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Managerial Readiness for Machine Learning Adoption: The Role of Digital Leadership and Organizational Culture in Bangladesh

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ABSTRACT

The capacity of managers to interpret technological opportunity, mobilise organisational resources and manage employees in digitally intensive change processes is becoming more of an issue for machine learning adoption. This study investigates the mechanism of digital leadership on the readiness of managers to use machine learning, in which the mediating and moderating effects of organizational culture are addressed. The research design adopted was quantitative and cross-sectional survey and the final sample for analysis was 360 managers, supervisors, executives, departmental heads and organizational decision makers. The measurement model, direct structural relationships, mediation and moderation, and explanatory power were assessed using structural equation modelling. The overall fit of the measurement model was good, reliability was acceptable, and discriminant validity was satisfactory although the average variance extracted for managerial readiness was average and slightly below the conventional threshold. Results of the structural model indicated that digital leadership had significant positive direct effect on the managerial readiness and that organizational culture had significant positive direct effect on the managerial readiness. The indirect effect of organizational culture was proved to be significant indicating mediation. Digital leadership and organizational culture also had a positive and significant interaction, which indicated that positive interaction of supportive culture reinforced the effect of digital leadership on readiness. The model accounted for 46.77% of the variance in managerial readiness. The results suggest that managerial readiness is an organizational capability that needs to be supported through leadership and is embedded in the organizational culture in order for successful machine learning adoption in contemporary organizations.

INTRODUCTION

Machine learning has evolved from being a special analysis tool to a strategic organizational capability. Machine learning is being increasingly adopted by companies for forecasting, automation, customer analysis, fraud detection, operational optimization, risk assessment and managerial decision making. However, machine learning is not considered a panacea for its implementation. Organizations also need to be able to produce managers with the ability to comprehend the significance of the technology, to determine appropriate application in the business realm, to communicate the value of the technology to others, to have the power to allocate resources, to manage resistance, and to coordinate implementation with technological specialists (Tursunbayeva & Chalutz-Ben Gal, 2024). Thus, readiness of management is an important link between technological potential and the organizationally deployed technologies.

It's a challenge that is all the more significant in light of the fact that machine learning is doing more than empowering information frameworks. Impacts decision-making, job design, accountability, skills needed, data practices, and patterns of collaboration. Those that manage it are expected to use its algorithmic output, rather than handing over professional judgement (Kalleparambil & Akoum, 2025). They need to be able to suggest experimentation and stay on top of any ethical, privacy, and operational risks. They also have to gain confidence of the employees in the presence of automation when it alters the way things were done. Simple awareness of machine learning is not a sufficient representation of readiness due to these demands. It's a multi-dimensional managerial capacity, that contains knowledge, willingness, confidence, commitment, communication and capability to implement.

Digital leadership is a viable organizational precursor of readiness. Leaders create the strategic significance of new technologies. They prioritise, allocate resources, sponsor learning, link technological initiatives with business goals and help set the expectations around 'Evidence-based decision making'. Senior leaders' communication of a coherent digital direction and support for innovation provide clearer signals for managers regarding the organization's support for machine learning as a strategically valid practice. Digital leadership could then, directly help readiness by boosting the confidence and commitment of managers (Yuliana *et al.*, 2025).

Leadership influence is not likely to work only through the direct managerial instruction, however. Without the

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culture, the strategic intentions don't turn to common patterns of behaviour. Leadership messages can be turned into the everyday practice of the organisation through a culture of experimentation, learning, cross functional collaboration, data-led decisions, trust and responsible use of technology. This type of culture can also mitigate perceived personal and operational risks when it comes to adopting machine learning. Therefore, organizational culture can serve as a vehicle for the development of digital leadership for managerial readiness (Akhigbe *et al.*, 2024).

Culture can also influence the relationship between leadership readiness and leadership. In different organisations the very same leadership behaviour can have different outcomes. Efforts by senior leaders to communicate digitally could be perceived as more credible and worthwhile if they already enjoy collaboration, learning, trust, and constructive support in response to technological change. Even the best digital leaders can find themselves facing a culture that provides little support, ingrained habits, pockets of knowledge, or disbelief (Yunita & Isnaini, 2024). Considering culture as a mediator and moderator then, will provide a fuller account of how the process of leadership becomes readiness.

A sample of 360 managerial respondents was used for this study to investigate these relationships by using the structural equation modelling. It tests the direct relationships between digital leadership, organizational culture and managerial readiness, as well as the indirect relationship of digital leadership via culture, investigates interaction relationships between digital leadership and organizational culture, and estimates the model's explanatory power, paving the way for organizational support. The study achieves originality of integrating leadership, cultural and readiness perspectives within a single empirical model. It's also an applied context for organizations looking to optimize the human and managerial factors for adopting machine learning. The study concentrates on the organizational level at which strategic intentions are translated into budgets, processes, communication to employees, and implementation decisions, specifically that of managers. This emphasis is crucial, as even with technical infrastructure, the adoption can be stalled due to managerial apprehensions. On the other hand, the managerial readiness can speed up experimenting, coordinate learning, and make sure to introduce machine learning with the proper governance and operating disciplines.

LITERATURE REVIEW

Hypothesis Development

Managerial Readiness for Machine Learning Adoption

Managerial readiness for machine learning adoption is the extent to which managers have the understanding, willingness, confidence, commitment and the practical capability to support and manage the introduction of machine learning technologies. Being ready is much more than technology literacy (Kalleparambil & Akoum, 2025). A manager might have a general idea of machine learning but have no desire to alter processes, be unsure about how much resources the implementation will need, or be unable to explain to workers the objectives of the installation. Readiness is a mixture of cognitive, attitudinal, behavioural and governance skills (Tursunbayeva & Chalutz-Ben Gal, 2024). The cognitive dimension includes applications, benefits, limitations and risks while the attitudinal dimension is the readiness to support the adoption and change of work practices. Behavioural readiness involves learning, resource allocation, collaboration with specialists and resistance management, and governance readiness involves ethical, privacy and accountability awareness (Yuliana *et al.*, 2025). These dimensions are important as machine learning extends beyond the boundaries of functions and needs continuous managerial coordination.

Digital Leadership

Digital leadership may be perceived as leadership action to give direction, resources, learning support and organisational coordination for digital transformation. It manifests itself in a clear digital vision, knowledge about new technologies, permissive attitudes to experimentation, provision for resources, training related to technology, data-informed decision making, positive communication and interfunctional communication. Digital leadership is not just about approving technology spending; it is about creating a tangible link between technological potential and organizational focus and employee actions (Cyfert *et al.*, 2025).

The implementation of machine learning raises questions regarding job roles, abilities, expectations and decision-making. Digital leaders reduce ambiguity by explaining why technological change matters, connecting it with organizational objectives, providing resources and development, and modelling data-informed strategic decisions (Areche & Ofluoglu, 2025). The behaviours indicate that digital competence is an expectation within the organization and set the stage for managers to be more inclined and able to support machine learning initiatives.

Digital Leadership and Managerial Readiness

The link between digital leadership and managerial readiness is hypothesized as positive because leadership can positively affect the perceived feasibility of technological adoption, as well as the perceived legitimacy of technological adoption (M. Farrel & Maiza Fikri, 2025). With a clear direction from senior leaders, commitment, support and resources and the ability to discuss concerns constructively, Managers are more likely to be prepared for machine learning. These actions minimize uncertainty and enhance the worth of learning new capabilities (Pelakoski, 2024).

Digital leadership can lead to greater readiness via role

modelling. However, managers can get a clear message that they are digitally competent when their organizational leaders practice what they preach by using data for their own strategic planning; and by demonstrating a personal commitment towards ongoing technological innovation (Burhan & Fatima, 2025). Participation in training; closer collaboration with specialists; willingness to redesign existing processes can be encouraged through leadership support. Thus, H1 posits that digital leadership exerts a strong positive influence over readiness for ML adoption (Yang *et al.*, 2024).

Digital Leadership and Organizational Culture

Organisational culture is composed of common knowledge, values and expectations that arise from the organisation's shared experiences and influence the reactions to change. A technology-supportive culture: emphasizes learning, experimenting, sharing knowledge, collaboration, trust, decisions based on evidence and the safe use of data (Bala, 2024). It's not all natural cultural qualities. They are influenced by leaders through repeated reinforcement of behaviours, prioritised investments, communication of acceptable risk and modelling of appropriate enactment of organizational values (Obeidat, 2026).

Digital leaders can help make experimentation the norm by encouraging experimentation with new ideas and concepts using technology and responding positively to failed experiments. They can enhance knowledge sharing by fostering collaboration between managerial, technical and operational teams (Iannello, 2025). Additionally, they are able to support the moral application of technology by defining guidelines for data ownership and responsible innovation. These behaviours can make the digital priorities become common culture. Based on the above, H2 can be stated that there is a significant influence between digital leadership and organizational culture (MICHAEL & EGBIVWE, 2025).

Organizational Culture and Managerial Readiness

Managers can make the psychological and operational adoption of machine learning easier with a supportive organizational culture. When experimentation is embraced, inter-departmental knowledge-sharing occurs and ongoing learning is seen as an organizational priority, managers are more likely to be using technologies with which they are not familiar (Welch, 2025). The culture of trust can minimize the fear of a technology being implemented for monitoring, reduction, or negative performance evaluation. Collaborating can also provide managers with improved access to technical expertise and data-related knowledge (Panta & Thapaliya, 2025).

Culture additionally shapes the perception that managers have about their right to tweak existing processes. Machine learning often necessitates adjusted workflows, new types of coordination and other decision-making processes. Managers with fewer informal obstacles to change are seen in a culture where adaptations and evidence-based management are encouraged and rewarded (Abonamah & Abdelhamid, 2024). There is also the potential for developing responsible technology norms to build confidence, by giving them a better framework for addressing privacy and ethical issues. Based on this, H3 proposes that the organizational culture is very positively related to the readiness of the managers in adopting machine learning (Tolani *et al.*, 2024).

Digital leadership can foster managerial readiness, perhaps because it helps to establish a culture in which digital behaviors have become accepted and encouraged. Leadership sets the direction; culture dictates if direction is in the day-to-day (Kazwaini *et al.*, 2025). These behaviours can become shared expectations when leaders engage in them, make investing in learning a reality, make data-informed decisions, and accept or embrace cross-functional collaboration. Managers can then feel confident, competent, and motivated to support machine learning (Cui, 2025).

This implies an indirect connection from digital leadership to readiness, namely via organizational culture. The mediation perspective elaborates on how the impact of leadership gets institutionalized beyond direct communication and how readiness is socially reinforced on the bases of collective values and norms (Kurter, 2025). Based on this, H4 proposes that the relationship between digital leadership and managerial readiness for the adoption of ML will be significantly mediated by organizational culture.

Moderating Role of Organizational Culture

Organizational culture can not only be a vehicle of leadership influence; it can also shape the effectiveness of the influence. Digital leadership should have a greater impact on managerial readiness when culture within the environment is open to change, learning, collaboration and innovation (Sun, 2025). Supportive cultural elements lock in leadership messages, through peer activity, practices and norms. Managers thus can turn strategy into action on readiness.

Conversely, cultures with low levels of information sharing or trust or extremely focused routines can limit the effectiveness of even the best leaders. Managers might hear the vision in the digital, but not have the local support to experiment, learn, and redesign work (Westover, 2025). Thus, the interaction perspective gives evidence of one complementary mechanism: culture influences the effectiveness of leadership. As digital leadership becomes more engaging, the positive connection with managerial readiness will be more pronounced, with greater support from the organizations' culture, as H5 suggests (Vera Zaliyanti *et al.*, 2025).

Organizational Support and Model Explanatory Power

Organisation resources and infrastructure is also critical for the adoption of machine learning. Managerial willingness can be translated into action due to technology,

analytical skills, reliable data, finance and clear policies. Organizational support is thus included as a control-related predictor, to differentiate leadership and culture effects from those of broader capabilities (Zamir, 2025). An integrated model suggests that the two; digital leadership and organizational culture together give significant explanatory power in terms of managerial readiness. H6 suggests that the proposed structural model provides a good account of the variance in managerial readiness for the adoption of machine learning (Pawar & Shah, 2024). The hypothesis is tested with the coefficient of determination and the structural model is significant.

Conceptual Framework

Digital leadership is introduced as the main antecedent; organizational culture is introduced as a mediator and moderator and the managerial readiness to adopt machine learning is introduced as a main outcome. Digital leadership is expected to have a direct and indirect impact on readiness via culture. Moderation effect is seen as interaction between digital leadership and organizational culture. Organizational support remains as a predictor of organizational control (Vera Zaliyanti *et al.*, 2025). The readiness of managers is defined in the framework as a capability that needs to be enabled by the organization and not merely as an individual attitude.

MATERIALS AND METHODS

Research Design

The study employed a quantitative, cross sectional, survey research design to study the relationships between structural components of digital leadership, organizational culture and managerial readiness for machine learning adoption. A quantitative approach was suitable as the proposed framework involved the simultaneous testing of well-defined latent constructs and hypotheses that were directional. The cross-sectional design was able to only assess the direct, indirect and interaction effects within a single analytical framework and captured managerial perceptions at a defined point in time (Pelakoski, 2024).

Participants and Analytical Sample

The focus was on people holding positions of managerial, supervisory, executive, departmental, functional-head, owner, and organizational decision making. The criteria for eligibility was linked to the aims of the study: respondents had to indicate that there was an adequate level of managerial involvement to evaluate leadership practices, organizational culture, and readiness for technology related change (M. Farrel & Maiza Fikri, 2025). Companies where machine learning was being deployed, planned, trialed, partially implemented and in some way making progress towards machine learning were all included in the organizational context. A total of 360 manager responses were valid, and all of the measurement items indicated a valid N of 360.

Sample showed a high degree of organizational diversity. Respondents included a variety of managerial positions and managerial experience, as well as functional area, organizational size, industry, ownership structure, and machine learning adoption stage. This diversity was helpful as managerial position and organizational context were likely to play a role in readiness for machine learning. There were also respondents who had and had not received any training in the areas of artificial intelligence and machine learning, allowing for some differences in relevant experience (Obeidat, 2026).

Survey Instrument and Measurement

Data were collected with a structured questionnaire on four analytical components. Ten items coded DL1-L10 were used to measure digital leadership. The items were based on leadership vision, strategic leadership understanding of ML, support for experimentation, resource allocation, training, data informed decision making, communication of benefits, management of employee concerns, cross functional collaboration, and commitment to digital innovation. Organizational culture was assessed by 10 items coded OC1 to OC10, which included support for innovation, experimentation, learning from failures, sharing knowledge, collaboration, adaptability, continuous learning, data driven decisions, trust and responsible use of technology.

Twelve items MR1 to MR12 were used to measure managerial readiness. These consisted of machines learning application and benefit, intention to support use, readiness to change work processes, communication with technical experts, interest in training, resource availability, communication skills, resistance management, ethical awareness and overall readiness. Five items coded OS1 to OS5 were used to represent organizational support, encompassing infrastructure, analytical skills, data availability, financial resources and formal policies. Items were written on a 5-point Likert continuum of disagreement and agreement, from 1 (strongly disagree) to 5 (strongly agree).

Preliminary Data Assessment

Descriptive statistics for each item of measure and for each of the constructs were used to start the analysis. To ascertain central tendency and dispersion, means and standard deviations were examined, and skewness and kurtosis were examined to note significant deviations from distributional symmetry. The pattern of associations among scores was explored by correlations among construct scores prior to the latent-variable model evaluation. Descriptive statistics for the respondent characteristics have been presented in frequency and percentage (Akhigbe *et al.*, 2024).

More than one diagnostic test was done to rule out potential common method bias. Harman's single factor variance test was used to determine if the total variance was dominated by one general factor. Also, a one-factor confirmatory factor analysis model was assessed and conceptually contrasted with the multidimensional measurement model. All these diagnostics together put together a better assessment of things than depending on just one procedural indicator.

Measurement Model Assessment

Confirmatory factor analysis was used to assess the measurement properties of the four constructs. Items were reviewed in terms of standardized factor loadings, standard errors, z-values, significance levels and confidence intervals for the interpretation of whether items reflect their respective latent variables (Kurter, 2025). The fit of the entire measurement model was evaluated using chi-square, chi-square to degrees-of-freedom, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA) with its 90% confidence interval, and Standardized Root Mean Square Residual (SRMR).

Cronbach's alpha, McDonald's omega, and composite reliability were used to assess internal consistency. Average variance extracted was used for checking convergent validity along with evidence of reliability and item loadings. The Fornell-Larcker approach and the heterotrait-monotrait ratio were used to test the discriminant validity (Panta & Thapaliya, 2025). Results were examined in light of each other and not as evidence for a single coefficient to show the quality of the construct.

Structural Model and Hypothesis Testing

After establishing the measurement model, the structural model was estimated to test the proposed relationships. H1 Once the measurement model was developed, the structural portion of the model was estimated to test the proposed relationships. H1 assessed the direct impact of digital leadership on managerial preparedness. H2 was to evaluate the impact of digital leadership on organization's culture and H3 was to evaluate the impact of organization's culture on the managerial readiness. The same family of global fit indices as used for the measurement model was used to test for structural-model adequacy (Pawar & Shah, 2024).

The direct, indirect and total effects of the relationship between digital leadership and managerial readiness were tested using mediation. The estimated effect, standard error, confidence interval and significance level for the indirect pathway via organizational culture was assessed. The interaction term (DL x OC) centered digital leadership and organizational culture variables was used to test the moderation effects. Organizational support was kept in the moderation equation as an added predictor (Burhan & Fatima, 2025). Variance inflation factors and tolerance statistics were used to check the multicollinearity problem and interpretation of the interaction effect was made.

Finally, how well the constructs of endogenous variables were explained, as measured by R-squared values, was assessed. Effect sizes were examined using f-squared statistics to determine the incremental contribution of digital leadership, organizational culture, their interaction, and organizational support. Hypotheses were deemed as confirmed when the corresponding effect was statistically significant and the attribute followed the positive direction as proposed in the hypothesis. All statistical conclusions were made on the results of the final SEM analysis tables (Zamir, 2025).

RESULTS AND DISCUSSION

Respondents' Demographic Profile

Response of 360 respondents shows significant diversity as shown in Table 1. 63.3% of the respondents were male and 34.4% female. The largest age group was 25–34 years

Table 1: Respondents' Demographic Profile

Characteristic	Category	Frequency	Percentage (%)
Gender	Female	124	34.4
	Male	228	63.3
	Prefer not to disclose	8	2.2
Age Group	Below 25	22	6.1
	25–34	133	36.9
	35–44	113	31.4
	45–54	74	20.6
	55 or above	18	5.0
Education	Diploma or equivalent	19	5.3
	Bachelor's degree	123	34.2
	Master's degree	173	48.1
	MPhil/PhD	11	3.1
	Professional qualification	34	9.4
Managerial Level	First-line manager/supervisor	66	18.3
	Middle-level manager	132	36.7
	Senior manager	77	21.4
	Departmental/functional head	53	14.7
	Director/executive	23	6.4
	Owner/entrepreneur	9	2.5

Managerial Experience	Less than 2 years	34	9.4
	2–5 years	102	28.3
	6–10 years	119	33.1
	11–15 years	69	19.2
	More than 15 years	36	10.0
Functional Area	Data/analytics	43	11.9
	Finance/accounting	42	11.7
	General management	45	12.5
	Human resources	50	13.9
	Information technology	50	13.9
	Marketing/sales	45	12.5
	Operations/supply chain	52	14.4
	Research/development	33	9.2
Organisation Size	Fewer than 50	46	12.8
	50–249	100	27.8
	250–499	76	21.1
	500–999	60	16.7
	1,000 or more	78	21.7
Industry	Banking/financial services	65	18.1
	Education	28	7.8
	Government/public sector	17	4.7
	Healthcare	26	7.2
	Information technology	66	18.3
	Manufacturing	71	19.7
	Professional services	16	4.4
	Retail/e-commerce	29	8.1
	Telecommunications	42	11.7
ML Adoption Stage	Initial discussion/exploration	54	15.0
	Planning/feasibility assessment	104	28.9
	Pilot implementation	73	20.3
	Partial implementation	88	24.4
	Full implementation	41	11.4
AI/ML Training	No	141	39.2
	Yes	219	60.8
Ownership	Public	21	5.8
	Private domestic	203	56.4
	Multinational	78	21.7
	State-owned	31	8.6
	NGO/nonprofit	27	7.5

at 36.9%, followed by 35–44 years at 31.4%. Nearly half of the respondents were Master's degree holders. The highest number of middle-level managers and 33.1% indicated that they have 6 to 10 years of managerial experience. The sample was broader to cover a range of organizational functions and industries and minimise reliance on any single professional group. Notably, respondents were from organisations with varying degrees of machine learning adoption. Exceeding half (60.8%) had experienced AI/machine learning training before.

Descriptive Statistics of Measurement Items

On the whole, the item scores were fairly high, ranging from 3.186 to 3.381, with positive perceptions in the four constructs. MR9 had the highest mean with 3.381 and

Table 2: Descriptive Statistics of Measurement Items

Construct	Item	N	Min	Max	Mean	SD	Skewness	Kurtosis
Digital Leadership	DL1	360	1	5	3.200	1.233	-0.116	-0.909
	DL2	360	1	5	3.375	1.192	-0.240	-0.781
	DL3	360	1	5	3.308	1.221	-0.245	-0.849
	DL4	360	1	5	3.350	1.217	-0.237	-0.845
	DL5	360	1	5	3.347	1.168	-0.290	-0.765
	DL6	360	1	5	3.219	1.163	-0.072	-0.830
	DL7	360	1	5	3.294	1.195	-0.277	-0.801
	DL8	360	1	5	3.314	1.221	-0.275	-0.861
	DL9	360	1	5	3.311	1.193	-0.163	-0.882
	DL10	360	1	5	3.272	1.219	-0.152	-0.935
Organizational Culture	OC1	360	1	5	3.206	1.167	-0.120	-0.783
	OC2	360	1	5	3.233	1.178	-0.040	-0.884
	OC3	360	1	5	3.253	1.192	-0.170	-0.824
	OC4	360	1	5	3.239	1.264	-0.140	-1.025
	OC5	360	1	5	3.186	1.164	-0.079	-0.842
	OC6	360	1	5	3.261	1.187	-0.154	-0.901
	OC7	360	1	5	3.283	1.186	-0.169	-0.868
	OC8	360	1	5	3.231	1.154	-0.054	-0.857
	OC9	360	1	5	3.214	1.164	-0.072	-0.847
	OC10	360	1	5	3.244	1.166	-0.146	-0.757
Managerial Readiness	MR1	360	1	5	3.328	1.167	-0.111	-0.984
	MR2	360	1	5	3.261	1.146	-0.077	-0.821
	MR3	360	1	5	3.361	1.148	-0.139	-0.830
	MR4	360	1	5	3.300	1.131	-0.110	-0.787
	MR5	360	1	5	3.350	1.124	-0.176	-0.711
	MR6	360	1	5	3.322	1.179	-0.143	-0.849
	MR7	360	1	5	3.367	1.136	-0.158	-0.817
	MR8	360	1	5	3.333	1.215	-0.126	-0.985
	MR9	360	1	5	3.381	1.098	-0.124	-0.869
	MR10	360	1	5	3.317	1.173	-0.197	-0.795
	MR11	360	1	5	3.247	1.184	0.028	-1.066
	MR12	360	1	5	3.294	1.133	-0.157	-0.757
Organizational Support	OS1	360	1	5	3.289	1.215	-0.257	-0.869
	OS2	360	1	5	3.269	1.214	-0.179	-0.968
	OS3	360	1	5	3.283	1.209	-0.130	-0.948
	OS4	360	1	5	3.281	1.223	-0.217	-0.925
	OS5	360	1	5	3.358	1.162	-0.192	-0.813

OC5 had the lowest mean with 3.186. Standard deviations were near the value of one or a little larger, which reflects that there were meaningful variations in managerial perceptions. The values of skewness and kurtosis were relatively small. No item showed an extreme distributional pattern and this is a satisfactory descriptive basis for the subsequent multivariate analysis (Yang *et al.*, 2024).

Construct-Level Statistics and Correlations

The highest construct mean was for Managerial Readiness (3.322), followed by Digital Leadership (3.299) and Organizational Support (3.296). The mean

Table 3: Construct-Level Descriptive Statistics and Correlations

Construct	Mean	SD	DL	OC	MR	OS
DL	3.299	0.918	1.000	0.447	0.541	0.338

OC	3.235	0.885	0.447	1.000	0.589	0.399
MR	3.322	0.811	0.541	0.589	1.000	0.397
OS	3.296	0.969	0.338	0.399	0.397	1.000

of Organizational Culture was 3.235. Correlations between all constructs were positive. There was a strong relationship between Organizational Culture and Managerial Readiness (0.589). Digital Leadership was also substantially related to Managerial Readiness at 0.541. These patterns offer initial support of the proposed relationships, and indicated that the constructs remained empirically separable.

Standardised Factor Loadings

Each of the standardised loadings was statistically significant at $p < .001$. The Digital Leadership loadings fell in the range of 0.630 to 0.807, Organizational Culture from 0.608 to 0.815, Managerial Readiness from 0.586 to

Table 4: Standardised Factor Loadings

Construct	Item	Loading	SE	Z	p-value	CI Lower	CI Upper	Assessment
DL	DL1	0.630	0.034	18.623	<.001	0.564	0.697	Acceptable
DL	DL2	0.670	0.031	21.742	<.001	0.609	0.730	Acceptable
DL	DL3	0.731	0.027	27.158	<.001	0.678	0.784	Strong
DL	DL4	0.805	0.022	37.287	<.001	0.763	0.848	Strong
DL	DL5	0.784	0.023	33.519	<.001	0.738	0.830	Strong
DL	DL6	0.645	0.033	19.605	<.001	0.580	0.709	Acceptable
DL	DL7	0.739	0.025	29.425	<.001	0.690	0.788	Strong
DL	DL8	0.757	0.025	29.989	<.001	0.707	0.806	Strong
DL	DL9	0.753	0.024	31.602	<.001	0.707	0.800	Strong
DL	DL10	0.807	0.020	39.498	<.001	0.767	0.847	Strong
OC	OC1	0.643	0.033	19.484	<.001	0.578	0.707	Acceptable
OC	OC2	0.645	0.033	19.309	<.001	0.579	0.710	Acceptable
OC	OC3	0.730	0.027	27.071	<.001	0.677	0.783	Strong
OC	OC4	0.757	0.025	29.925	<.001	0.707	0.807	Strong
OC	OC5	0.755	0.026	28.944	<.001	0.704	0.806	Strong
OC	OC6	0.608	0.036	16.899	<.001	0.538	0.679	Acceptable
OC	OC7	0.709	0.028	25.575	<.001	0.654	0.763	Strong
OC	OC8	0.709	0.027	26.197	<.001	0.656	0.762	Strong
OC	OC9	0.815	0.019	42.767	<.001	0.777	0.852	Strong
OC	OC10	0.786	0.024	32.674	<.001	0.739	0.833	Strong
MR	MR1	0.590	0.037	15.891	<.001	0.517	0.663	Acceptable
MR	MR2	0.647	0.034	19.197	<.001	0.581	0.713	Acceptable
MR	MR3	0.659	0.030	21.721	<.001	0.600	0.719	Acceptable
MR	MR4	0.753	0.025	30.161	<.001	0.704	0.802	Strong
MR	MR5	0.715	0.028	25.203	<.001	0.659	0.770	Strong
MR	MR6	0.586	0.037	15.666	<.001	0.512	0.659	Acceptable
MR	MR7	0.655	0.032	20.443	<.001	0.592	0.718	Acceptable
MR	MR8	0.694	0.029	23.646	<.001	0.637	0.752	Acceptable
MR	MR9	0.699	0.033	21.515	<.001	0.636	0.763	Acceptable
MR	MR10	0.774	0.023	33.184	<.001	0.728	0.820	Strong
MR	MR11	0.626	0.034	18.466	<.001	0.559	0.692	Acceptable
MR	MR12	0.650	0.035	18.327	<.001	0.581	0.720	Acceptable
OS	OS1	0.757	0.026	29.390	<.001	0.706	0.807	Strong
OS	OS2	0.781	0.025	30.992	<.001	0.732	0.831	Strong
OS	OS3	0.819	0.021	38.396	<.001	0.777	0.861	Strong

OS	OS4	0.690	0.031	21.985	<.001	0.629	0.752	Acceptable
OS	OS5	0.687	0.031	21.955	<.001	0.626	0.748	Acceptable

0.774 and Organizational Support loadings from 0.687 to 0.819. Most of these were greater than 0.60 and some even higher than 0.70. While MR6 and MR1 were weaker in comparison, both were still meaningful with statistically significant loadings. The overall indicators were found to have satisfactory representation for their attempted latent constructs (Welch, 2025).

Measurement-Model Fit

The overall fit for the measurement model was very good. A chi-square to degrees of freedom ratio of only 1.0788 was achieved. The values of CFI and TLI were 0.9924 and 0.9919 respectively which is much higher than the criterion adopted. The RMSEA value was .015 with a small confidence interval and the SRMR equals .0358

Table 5: Measurement-Model Fit Indices

Fit Index	Obtained Value	Recommended Criterion	Assessment
Chi-square	672.082	Report	Reported
Degrees of freedom	623	Report	Reported
Chi-square p-value	0.0847	Report	Reported
Chi-square/df	1.0788	< 3.00	Acceptable
CFI	0.9924	≥ 0.90	Acceptable
TLI	0.9919	≥ 0.90	Acceptable
RMSEA	0.0150	< 0.08	Acceptable
RMSEA 90% CI lower	0.000	Report	Reported
RMSEA 90% CI upper	0.023	Report	Reported
SRMR	0.0358	< 0.08	Acceptable

All of the above statistics suggest that the proposed measurement structure is highly consistent with the observed data.

Reliability and Convergent Validity

Internal consistencies of all constructs are strong. In all cases, both Cronbach's alpha and McDonald's omega and composite reliability were > 0.86. AVE values for Digital Leadership, Organizational Culture and Organizational Support were also greater than 0.50, which is satisfactory to see that these constructs are converging. The AVE for Managerial Readiness was 0.453, which was just below the traditional cut-off of 0.5. Therefore, the convergent validity of it should be taken with a grain of salt.

Table 6: Construct Reliability and Convergent Validity

Construct	Cronbach's Alpha	McDonald's Omega	Composite Reliability	AVE	Assessment
DL	0.920	0.921	0.921	0.540	Established
OC	0.913	0.914	0.914	0.516	Established
MR	0.907	0.908	0.908	0.453	Review required
OS	0.864	0.865	0.864	0.560	Established

However, the fact that its reliability coefficients are very high and it has high factor loadings gives strong evidence that the construct has sufficient measurement quality for structural analysis (Westover, 2025).

Fornell-Larcker Discriminant Validity

The square roots of AVE exceeded by the diagonal values the inter-construct associations. Four diagonal values were obtained: Digital Leadership 0.735, Organizational Culture 0.718, Managerial Readiness 0.673 and Organizational Support 0.748. Results showed that each latent construct had more variance with its respective indicators than with the other constructs in the model. Thus, the Fornell-Larcker assessment validates satisfactory discriminant validity.

Table 7: Fornell-Larcker Discriminant Validity

Construct	DL	OC	MR	OS
DL	0.735	0.498	0.598	0.395
OC	0.498	0.718	0.644	0.458
MR	0.598	0.644	0.673	0.465
OS	0.395	0.458	0.465	0.748

HTMT Discriminant Validity

All the HTMT coefficient values were kept below 0.85. The highest score (0.646) was found between Organizational Culture and Managerial Readiness, and the lowest score (0.379) was found between Digital Leadership and Organizational Support. For this reason, the construct pairs did not come close to the specified threshold. This supplemental analysis is used to suggest that the four constructs were sufficiently different to estimate their structures in subsequent analyses.

Table 8: HTMT Discriminant Validity

Construct Pair	HTMT	Criterion	Decision
DL–OC	0.488	< 0.85	Established
DL–MR	0.592	< 0.85	Established
DL–OS	0.379	< 0.85	Established
OC–MR	0.646	< 0.85	Established
OC–OS	0.449	< 0.85	Established
MR–OS	0.448	< 0.85	Established

Common Method Bias

A single factor solution was extracted from Harman which accounted for 34.785% of the total variance but did not meet the criterion of 50%. In addition, the alternative single-factor confirmatory model had a poor fit (CFI = 0.653, RMSEA = 0.101). As this result shows, there was not one general factor that would fully account for the relationships that were found. The empirical results seem not to be dominated by serious common method bias (Kurter, 2025).

Table 9: Common Method Bias Assessment

Assessment	Result	Criterion	Conclusion
Harman's single-factor variance	34.785%	< 50%	No serious common method bias
Single-factor CFA: CFI	0.653	Poor fit	Single-factor model not supported
Single-factor CFA: RMSEA	0.101	Poor fit	Single-factor model not supported

Structural-Model Fit

The fit of the structural model was also very good. A chi-square/df ratio of 1.1238 was found. CFI and TLI were still very high (0.9880 and 0.9872). RMSEA was only 0.0189, and SRMR was 0.0517. The overall chi-square test was statistically significant, but each of the other fit indices shows good representation of the empirical covariance structure. With confidence the structural paths hence could be interpreted (Cui, 2025).

Table 10: Structural-Model Fit Indices

Fit Index	Obtained Value	Recommended Criterion	Assessment
Chi-square	701.2461	Report	Reported
Degrees of freedom	624	Report	Reported
Chi-square p-value	0.017	Report	Reported
Chi-square/df	1.1238	< 3.00	Acceptable
CFI	0.9880	≥ 0.90	Acceptable
TLI	0.9872	≥ 0.90	Acceptable
RMSEA	0.0189	< 0.08	Acceptable
RMSEA 90% CI lower	0.0089	Report	Reported
RMSEA 90% CI upper	0.0259	Report	Reported
SRMR	0.0517	< 0.08	Acceptable

Multicollinearity Assessment

Variance inflation factors (VIFs) varied from 1.003 to 1.368 and tolerance values varied from 0.731 to 0.997. These values suggest that there was an acceptable level of correlation between the predictors. In particular, the interaction term resulted in a VIF of 1.003. The direct and interaction effects do not pose a serious threat to the coefficient estimation because of multicollinearity.

Table 11: Multicollinearity Assessment

Predictor	Outcome	VIF	Tolerance	Assessment
DL Centered	Managerial Readiness	1.301	0.769	No serious multicollinearity
OC Centered	Managerial Readiness	1.368	0.731	No serious multicollinearity
DL × OC	Managerial Readiness	1.003	0.997	No serious multicollinearity
OS Centered	Managerial Readiness	1.237	0.809	No serious multicollinearity

Mediation Effect of Organizational Culture

There was direct effect of Digital Leadership with a standardised effect of 0.3372 on Managerial Readiness and this effect was significant. The indirect effect via Organizational Culture was also significant (0.2108) with a lower bound that did not contain zero. The overall effect was 0.548. The results showed that the direct path as well as the indirect path was statistically significant, suggesting partial mediation. Thus, digital leadership can directly strengthen managerial readiness, as well as indirectly reinforce an organizational culture that is more conducive to readiness.

Table 12: Mediation Effect of Organizational Culture

Effect	Estimate	Standardised Effect	SE	CI Lower	CI Upper	p-value	Decision
Direct: DL → MR	0.4873	0.3372	0.0826	0.3356	0.6597	<.001	Significant
Indirect: DL → OC → MR	0.3047	0.2108	0.0551	0.2076	0.4243	<.001	Significant mediation
Total effect	0.7919	0.5480	0.0837	0.6392	0.9684	<.001	Significant

Moderating Effect of Organizational Culture

The interaction between Digital Leadership and Organizational Culture was positive and statistically significant, β = 0.1035, p = 0.008. The positive coefficient suggests that Digital Leadership is positively related to Managerial Readiness in a supportive culture. Digital Leadership and Culture were also independently significant. Organizational Support also produced a positive result of β = 0.1348, thereby providing evidence that structure and resource factors are also factors contributing to managerial readiness, not just leadership and culture (Iannello, 2025).

Table 13: Moderating Effect of Organizational Culture

Predictor	Estimate	SE	Standardised β	t-value	p-value	CI Lower	CI Upper	Decision
Digital Leadership	0.2874	0.0391	0.3251	7.3599	<.001	0.2106	0.3642	Significant
Organizational Culture	0.3578	0.0415	0.3904	8.6189	<.001	0.2762	0.4395	Significant
DL × OC	0.1030	0.0386	0.1035	2.6705	0.008	0.0271	0.1788	Significant
Organizational Support	0.1128	0.0360	0.1348	3.1300	0.002	0.0419	0.1837	Significant

Explanatory Power and Effect Sizes

Digital Leadership accounted for 19.97% of the variance in Organizational Culture. The predictors collectively explained 46.77% of the variance in Managerial Readiness. These were interpreted as very weak and weak, respectively, in the analysis output by the interpretation that was adopted. In terms of predictor levels, Digital Leadership and Organizational Culture yielded medium effect sizes on Managerial Readiness whereas the interaction effect

Table 14: Explanatory Power and Effect Sizes

Outcome	R^2	Reported Interpretation	Predictor	f^2	Effect Size
Organizational Culture	0.1997	Very weak	Digital Leadership	0.2495	Medium
Managerial Readiness	0.4677	Weak	Digital Leadership	0.1526	Medium
Managerial Readiness	0.4677	Weak	Organizational Culture	0.2093	Medium
Managerial Readiness	0.4677	Weak	DL × OC	0.0201	Small
Managerial Readiness	0.4677	Weak	Organizational Support	0.0276	Small

and Organizational Support yielded smaller incremental effect sizes. So, the two main organizational constructs were the major sources of explanatory contributions.

Hypothesis-Testing Results

Results of the six hypotheses were found to be supported. Digital Leadership had a significant impact on Managerial Readiness and Organizational Culture. Organizational Culture partially mediated the relationship between Digital Leadership and Managerial Readiness, which became stronger after adding in Organizational Culture. The significant interaction term also supported the moderating effect of culture. Finally, the model

Table 15: Summary of Hypothesis-Testing Results

Hypothesis	Proposed Relationship	Standardised Coefficient/Effect	p-value	CI Lower	CI Upper	Decision
H1	Digital Leadership → Managerial Readiness	0.3372	<.001	0.3259	0.6486	Supported
H2	Digital Leadership → Organizational Culture	0.5068	<.001	0.4546	0.7214	Supported
H3	Organizational Culture → Managerial Readiness	0.4160	<.001	0.3678	0.6686	Supported
H4	DL → OC → Managerial Readiness	0.2108	<.001	0.2076	0.4243	Supported
H5	DL × OC → Managerial Readiness	0.1035	0.008	0.0271	0.1788	Supported
H6	Joint explanatory effect on Managerial Readiness	0.4677	<.001	—	—	Supported

accounted for a R2 of 0.4677 for Managerial Readiness with proposed joint explanation. These results collectively highlight that leadership and culture are complementary mechanisms in organisations in preparing managers to adopt machine learning.

Discussion

The empirical findings offer compelling support that managerial readiness to adopt machine learning is related to leadership behaviour and organisation context. The findings go beyond the technological dimension of the discussion on machine learning adoption and indeed highlight managerial capability as one of the most important organisational factors for machine learning adoption.

Digital Leadership had an important positive correlation with Managerial Readiness, thus supporting H1. The direct standardized path coefficient of 0.3372 demonstrates that the readiness of managers towards machine learning tends to increase with clear technological priorities and communication of value of the technology strategy, experimentation, the provision of resources, training and commitment to digital transformation through organizational leaders. This finding supports the idea that technological readiness is not only an individual property, but also a property, which is to some extent built by leadership (Yunita & Isnaini, 2024).

H2 was also validated, with Digital Leadership having a relatively high impact with regard to Organizational Culture. The normalised coefficient with value of 0.5068 indicates that leadership behavior plays a significant role for the culture of technological change. There are organisational norms surrounding innovation, collaboration, learning and decision-making based on data that are not independent of managerial cues (Yunita & Isnaini, 2024). Leaders have the power to determine which behaviours are allocated resources, recognise, legitimate and attract organisational attention. Digital leadership can thus establish an institutional culture that increasingly normalises a technological experimentation.

Organizational Culture also had a significant positive effect on Managerial Readiness, thus supporting H3. Its standardised coefficient was 0.416 which was stronger than the direct coefficient given in the hypothesis summary for Digital Leadership. This result is significant and further suggests that typical working habits, values and attitudes within organizations can have a strong impact on managers' self-efficacy to implement ML. Even the strongest formal leadership can be undermined by management contexts that are unfriendly to experimentation, unfriendly to cross-functional sharing or where technological errors are mostly considered failures (Cyfert *et al.*, 2025).

An important explanation as to how leadership generates readiness is given by the mediation findings. The role of Organizational Culture was significant in the relationship between Digital Leadership and Managerial Readiness, supporting H4. The standardised indirect effect was 0.2108, and the direct effect was still significant: 0.3372. This shows partial mediation and not full mediation. So, digital leadership is a bi-directional journey. While the impact of this may be direct in nature via strategic direction, communication, resources and encouragement for managers, it also establishes conditions for cultural change that in turn develops and reinforces managerial readiness.

This distinction is of far-reaching organisational nature. Unless there are cultural practices to complement the leadership initiatives, those initiatives may create benefits but leave the impact incomplete. Leaders need to foster behaviours that lead to learning, collaboration, sharing of knowledge, responsible experimentation and trust within their organisation to build sustainable readiness.

The H5 was also supported. The important positive interaction coefficient of 0.1035 shows that the impact of Digital Leadership on Managerial Readiness is accentuated by the factor of Organizational Culture. Culture thus has a double theoretical function. It conveys part of the leadership impact and at the same time changes the impact of the leadership (Burhan & Fatima, 2025). This discovery clearly shows that mediation and moderation are not mutually exclusive interpretations. Leadership can also over time influence the nature of culture and the current state of cultural support may be what also influences the extent to which managerial groups react to leadership behaviour (Obeidat, 2026).

Organizational Support also had a strong beneficial effect. The impact was less intense than the two main and cultural impacts, but it does show that there must be enabling conditions for the managers. The willingness to implement can be translated into the ability by technological infrastructure, availability of skilled personnel, relevant data, financial resources, and clear governance mechanisms.

The findings in the explanatory part also show that the model was able to explain a significant portion of the variance in managerial readiness. The fit for the combined predictors was 46.77% variance of the dependent construct. Medium effect sizes of Digital Leadership and Organizational Culture existed, while smaller incremental contributions of interaction and Organizational Support were found. Managerial readiness, then, seems to be mostly a function of leadership and cultural factors, but can also be affected by other factors not captured in the current model (Panta & Thapaliya, 2025).

There are also important nuances to interpreting the measurement analysis. The results indicated a high level of reliability for all constructs, and both Fornell-Larcker and HTMT were used to assess the discriminant validity. Managerial Readiness, on the other hand, had an AVE of 0.453. This score is slightly lower than 0.50 but does not in itself mean that this scale is unreliable. Evidence can be found in strong composite reliability and high item significance along with acceptable overall measurement-model fit. However, with further measurement development it may be possible to better tap into the variance of the construct.

Theoretical Implications

The study adds to the growing body of research on organisational readiness for advanced analytics by viewing managerial readiness as an outcome and not technology adoption as only an organisational or technical choice. The results show that readiness can be understood in an Integrated Leadership-Culture framework. The direct influence of digital leadership reached beyond boundaries in the organization, and there was indirect influence in terms of organizational culture, suggesting that effects of leadership need to be understood on different organizational levels.

A second one comes from the modelling of organizational culture as mediator and moderator. The positions are fundamentally different. The difference between mediation and moderation is that mediation provides an explanation of how leadership influence is spread through the shared norms, and moderation provides an explanation of when leadership is more effective. Importantly, the concurrent demonstration of both mechanisms in one model helps to understand the construction of culture as both produced by leadership and influential in shaping leadership responses. Availability of resources is not, in itself, an adequate reflection of readiness, as affirmed by organizational support. The model thus brims with just one description of managerial readiness to adopt new technology: strategic leadership, shared organizational meaning, and implementation capability (MICHAEL & EGBIVWE, 2025).

Managerial Implications

The readiness of the management should be treated as an explicit goal for the implementation of machine learning by organisations. The most important steps for senior leaders to take are to share a credible digital vision, tie machine learning projects to real business challenges, make resources more visible, and show their own personal use of data to make business decisions. Limited Training to Technical Personnel. Managers need to know enough to realize useful applications, talk with specialists about what they need, estimate risks, and tell what changes you need to make to your employees (Cyfert *et al.*, 2025).

The results also show that leadership programmes are more effective if the organizations are accompanied by conscious cultural development. Experimentation should be encouraged, lessons learned from failed pilots, cross functional sharing of knowledge should be rewarded, and an open forum should be made available for concerns regarding concerns about automation and data use. Technology policies should be converted from policies to understand and implement rather than just policy documents. When the interaction is significant, the leaders should first determine the state of culture before waiting for digital communication to create readiness for behaviour (Areche & Ofluoglu, 2025). In cultures where there is fragmentation or reluctance to take risks, readiness interventions should not be limited to communication with leaders but should also include local change in collaboration, learning routine, and trust. Managerial knowledge, training participation, cross-functional engagement and confidence can also be tracked on readiness dashboards before big implementation decisions are made (Vera Zaliyanti *et al.*, 2025).

Limitations and Future Research

This study has some limitations. The cross-sectional design does not allow to determine temporal causal relationships; instead, it reveals statistically consistent relationships. Longitudinal research designs might be employed in the future to investigate the relationships between digital leadership and culture and readiness in each of these phases: pre-ML, during ML, and following ML. They are perceptual measures, and were gathered using a common survey source, but the common method diagnostics did not suggest a serious single factor issue. In the future, it might be interesting to use managerial surveys coupled with objective adoption milestones, training data, technology investments, or project success. The AVE of managerial readiness was 0.453 and while the reliability was high and discriminant validity was good, the results still suggest further refinement of measurement. Future studies might want to reconsider the low-loading readiness items and replicate the scale in other industry sectors, organization settings, and countries (Westover, 2025). Other antecedents, for instance, data governance maturity, technology anxiety, managerial digital competence, employee participation or competitive pressure, can contribute to expanding the explanatory power above the current 46.77%.

CONCLUSION

In this study, managerial readiness in adopting ML was examined considering the joint effect of digital leadership and organizational culture. The SEM findings confirm the suggested framework. Digital leadership had a significant positive effect on managerial readiness and on organizational culture and organizational culture had a significant positive effect on readiness. Culture also mediated and moderated the leadership-readiness relationship in a positive way, which shows that culture not only transfers the leadership influence but also reinforces it. Organizational support was added as an explanatory variable and the overall model explained 46.77% of the variance in managerial readiness.

The main takeaway is that acquiring technology is not enough to be ready for machine learning. Managers are ready when the following conditions are present: strategic direction and resources from leadership, learning, experimentation, collaboration, trust and responsible use of technology in the organizational culture. Those who coordinate them are better equipped to make machine learning part and parcel of management practice. The results thus provide a comprehensive base for designing leadership development, cultural change and governance of implementation of machine learning adoption in contemporary practice in complex contemporary organizations.

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