), or other forms of education (n = 1, 0.71%). Employment types varied, with the majority having permanent full-time employment (n = 69, 49.29%), and a considerable number having permanent part-time employment (n = 41, 29.29%). Furthermore, 20 of the participants (14.29%) were on temporary full-time employment and 10 (7.14%) on temporary part-time employment. Employment functions revealed a distribution across hierarchical levels: 44 of the participants (31.43%) identified themselves as team leaders or supervisors, 40 (28.57%) as department or unit managers, and 23 (16.43%) as executive or senior management. Non-supervisory personnel accounted for 22.14% of the sample (n = 31), and only two respondents selected "Other." The sample was also diverse with respect to industry affiliation. The most prevalent industries represented included Manufacturing (n = 27, 19.29%), Construction (n = 23, 16.43%), and Finance, Insurance, and Real Estate (n = 22, 15.71%). The remaining industries included Wholesale Trade (n = 18, 12.86%), Transportation and Public Utilities (n = 13, 9.29%), Services (n = 9, 6.43%), Retail Trade (n = 8, 5.71%), Public Administration (n = 7, 5%), Mining (n = 6, 4.29%), and Agriculture (n = 5, 3.57%).

Table 1

VARIABLE		*n=%*
Gender	Male	95
	Female	44
	No information	01
Age	18-25	16
	26-35	41
	36-45	45
	46-55	27
	56-65	08
	Older than 65	03
Education	High School Diploma	07
	Bachelor	43
	Master	44
	Doctorate/PhD	32
	Vocational Training	13
	Other	01
Employment Type	Permanent & Full-Time	69
	Permanent & Part-Time	41
	Temporary & Full-Time	20
	Temporary & Part-Time	10
Employment Position	Employee without Supervisor Responsibility	31
	Team Leader or Supervisor	44
	Department or Unit Manager	40
	Executive/ Senior Management	23
	Other	02
Industry	Agriculture	05
	Mining	06
	Construction	23
	Manufacturing	27
	Transportation & Public utilities	13
	Wholesale Trade	18
	Retail Trade	08
	Finance, Insurance, Real Estate	22
	Services	09
	Public Administration	07
	Other	02

Reliability

To assess the internal consistency of the measurement instruments used in this study, reliability analyses were conducted for both the Digital Leader Questions and the LMX Questions scales.

For the Digital Leader (see Table 2) Cronbach's Alpha was calculated at α = 0.944 (standard error = 0.022, 95% CI: 0.878–0.968), indicating an excellent level of internal consistency. This suggests that the items on the scale are highly reliable and consistently measure the intended construct. An examination of item-level reliability further supports this conclusion: all "α if item dropped" values ranged between 0.939 and 0.943, confirming that no single item significantly weakens the scale. The item QDL[QDLC3] contributed most strongly to the overall reliability, with the highest item-total correlation of 0.763. Conversely, the lowest item-total correlations were observed for QDL[QDLDAR1] (0.620) and QDL[QDLCL2] (0.604), though these values remain within an acceptable range. One item, QDLFL1, displayed a relatively low lower confidence interval bound for its item-total correlation (0.284), which may suggest a potential concern. However, this does not appear to critically undermine the reliability of the overall scale.

Table 2

Frequentist Scale Reliability Statistics

			95% CI	
Coefficient	Estimate	Std. Error	Lower	Upper
Coefficient α	0.902	0.043	0.770	0.943

Frequentist Individual Item Reliability Statistics

	Coefficient α (if item dropped)			Item–rest correlation		
Item	Estimate	Lower 95% CI	Upper 95% CI	Estimate	Lower 95% CI	Upper 95% CI
QLMX[QLMXAFF1]	0.894	0.753	0.939	0.626	0.414	0.750
QLMX[QLMXAFF2]	0.894	0.751	0.939	0.635	0.452	0.753
QLMX[QLMXAFF3]	0.903	0.786	0.943	0.450	0.114	0.657
QLMX[QLMXL1]	0.894	0.742	0.939	0.634	0.488	0.732
QLMX[QLMXL2]	0.889	0.725	0.936	0.730	0.579	0.818
QLMX[QLMXL3]	0.893	0.749	0.938	0.644	0.452	0.761
QLMX[QLMXPC1]	0.896	0.767	0.939	0.600	0.260	0.756
QLMX[QLMXPC2]	0.896	0.781	0.938	0.582	0.171	0.773
QLMX[QLMXPC3]	0.896	0.768	0.939	0.598	0.250	0.764
QLMX[QLMXPR1]	0.891	0.742	0.937	0.691	0.506	0.809
QLMX[QLMXPR2]	0.894	0.746	0.939	0.638	0.480	0.749
QLMX[QLMXPR3]	0.892	0.753	0.937	0.682	0.468	0.798

The LMX (see Table 3) also demonstrated high internal consistency, with Cronbach's Alpha calculated to be α = 0.902 (standard error = 0.043, 95% CI: 0.770–0.943). Though slightly less than that for the DL scale, this score still reflects a very high degree of reliability. The "α if item dropped" values ranged from 0.889 to 0.903, indicating the scale remains stable even when individual items are removed. Some of the item-level results do suggest some room for improvement in some areas. Specifically, the QLMXAFF3 item had the lowest item-total correlation (0.450) and a very low lower bound of its confidence interval (0.114), suggesting that this item does not concur with the remaining portion of the scale and could potentially be a problem. Other items, such as QLMXPC2 (item-total correlation = 0.582, CI: 0.171–0.773) and QLMXPC1 (0.600, CI: 0.260–0.756), also had weaker associations. For Comparison, however, QLMXPR1 emerged as the strongest item, with the strongest item-total correlation (0.691), indicating a closer fit with the total construct.

Table 3

Frequentist Scale Reliability Statistics

			95% CI	
Coefficient	Estimate	Std. Error	Lower	Upper
Coefficient α	0.944	0.022	0.878	0.968

Frequentist Individual Item Reliability Statistics

	Coefficient α (if item dropped)			Item–rest correlation		
Item	Estimate	Lower 95% CI	Upper 95% CI	Estimate	Lower 95% CI	Upper 95% CI
QDL[QDLC1]	0.940	0.870	0.966	0.718	0.538	0.824
QDL[QDLC2]	0.941	0.874	0.967	0.656	0.466	0.771
QDL[QDLC3]	0.939	0.867	0.966	0.763	0.596	0.853
QDL[QDLDAR1]	0.942	0.875	0.967	0.620	0.359	0.790
QDL[QDLDAR2]	0.941	0.872	0.967	0.668	0.435	0.813
QDL[QDLDAR3]	0.941	0.873	0.967	0.668	0.476	0.790
QDL[QDLDCL1]	0.942	0.878	0.967	0.611	0.427	0.735
QDL[QDLDCL2]	0.942	0.876	0.967	0.604	0.411	0.735
QDL[QDLDCL3]	0.941	0.875	0.967	0.672	0.494	0.778
QDL[QDLDS1]	0.940	0.872	0.966	0.700	0.523	0.811
QDL[QDLDS2]	0.940	0.869	0.966	0.734	0.591	0.831
QDL[QDLDS3]	0.941	0.871	0.967	0.686	0.513	0.792
QDL[QDLED1]	0.940	0.871	0.967	0.692	0.538	0.794
QDL[QDLED2]	0.940	0.870	0.966	0.700	0.528	0.805
QDL[QDLED3]	0.940	0.869	0.966	0.734	0.565	0.818
QDL[QDLF1]	0.943	0.881	0.967	0.580	0.284	0.740
QDL[QDLF2]	0.940	0.873	0.966	0.737	0.512	0.839
QDL[QDLF3]	0.942	0.876	0.967	0.616	0.347	0.763

Distribution Analysis

The sample consisted of 140 valid cases, providing a solid foundation for correlation analyses. The central tendency indicators show that perceptions of both digital leadership and leader-member relationships were overall very positive.

The mean score for the Digital Leadership (DL) scale is M = 5.117, and the mean for the LMX (Leader-Member Exchange) scale is M = 5.096. Because both numbers are near the top of the six-point Likert scale, this implies an extremely positive leadership rating provided by the respondents. Distribution skewness reflects a strongly negative skewness, in both the case of DL (Skewness = -2.694) and in the case of LMX (Skewness = -3.148). This suggests that most of the scores were at a positive position on the scale, reflecting a positively skewed perception. Moreover, the coefficients of kurtosis are highly positive (DL = 12.055; LMX = 14.249), indicating a highly peaked, highly concentrated distribution with little variability.

Single low scores (minimum DL = 1.5, minimum LMX = 1.8) are also potential exceptions, strongly differing from the mean score and possibly reflecting single cases with more negative experiences. They have, however, a minor impact due to their low frequency.

To statistically test the distribution, a Shapiro-Wilk test was conducted. The test produced a significant p-value ($p < .001$) on both scales, leading to the null hypothesis of normality being rejected. This suggests the underlying variables are not normally distributed and is most likely due to the very high number of extreme (read very high) scores (see Table 4).

Table 4

Distribution Analysis

	Mean LMX	*Mean DL*
Valid	140	140
Missing	0	0
Mean	5.096	5.117
Std. Deviation	0.653	0.645
Skewness	-3.148	-2.694
Std. Error of Skewness	0.205	0.205
Kurtosis	14.249	12.055
Std Error of Kurtosis	0.407	0.407
Shapiro-Wilk	0.711	0.778
P-value of Shapiro-Wilk	<.001	<.001
Minimum	1.500	1.500
Maximum	6.000	6.000

In addition to the scale mean analysis, individual item analysis of the standard deviations and means was also conducted (see Appendix 1). The purpose was to identify potential anomalies at the item level which may not be apparent when using composite scale scores. This facilitates a more detailed assessment of which particular aspects of digital leadership or the leadership relationship were rated highly or weaker. Item-level analysis reveals

positive overall ratings, with mean scores ranging from 4.5 to 5.6. The lowest rated item is QLMXAFF1 (M = 4.571), reflecting a less strong affective bond with the leader. QLDLCL1 (M = 4.700) also stands out due to its comparatively low mean, indicating potential for improvement in digital communication. On the other hand, QDLF2 (M = 5.614), QDLF3 (M = 5.543), and QLMXPC2 (M = 5.586) are highly rated, reflecting high digital leadership ability and professional regard. Highest variation in response was seen for QLMXL2 (SD = 1.044), and the most consistent and positively rated responses were for QDLDAR1 (SD = 0.748).

Correlation

The following section presents a thorough analysis of the correlations relevant to the three hypotheses, based on Spearman's rank correlation coefficients (see Appendix 2).

The first correlation analyses H1: "*Employees who perceive their leaders as digital leader tend to report a higher quality in the leader-member relationship.* "The analysis revealed a moderate to strong positive correlation between the mean digital leadership score and the mean LMX score (*Spearman's rho* = 0.550, $p < 0.001$) - meaning the result is highly significant. H1 is clearly supported by the data.

Correlation two depicts H2: "*A higher perceived level of digital competence in leaders is associated with stronger employee commitment."* The analysis reports a very weak positive correlation between mean LMX and the mean score on facilitating digital developments (*Spearman's rho* = 0.101, $p = 0.234$), which is not statistically significant. This finding still supports H2.

The last correlation H3: "*There is an association between how actively leaders are perceived to communicate digital changes and how satisfied employees are with their leadership.*" The examination revealed a very weak positive association between the mean LMX and the average score for facilitating digital developments (Spearman's rho = 0.101, p = 0.234), which does not reach statistical significance. H3 is not supported by the data.

5. Discussion

In the following chapter, the main results of the study are examined in detail. Each hypothesis is considered in light of the data, and the findings are discussed in the context of existing research. In addition, the chapter explores what these results mean for theory and practice, reflects on the study's limitations, and offers suggestions for future research.

Hypotheses

The results provide clear support for H1 which suggested that employees who see their leader as digitally capable have a closer or better quality of LMX. The positive correlation between perceived digital leadership and LMX was statistically significant and moderately strong (Spearman's rho = 0.550, $p < 0.001$) and this finding demonstrates the relevance of digital leadership as a relational leadership construct that contributes to a greater sense of connections and trust between leaders and followers.

H2 suggested that perceptions of digital leadership would be positively related to

employees' willingness to engage in behaviours beyond their prescribed roles or obligations, a consideration we define as "perceived commitment". There was limited support for this hypothesis. The correlation was positive but very weak (rho 0.101) and not statistically significant (p 0.234). While this indicates that digital leadership is potentially involved in some way with improving perceived commitment, it is likely to interact with other contextual or personal variables to create significant outcomes.

Finally, H3 suggested that the active communication of digital development from leaders to their employees would be associated with greater overall satisfaction. This was not supported. The correlation between "Facilitating Digital Developments" and LMX was weak and approached statistical significance (rho = 0.101, p 0.234) suggesting that merely communicating from leaders about their digital development does not necessarily enhance relational satisfaction or workplace engagement.

Interpretation of the Findings in Relation to Existing Literature

These findings are aligned with prior research emphasizing the relational quality of digital leadership. Antoni, Hellert, and Latniak (2024) note that digital leadership exceeds technological ability and is about establishing quality leader-member relationships that enable greater trust and collaboration. Erhan, Uzunbacak, and Aydin (2022) also illustrate that digitally competent leaders positively influence employee engagement through the intersection of social and technical competencies. The qualified support for H2 is consistent with insights from Fernandes (2022), who highlights that employee commitment is a function of many intrinsic and extrinsic factors, such that digital leadership alone cannot explain discretionary effort. Digital leadership may generate favorable conditions for commitment, but other organizational and psychological factors have fundamental roles to play. For H3, the results are against expectations in strategic communication studies in digital contexts, such as in the study of Gierlich-Joas, Hess, and Neuburger (2020), who assert that transparent communication alone is insufficient. This suggests that communicational openness regarding digital initiatives needs to be supplemented with participatory leadership and real staff involvement to have an influencing effect on satisfaction.

Theoretical Implications

This study contributes to the burgeoning theoretical digital leadership literature by empirically validating its impact on relationship quality (LMX). This validates that digital leadership is not just a technical skill and involves socio-relational elements impacting leader-follower relations. These findings support the consideration of digital leadership within overarching transformational and relational theories, and highlight conceptualizing it as a multi-dimensional construct.

Relational explanation for innovation outcomes. The strong DL–LMX association supports an innovation-management argument: digital leadership should be treated as an input that shapes the relational exchange conditions under which employees are willing to engage in uncertain, discretionary innovation activities. Mascareño et al. (2020) show that LMX often affects innovation through creativity rather than via direct effects on implementation. Our results are consistent with this logic: digital leadership strongly relates to LMX (a prerequisite relational resource) and also relates to contribution (extra-

role effort), which is a behavioral condition required for innovative work behavior and later-stage idea championing.

Competing hypotheses logic and interpretation. Mascareño et al. (2020) caution that leadership–innovation links may appear inconsistent when creativity and innovation are not separated and when dimensionality is ignored. Applying this perspective, we interpret our pattern as stronger support for an indirect/relational mechanism than for a simple "communication-only" mechanism. Specifically, while overall digital leadership aligns with higher relational exchange, communication about digital developments alone does not. This suggests that relationship-building behaviors (support, competence signals, adaptability, respect) are more consequential than broadcasting information—echoing Son et al.'s (2017) finding that leadership behaviors shape innovation inputs (creativity, knowledge sharing) through relational exchange quality.

Positioning within innovation management outcomes. van Assen and Caniëls (2022) show that social LMX is associated with innovative work behavior, implying that exchange quality—especially its social dimension—supports innovation behavior. Ye et al. (2022) further show that creative leadership and innovation climate affect innovation behavior and highlight knowledge sharing as a key ingredient in that system. Al-Husseini (2024) identifies knowledge acquisition/sharing and absorptive capacity as mediators linking management support to employee creativity. Together, these studies support an integrated innovation pathway that our results help enable in digital contexts: digital leadership → LMX quality (trust/professional respect/contribution) → knowledge sharing & absorptive capacity → creativity → innovative work behavior. While we did not measure creativity, knowledge sharing, or absorptive capacity directly, our findings establish the relational entry point (LMX) that this high-quality innovation literature identifies as a central enabling mechanism.

Practical Implications for Companies and Leadership

Organizations must prioritize developing digital leadership skills - not only to manage technology change but also to enhance people dynamics between teams. Leadership development programs must complement digital tool competence with competency development in emotional intelligence, trust-building, and collaborative leadership. Furthermore, the research indicates that communicating simple digital strategy is not sufficient to increase the quality of leader-member relationships. Leaders must go beyond dissemination and involve employees directly in digital transformation initiatives to achieve meaningful engagement and satisfaction.

Limitations of the Study

There are several limitations that need to be noted. First, the study is cross-sectional; therefore, making causal inference is not possible. The relationships that were observed are associations, not cause-effect relationships. Second, the data is based on self-reported perceptions and are subject to social desirability bias, particularly with the highly skewed responses and peaked distributions (high kurtosis) for the responses for both the DL and LMX scales. Third, while the internal consistency for both scales was high (Cronbach's $\alpha > .90$), some items, especially the LMX scale, had lower item-total correlations, suggesting the scale requires refinement.

Suggestions for Future Research

Additional longitudinal and experimental work is necessary to explore the causal mechanisms of digital leadership-related relational and behavioral outcomes. Identifying further mediators and moderators of these mechanisms (e.g., psychological safety, team digital readiness, organizational culture) would be useful. A larger sample involving multiple sectors, levels of authority, and cross-cultural contexts would increase generalizability and identify boundary conditions for the effectiveness of digital leadership.

Finally, further examination of how specific digital behaviors (e.g., digital coaching, real-time communications, data-driven decision-making) are related to various employee outcomes could provide more precise models and enhance understanding of more precise leadership practices.

6. Conclusion

This study investigates the connection between digital leadership behavior and job satisfaction, based on the LMX theory, which concentrates on the quality of the relationship between the leader and employee. The results provide key implications for organizations dealing with digital transformations now. The implications also highlight that digital leadership is more about socio-emotional skills, such as developing a bond with employees through empathy, building rapport and trust, and communicating through technology, than it is about digital competence which is imperative to the quality of leader-member relationships and trust. Furthermore, the study cautioned organizations to not rely on top-down digital communication; merely informing employees undoubtedly about their hands is not the answer for improving satisfaction, instead it is about how to get employees meaningfully involved along with participative leadership for a deeper satisfaction engagement. Because participative methods for capacity building are multifaceted and complex, leadership development should encompass interpersonal aspects of emotional and relational capacities along with digital capabilities so that leaders can apply a best whole method for optimizing effectiveness in digital contexts.

The study advances the ongoing development of leadership theory by empirically demonstrating the relational aspect of digital leadership considering the implications of LMX theory. It alters the view of digital leadership as a purely technical or strategic role and expands it as an influence on multi-dimensional factors including organizational culture, and interpersonal relationship dynamics. In addition, it also lays a foundation for future research exploring the role moderating factors such as team digital maturity or culture, or psychological safety might play. Positioned along academic authenticity through its methodological strength, including high internal consistency and the use of validated scales, this study adds value to the empirical literature on leadership in digitally mediated workplaces.

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Appendix 1

Descriptive Statistics

	Mean	Std. Deviation	Minimum	Maximum
QLMX[QLMXAFF1]	4.571	0.953	1.000	6.000
QLMX[QLMXAFF2]	4.907	0.813	2.000	6.000
QLMX[QLMXAFF3]	4.914	1.000	1.000	6.000
QLMX[QLMXL1]	4.979	0.948	2.000	6.000
QLMX[QLMXL2]	4.943	1.044	1.000	6.000
QLMX[QLMXL3]	5.043	0.974	1.000	6.000
QLMX[QLMXPR1]	5.029	0.921	1.000	6.000
QLMX[QLMXPR2]	5.057	0.980	1.000	6.000
QLMX[QLMXPR3]	5.107	0.911	1.000	6.000
QLMX[QLMXPC1]	5.443	0.984	1.000	6.000
QLMX[QLMXPC2]	5.586	0.865	1.000	6.000
QLMX[QLMXPC3]	5.571	0.866	2.000	6.000
QDL[QDLDCL1]	4.700	0.927	1.000	6.000
QDL[QDLDCL2]	4.929	0.845	2.000	6.000
QDL[QDLDCL3]	4.957	0.988	1.000	6.000
QDL[QDLDS1]	5.021	0.909	1.000	6.000
QDL[QDLDS2]	4.950	0.916	1.000	6.000
QDL[QDLDS3]	5.014	0.906	1.000	6.000
QDL[QDLC1]	4.950	0.955	1.000	6.000
QDL[QDLC2]	5.157	0.900	2.000	6.000
QDL[QDLC3]	5.086	1.000	1.000	6.000
QDL[QDLED1]	5.093	0.864	2.000	6.000
QDL[QDLED2]	5.064	0.923	1.000	6.000
QDL[QDLED3]	5.221	0.866	2.000	6.000
QDL[QDLF1]	5.514	0.963	1.000	6.000
QDL[QDLF2]	5.614	0.819	2.000	6.000
QDL[QDLF3]	5.543	0.893	1.000	6.000
QDL[QDLDAR1]	5.243	0.748	2.000	6.000
QDL[QDLDAR2]	5.036	0.860	1.000	6.000
QDL[QDLDAR3]	5.021	0.917	1.000	6.000

Appendix 2

Correlation

Spearman's Correlations

Variable		Mean LMX	Mean DL
1. Mean LMX	Spearman's rho	—	
	p-value	—	
2. Mean DL	Spearman's rho	0.550	—
	p-value	< .001	—

Correlation

Spearman's Correlations

Variable		Mean DL	Mean PC
1. Mean DL	Spearman's rho	—	
	p-value	—	
2. Mean PC	Spearman's rho	0.269	—
	p-value	0.001	—

Correlation

Spearman's Correlations

Variable		Mean LMX	Mean F
1. Mean LMX	Spearman's rho	—	
	p-value	—	
2. Mean F	Spearman's rho	0.101	—
	p-value	0.234	—

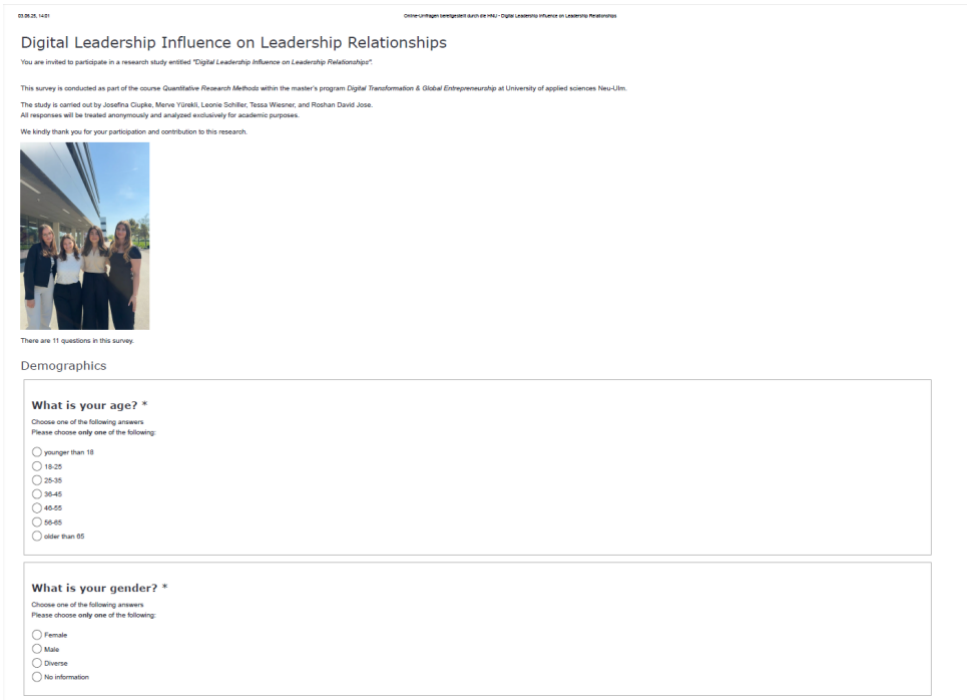
Codebook

Part of Survey	*Code*	*Question Represented*
Demographics	QDA	Age
	QDG	Gender
	QDE	Highest level of education
	QDES	Employment status
	QDEL	Current position
	QDS	Sector
Exclusion Criteria	QE1	Led by a digital leader
	QE2	Led by more than 1 year
	QE3	German Company
LXM	QLMXAFF1	My supervisor is a person I would like to have as a friend.
	QLMXAFF2	I really like my supervisor as a person.
	QLMXAFF3	It is a lot of fun working with my supervisor.
	QLMXL1	My supervisor would defend me against others in the company if I had made a real mistake.
	QLMXL2	My supervisor defends my actions to a superior, even if he/she does not have full knowledge of the matter.
	QLMXL3	My supervisor would defend me if I were attacked by others.
	QLMXPR1	I value my supervisor's professional skills.

	QLMXPR2	I respect my supervisor's knowledge and competence regarding his/her job.
	QLMXPR3	I am impressed by the knowledge my supervisor has about his/her work.
	QLMXPC1	I do more for my supervisor than what is required by my job description.
	QLMXPC2	In order to achieve my supervisor's goals at work, I am willing to make more effort than usual.
	QLMXPC3	I don't mind working very hard for my supervisor's sake.
Digital Leadership	QDLDCL1	My supervisor understands how digital trends impact our business.
	QDLDCL2	My supervisor bases decisions on current market and competitor analysis.
	QDLDCL3	My supervisor identifies risks and opportunities in digital transformation early.
	QDLDS1	My supervisor is proficient in the digital tools used in our daily work.
	QDLDS2	My supervisor understands and can explain digital processes.
	QDLDS3	My supervisor promotes data-driven decision-making.
	QDLC1	My supervisor actively promotes a culture of digital collaboration.
	QDLC2	My supervisor is open to ideas for digital innovation.
	QDLC3	My supervisor considers the needs of different generations in the digital work environment.
	QDLED1	My supervisor has a positive attitude toward digital change.
	QDLED2	My supervisor motivates the team to pursue continuous digital learning.
	QDLED3	My supervisor takes ownership of driving digital progress in the team.
	QDLF1	My supervisor regularly shares knowledge about digital developments with the team.

	ODLF2	My supervisor supports employees in finding digital solutions.
	ODLF3	My supervisor makes confident decisions even in complex digital situations.
	ODLDAR1	My supervisor stays calm and solution-oriented during digital challenges.
	ODLDAR2	My supervisor adapts flexibly to new digital conditions.
	QDLDAR3	My supervisor creates an environment in which employees feel secure during digital changes.
Measurement (Likert scale)	1	strongly disagree
	2	moderately disagree
	3	mildy disagree
	4	mildy agree
	5	moderately agree
	6	strongly agree

Appendix 3



03.06.25, 14:01 Online-Umfragen bereitgestellt durch die HNU - Digital Leadership Influence on Leadership Relationships

Digital Leadership Influence on Leadership Relationships

You are invited to participate in a research study entitled *"Digital Leadership Influence on Leadership Relationships"*.

This survey is conducted as part of the course *Quantitative Research Methods* within the master's program *Digital Transformation & Global Entrepreneurship* at University of applied sciences Neu-Ulm.

The study is carried out by Josefina Ciupke, Merve Yürekli, Leonie Schiller, Tessa Wiesner, and Roshan David Jose.
All responses will be treated anonymously and analyzed exclusively for academic purposes.

We kindly thank you for your participation and contribution to this research.

There are 11 questions in this survey.

Demographics

What is your age? *

Choose one of the following answers
Please choose **only one** of the following:

- younger than 18
- 18-25
- 25-35
- 36-45
- 46-55
- 56-65
- older than 65

What is your gender? *

Choose one of the following answers
Please choose **only one** of the following:

- Female
- Male
- Diverse
- No information

What is your highest level of education completed? *

Choose one of the following answers
Please choose **only one** of the following:

- ◯ High School Diploma / A-Level
- ◯ Bachelor
- ◯ Master
- ◯ Doctorate / Ph.D.
- ◯ Vocational Training
- ◯ Other

What is your current employment status? *

Choose one of the following answers
Please choose **only one** of the following:

- ◯ Permanent & full-time employment
- ◯ Permanent & part-time employment
- ◯ Temporary & full-time employment
- ◯ Temporary & part-time employment

Which of the following best describes your role in the organization? *

Choose one of the following answers
Please choose **only one** of the following:

- ◯ Employee without supervisor responsibility
- ◯ Teamleader or supervisor
- ◯ Department or unit manager
- ◯ Executive or senior management
- ◯ Other

What sector does your organization belong to? *

Choose one of the following answers
Please choose **only one** of the following:

- ◯ Agriculture
- ◯ Mining
- ◯ Construction
- ◯ Manufacturing
- ◯ Transportation & Public Utilities
- ◯ Wholesale Trade
- ◯ Retail Trade
- ◯ Finance, Insurance, Real Estate
- ◯ Services
- ◯ Public Administration
- ◯ Other

Additional Information

Does your leader have responsibility and leadership for digital innovations, transformations or projects? *

Choose one of the following answers
Please choose **only one** of the following:

- ◯ Yes
- ◯ No

Has this leader been managing you for at least one year? *

Choose one of the following answers
Please choose **only one** of the following:

- ◯ Yes
- ◯ No

Do you work for a german owned company? *

Choose one of the following answers
Please choose **only one** of the following:

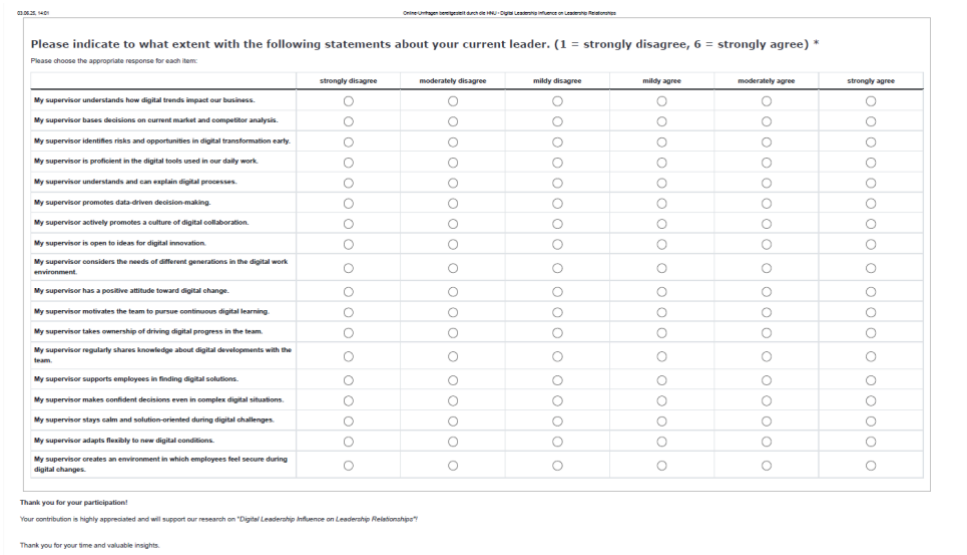
- ◯ Yes
- ◯ No

Leadership Relationship Quality

Please indicate to what extent you agree with the following statements about your current leader. (1 = strongly disagree, 6 = strongly agree) *

Please choose the appropriate response for each item:

	strongly disagree	moderately disagree	mildly disagree	mildly agree	moderately agree	strongly agree
My supervisor is a person I would like to have as a friend.	◯	◯	◯	◯	◯	◯
I really like my supervisor as a person.	◯	◯	◯	◯	◯	◯
It is a lot of fun working with my supervisor.	◯	◯	◯	◯	◯	◯
My supervisor would defend me against others in the company if I had made a real mistake.	◯	◯	◯	◯	◯	◯
My supervisor defends my actions to a superior, even if he/she does not have full knowledge of the matter.	◯	◯	◯	◯	◯	◯
My supervisor would defend me if I were attacked by others.	◯	◯	◯	◯	◯	◯
I value my supervisor's professional skills.	◯	◯	◯	◯	◯	◯
I respect my supervisor's knowledge and competence regarding his/her job.	◯	◯	◯	◯	◯	◯
I am impressed by the knowledge my supervisor has about his/her work.	◯	◯	◯	◯	◯	◯
I do more for my supervisor than what is required by my job description.	◯	◯	◯	◯	◯	◯
In order to achieve my supervisor's goals at work, I am willing to make more effort than usual.	◯	◯	◯	◯	◯	◯
I don't mind working very hard for my supervisor's sake	◯	◯	◯	◯	◯	◯



03.06.25, 14:01 Online-Umfrage bereitgestellt durch die HHU - Digital Leadership Influence on Leadership Relationships

Please indicate to what extent with the following statements about your current leader. (1 = strongly disagree, 6 = strongly agree) *

Please choose the appropriate response for each item:

	strongly disagree	moderately disagree	mildly disagree	mildly agree	moderately agree	strongly agree
My supervisor understands how digital trends impact our business.	○	○	○	○	○	○
My supervisor bases decisions on current market and competitor analysis.	○	○	○	○	○	○
My supervisor identifies risks and opportunities in digital transformation early.	○	○	○	○	○	○
My supervisor is proficient in the digital tools used in our daily work.	○	○	○	○	○	○
My supervisor understands and can explain digital processes.	○	○	○	○	○	○
My supervisor promotes data-driven decision-making.	○	○	○	○	○	○
My supervisor actively promotes a culture of digital collaboration.	○	○	○	○	○	○
My supervisor is open to ideas for digital innovation.	○	○	○	○	○	○
My supervisor considers the needs of different generations in the digital work environment.	○	○	○	○	○	○
My supervisor has a positive attitude toward digital change.	○	○	○	○	○	○
My supervisor motivates the team to pursue continuous digital learning.	○	○	○	○	○	○
My supervisor takes ownership of driving digital progress in the team.	○	○	○	○	○	○
My supervisor regularly shares knowledge about digital developments with the team.	○	○	○	○	○	○
My supervisor supports employees in finding digital solutions.	○	○	○	○	○	○
My supervisor makes confident decisions even in complex digital situations.	○	○	○	○	○	○
My supervisor stays calm and solution-oriented during digital challenges.	○	○	○	○	○	○
My supervisor adapts flexibly to new digital conditions.	○	○	○	○	○	○
My supervisor creates an environment in which employees feel secure during digital changes.	○	○	○	○	○	○

Thank you for your participation!

Your contribution is highly appreciated and will support our research on "*Digital Leadership Influence on Leadership Relationships*"!

Thank you for your time and valuable insights.

Appendix 4

Exclusion Criteria

	Relevant Question(s)	*Exclusion Answer*
Age	QDA	younger than 18
Led by a digital leader	QE1	No
Led by more than a year	QE2	No
German Company	QE3	No