CAPITAL UNIVERSITY OF SCIENCE AND TECHNOLOGY, ISLAMABAD



Impact of Leadership 4.0 on Organizational Performance: A Moderated Mediation Model of Employee Engagement and Digital Readiness in the Healthcare Sector of South Punjab, Pakistan

by

Anoshiya Imran

A thesis submitted in partial fulfillment for the degree of Master of Science

in the

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CERTIFICATE OF APPROVAL

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(Anoshiya Imran)

Abstract

This study aims to examine the effect of Leadership 4.0 (L4.0) on the organizational performance in the healthcare sector of South Punjab, Pakistan, while examining employee engagement (EE) as a mediator and digital readiness (DR) as a moderator of that relationship. It is based on the Unified Theory of Acceptance and Use of Technology (UTAUT) which models the before/after perceptions of technology-related expectations and facilitating conditions, as well as social influence on individual and organizational outcomes. The type of research was a quantitative explanation approach with a cross-sectional research design. Descriptive statistics and reliability tests were used to analyze data that consisted of 356 valid responses from healthcare employees; correlation, regression, and Hayes' PROCESS mediation, moderation, and moderated mediation analysis were employed for this analysis. The findings revealed a positive and significant impact on organizational performance and employee engagement due to Leadership 4.0 and the positive and significant influence of employee engagement on organizational performance, partially mediating the leadership and the organizational performance. Digital readiness showed a significant moderation effect for the relationship between Leadership 4.0 and employee engagement (interaction B = -0.149, p = .017) indicating a buffering interaction in which the positive effect of Leadership 4.0 on employee engagement was strongest where digital readiness was lowest (conditional effect 0.468 at low readiness versus 0.242 at high readiness). Results also showed the conditional indirect effects of the mediation model via employee engagement at low, mean and high digital readiness were significant, and the index of moderated mediation was found to be significant, indicating that the extent of the indirect pathway (via employee engagement) to organizational performance was also conditional on digital readiness. Leadership 4.0 directly and indirectly enhanced health care organizational performance, while digital readiness was a statistically significant contextual variable in the model. The study adds to the existing literature on Leadership 4.0, employee engagement, digital

readiness, healthcare management and UTAUT-related research, and provides implications for hospital managers, human resource (HR) managers, managers of digital transformation and policy-makers.

Keywords: Leadership 4.0, organizational performance, employee engagement, digital readiness, healthcare sector, Pakistan, UTAUT, moderated mediation.

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Abbreviations

AI	Artificial Intelligence
AVE	Average Variance Extracted
BDS	Bachelor of Dental Surgery
CI	Confidence Interval
CR	Composite Reliability
DR	Digital Readiness
DV	Dependent Variable
EE	Employee Engagement
EHR	Electronic Health Record
FCPS	Fellow of the College of Physicians and Surgeons
HIS	Hospital Information System
ICU	Intensive Care Unit
IV	Independent Variable
L4.0	Leadership 4.0
MBBS	Bachelor of Medicine, Bachelor of Surgery
MD/MS	Doctor of Medicine / Master of Surgery
OP	Organizational Performance
OPD	Outpatient Department
PROCESS	Hayes PROCESS Macro for Conditional Process Analysis
SD	Standard Deviation
SE	Standard Error
SPSS	Statistical Package for the Social Sciences
UTAUT	Unified Theory of Acceptance and Use of Technology
VIF	Variance Inflation Factor

Chapter 1

Introduction

1.1 Background of Study

Leadership has always been considered the key element of why some organizations adapt, learn, innovate and perform better than others. While the classical understanding of leadership centers on planning, supervision, direction and control, the landscape of organizations has been changed by digitalization, artificial intelligence, data analytics, automation and platform-based coordination and digitally mediated work processes (Avolio, Sosik, Kahai, & Baker, 2014; Cortellazzo, Bruni, & Zampieri, 2019). These changes have transformed leadership roles from traditional administration into one characterized by digital visioning, empowerment, agility, collaborative decision making, ethical technology use and continuous learning (Kane, Phillips, Copulsky, & Andrus, 2019; Verhoef et al., 2021; Zeike, Bradbury, Lindert, & Pfaff, 2019). In this regard, Leadership 4.0 is a leadership orientation appropriate for the Fourth Industrial Revolution and combines technological awareness and human-centered ways of exercising influence in the organization (Schwab, 2016; Shamim, Cang, Yu, & Li, 2016).

Leadership 4.0 goes beyond the mere technical ability to utilize digital tools. It demonstrates leaders' ability to inspire a digital vision, to coach and support staff as part of the process of technological change, to foster experimentation and the adoption of information from data-driven decision making; to instill a culture in

which technology is considered a means of enhancing work, instead of posing a threat (Cortellazzo et al., 2019; Kane et al., 2019; Sacavém, Palma-Moreira, & Correia, 2025). As part of digitally transforming organizations, leaders should connect the dots between the strategy and execution, aligning the digital infrastructure with the employee capabilities and service innovation and performance goals (Vial, 2019; Verhoef et al., 2021). Thus, Leadership 4.0 is a relevant construct in industries where technical reliability and dedication of people are necessary for the success of an organization (Avolio et al., 2014; Zeike et al., 2019). Digital leadership is a no-brainer in many institutional settings, and the healthcare industry is a prime example. Today, hospital-based facilities use electronic health records (EHRs), hospital information systems (HIS), digital radiology, laboratory information systems (LISs), telemedicine, mobile health technologies, data dashboards, digital appointment systems and clinical decision-support tools (CDSTs) (Cresswell & Sheikh, 2013; Greenhalgh et al., 2017; World Health Organization, 2021). Such technologies are believed to increase efficiency, enhance documentation, facilitate faster communication, make decisions more transparent, provide care more centered towards patients, and coordinate the institutions better (Cresswell & Sheikh, 2013; Vial, 2019). But with technological investment it is not automatic that the organizational performance will be better. Digital transformation threatened depends on whether or not individuals understand, accept, trust and are actively using new systems; which have the potential to enhance service quality and operations (Greenhalgh et al., 2017; Venkatesh, Morris, Davis, & Davis, 2003; Williams, Rana, & Dwivedi, 2015).

Healthcare organizational performance is multi-directional. It encompasses aspects of service quality, patient satisfaction, patient safety, operational efficiency, innovation, employee productivity, staff retention, learning capability and achievement of strategic goals (Donabedian, 1988; Kaplan & Norton, 1992; Richard, Devinney, Yip, & Johnson, 2009).

Employees' attitude and behaviors are directly related to the quality and reliability of healthcare organization outcomes because this sector is labor-intensive, knowledge intensive and emotionally demanding (Bakker & Demerouti, 2008; Harter,

Schmidt, & Hayes, 2002; Macey & Schneider, 2008). Leadership 4.0 can contribute to a better performance in healthcare if it empowers individuals to make the most of digital tools, work together in teams, and continuously learn, which will allow them to respond to patients with more efficiency and accuracy (Cortellazzo et al., 2019; Kane et al., 2019; Zeike et al., 2019).

Leadership 4.0 could positively impact organizational performance via the strong psychological links of its key constructs in the form of employee engagement. Engagement is a positive and fulfilling experience of work, in which three dimensions are considered as important – vigor, dedication, and absorption (Schaufeli, Salanova, González-Romá, & Bakker, 2002).

Engaged employees are energy, attention and persistence providing in their work roles, express willingness to change, often employ extra-role behaviors (Bakker & Demerouti, 2008; Kahn, 1990; Saks, 2006). Engagement is particularly significant in the health care sector, where workers are involved with patients, use sophisticated systems, and perform time-sensitive tasks and decisions that impact quality of care (Bailey, Madden, Alfes, & Fletcher, 2017; Knight, Patterson, & Dawson, 2017). The digital vision offered by the leader along with supporting employees to learn new tools can have a positive impact on employees' feelings of competence, meaningfulness, and commitment to transformation (Avolio et al., 2014; Kahn, 1990).

Digital readiness is not without significance as the impact of Leadership 4.0 may be linked to the readiness of employees and hospitals to work in digitally enabled environments. Digital readiness is how far organizations and individuals have developed regarding the necessary digital infrastructure, skills, confidence, digital technical support, digital culture, and digital managerial commitment for the adoption and benefits of digital technologies (Lokuge, Sedera, Grover, & Xu, 2019; Weiner, 2009). In hospitals that have not completed a great deal of digital readiness, digital leadership projects can be looked at as added pressure issues due to a lack of training, equipment, connectivity, and/or confidence among employees. These same behaviors are more likely to result in engagement in a highly digitally ready hospitals where employees can use their efforts to translate leadership

support into positive digital work behavior (Lokuge et al., 2019; Venkatesh et al., 2003; Williams et al., 2015).

Therefore, employee engagement has been checked and included as a mediator to test the impact of Leadership 4.0 on organizational performance, while digital readiness has been tested as a moderator between the effects of Leadership 4.0 and employee engagement. This conditional process-based approach provides clarity on the condition for which the relationship between Leadership 4.0 and performance is weak (vs. strong) and to what degree of digital readiness (Edwards & Lambert, 2007; Hayes, 2022; Preacher, Rucker, & Hayes, 2007). The model centered itself on the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003; Williams et al., 2015), which posits that performance expectancy, effort expectancy, social influence and facilitating conditions impact technology acceptance and use. Leadership 4.0 was conceived as the social influence of leadership in institutions, digital readiness as facilitators, employees' engagement as the motivational response and organizational performance as the institutional outcome.

1.2 Healthcare Sector of South Punjab, Pakistan and the Digital Transformation Imperative

South Punjab's healthcare sector has come under strain to enhance the quality of healthcare, institutional efficiency, responsiveness and providing patient-centered care. Public and private healthcare providers in South Punjab are both adopting digital systems such as electronic medical records, online registration, diagnostic information systems, digital radiology, teleconsultation and computerized administration, but from different starting points: public hospitals typically depend on government budget cycles and centralized procurement, whereas private hospitals generally finance and upgrade their own systems, so infrastructure, training access and technical support are likely to differ between them. These initiatives align with the worldwide process of digitalization from the field of health, which involves the promotion of utilizing information and communication technologies

as a means to achieve better accessibility, quality and continuity of care (World Health Organization, 2021). However, the effective performance of such systems is not only a matter of technology (Cresswell & Sheikh, 2013; Greenhalgh et al., 2017; Vial, 2019) but in all probability dependent on leadership, employee readiness and organizational culture.

Hospitals are a typical example where we can introduce and study Leadership 4.0 in South Punjab healthcare setting due to Digital Illiteracy, uneven access to digital tools, limited resources, and physical overloading.

Lack of leadership and preparedness for the use of technology may lead employees to feel uncertain, resistant, anxious or overloaded with work (Venkatesh et al., 2003; Weiner, 2009). Organizational leaders with digital competency, on the other hand, can help to design and explain the value of digital technologies, train users and support the use of the technology, and provide a connection between the use of the technology and the improvement of patient care and the organization as a whole (Cortellazzo et al., 2019; Kane et al., 2019; Zeike et al., 2019).

Healthcare workers are key players in this change. Staff working in different roles within the hospital or clinic can be involved with interaction with the digital systems, such as doctors, nurses, radiologists, technicians, administrative staff, and HR personnel, who require documentation of care, coordination of patient flow, support in billing, monitoring personnel performance and providing information for decision-making.

Thus, the response at the employee level to digital leadership is of critical importance. However, the performance improvement of Leadership 4.0 may not manifest directly unless there is the engagement of employees with the process of digital transformation and the implementation of technology increases working speed, accuracy and quality (Schaufeli et al., 2002; Harter et al., 2002; Bailey et al., 2017). This phenomenon was not explored much in this study, so they decided to try out a medium of employee engagement between Leadership 4.0 and performance.

Interpretation. The research has basic logic as shown in Figure 1.1. Leadership 4.0 was hypothesized as the independent variable, employee engagement was hypothesized to be the mediator, and digital readiness was hypothesized to be the

moderator while organizational performance was supposed as the dependent variable. The direct pathway from Leadership 4.0 to organizational performance was aligned with the basic performance proposition while the indirect pathway via employee engagement represented the mediated mechanism. The dashed line from digital readiness to Leadership 4.0–employee engagement path, and moderated mediation based on UTAUT included the full model.

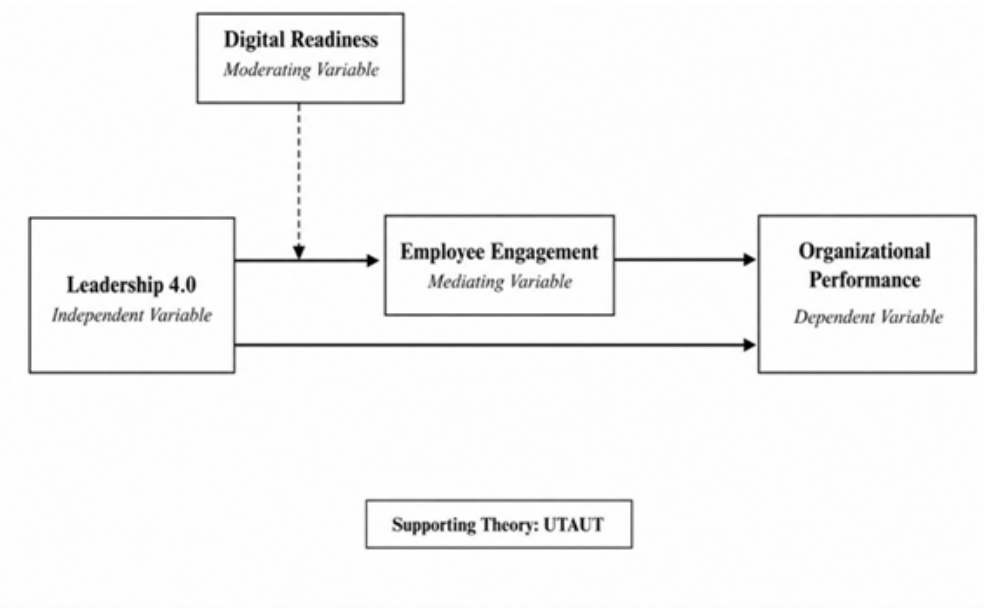


FIGURE 1.1: Proposed Moderated Mediation Model of the Study

1.3 Gap Analysis

Despite the extensive study on Leadership, organizational behavior, and performance, there are still a number of gaps in the field of Leadership 4.0, employee engagement, and digital readiness and performance in healthcare. First, previous research on leadership has primarily focused on classic leadership approaches like transformational, transactional, ethical, servant and authentic leadership, but in the context of digitalization of work more new demands emerge which are not adequately described by these classic approaches (Avolio et al., 2014; Cortellazzo et al., 2019; Dinh et al., 2014). Leadership 4.0 responds to those demands as it focuses on digital vision, agility, technology-enabled collaboration, innovation and

continuous learning in the context of Industry 4.0 (Kane et al., 2019; Schwab, 2016; Zeike et al., 2019).

Second, most of the literature has focused on the direct effects of leadership on performance but less has coddled the psychological route by which digital leadership leads to organizational effects. Employee engagement is a theoretically strong mechanism as the leadership has an influence on meaningfulness, psychological safety, competence and the willingness of employees to spend discretionary effort (Kahn, 1990; Saks, 2006). Although engagement is consistently associated with outcomes related to performance, the connection between Leadership 4.0, engagement, and organizational performance is poorly understood in healthcare (Bailey et al., 2017; Christian, Garza, & Slaughter, 2011; Knight et al., 2017).

Third, there is a lack of incorporation of digital readiness as boundary condition in leadership-performance models.

The success of digital leadership may be related to having sufficient digital infrastructure, digital skills of staff members, technology support and technology supportive culture (Lokuge et al., 2019; Weiner, 2009).

Theoretically, this gap will be significant as UTAUT emphasizes facilitating conditions as a factor of technology-related behavior (Venkatesh et al., 2003; Williams et al., 2015). If readiness is lacking, the "leadership" may not be acted upon. Readiness, leadership signals translate to engagement and performance.

TABLE 1.1: Summary of Major Research Gaps

Gap Type	**Explanation**	**How the Present Study Addressed the Gap**
Theoretical gap	Existing leadership theories do not fully capture digital leadership demands in Industry 4.0 healthcare settings.	The study used Leadership 4.0 and anchored it in UTAUT to explain digital leadership behavior.

Table 1.1 continued from previous page

Gap Type	**Explanation**	**How the Present Study Addressed the Gap**
Mechanism gap	Prior work often tested leadership-performance links without explaining the employee-level process.	Employee engagement was examined as the mediating mechanism between Leadership 4.0 and organizational performance.
Boundary-condition gap	Digital readiness has received limited attention as a moderator in healthcare leadership models.	Digital readiness was tested as a first-stage moderator of the Leadership 4.0-engagement relationship.
Contextual gap	Digital leadership research is concentrated in developed contexts and general organizations.	The study focused on healthcare organizations in South Punjab, Pakistan.
Methodological gap	Separate mediation and moderation models may fail to reveal conditional indirect effects.	The study adopted a moderated mediation model following conditional process logic.

Interpretation. As shown on the table, this study aims to make input theoretically, empirically, contextually and methodologically. What was most significant was not only the fact that the variables had been explored individually, but also that they seldom had been gathered and brought together into a single conditional process which clearly showed when Leadership 4.0 transformed to employee engagement, and then, through engagement, to organizational performance.

1.4 Novelty of the Study

The novelty of this research is that it brings together four conceptually distinct, but practically connected constructs - Leadership 4.0, employee engagement, digital readiness and organizational performance.

Leadership 4.0 was conceptualized as a characteristic of leadership that emerged with digitalization, employee engagement was considered as a motivational and behavioral mechanism, and digital readiness was considered as a boundary condition that facilitates it.

This integration was a response to a call for literature to shift towards process and context in leadership research in a digitally transformed world (Avolio et al., 2014; Cortellazzo et al., 2019; Dinh et al., 2014).

The second novelty was the implementation of UTAUT in a non-traditional perspective of the technology adoption model. Within the framework of the present research, Leadership 4.0 was translated into social influence, since Leadership 4.0 is about communicating expectations to employees and influencing their orientation towards digital systems.

Digital readiness was overlaid on the facilitating conditions, as infrastructural and skill and organization support factors are the necessary conditions for whether and how technology-related leadership can translate to action. Employees' engagement was considered the motivational reaction that employees used to translate the leadership influence into work behavior (Venkatesh et al., 2003; Williams et al., 2015).

The third novelty was "contextual". In South Punjab, Pakistan, the health sector is going through a digital transformation, and the leadership/readiness landscape is under-explored. The focus on healthcare employees in South Punjab, Pakistan provided context-specific evidence that may assist hospital leaders, HR managers, and administrators along with policymakers in enhancing their hospital's performance through digital transformation (World Health Organization, 2021).

1.5 Problem Statement

Many healthcare organizations have not yet evolved at the same rate as digital transformation on how it affects the structure of healthcare work, and therefore this has fallen out on leadership practices.

The traditional command and control leadership model is not enough to lead people through electronic records, electronic decision support, telemedicine, artificial intelligence-based diagnostics, and computerized workflows and data-driven performance management. Leaders can leave employees disengaged if they don't provide a clear digital vision, a sense of employee empowerment, and digital technological support and learning opportunities (Cortellazzo et al., 2019; Greenhalgh et al., 2017; Kane et al., 2019). As a result, hospitals can purchase digital tools, but fail to achieve the expected outcomes in terms of service quality, operational efficiency or an improvement in organizational performance (Vial, 2019; Verhoef et al., 2021).

Digital readiness is influencing it to be a problem, as there's some digital readiness and some wasn't. All employees must be added with digital skills, training, infrastructure, confidence, and technical support to react positively to Leadership 4.0. Thus, Leadership 4.0 impact on organizational performance can be contingent upon employees' engagement and digital readiness. The proposed solution to this problem was that employee engagement would mediate between Leadership 4.0 and organizational performance and digital readiness would moderate between Leadership 4.0 and employee engagement and between employee engagement and organizational performance (Edwards & Lambert, 2007; Hayes, 2022; Preacher et al., 2007).

1.6 Research Questions

RQ1: Does Leadership 4.0 have a significant direct impact on organizational performance in the healthcare sector of South Punjab, Pakistan?

RQ2: Does Leadership 4.0 have a significant impact on employee engagement in the healthcare sector of South Punjab, Pakistan? RQ3: Does employee engagement have a significant impact on organizational performance in the healthcare sector of South Punjab, Pakistan?

RQ4: Does employee engagement mediate the relationship between Leadership 4.0 and organizational performance in the healthcare sector of South Punjab, Pakistan?

RQ5: Does digital readiness moderate the relationship between Leadership 4.0 and employee engagement in the healthcare sector of South Punjab, Pakistan?

RQ6: Does digital readiness moderate the indirect effect of Leadership 4.0 on organizational performance through employee engagement in the healthcare sector of South Punjab, Pakistan?

1.7 Research Objectives

Objective 1: To examine the direct impact of Leadership 4.0 on organizational performance in the healthcare sector of South Punjab, Pakistan.

Objective 2: To investigate the impact of Leadership 4.0 on employee engagement in the healthcare sector of South Punjab, Pakistan.

Objective 3: To assess the impact of employee engagement on organizational performance in the healthcare sector of South Punjab, Pakistan.

Objective 4: To examine the mediating role of employee engagement in the relationship between Leadership 4.0 and organizational performance.

Objective 5: To determine the moderating role of digital readiness in the relationship between Leadership 4.0 and employee engagement.

Objective 6: To examine the moderated mediation effect of digital readiness on the indirect relationship between Leadership 4.0 and organizational performance through employee engagement.

1.8 Significance of the Study

1.8.1 Theoretical Significance

The study added the concept of Leadership 4.0 as a leadership construct for the digital era that can be used to explain performance in technologically evolving healthcare organizations. It furthered previous work on leadership in that it connected digital leadership behaviors with employee engagement and organizational outcomes using a moderated mediation model (Avolio et al., 2014; Cortellazzo et al., 2019; Dinh et al., 2014). The study further contributed to the literature on employee engagement by substituting the process of engagement as between work and individual as the behavioral link between digitally oriented leadership and institutional outcomes (Bakker & Demerouti, 2008; Kahn, 1990; Saks, 2006).

Additionally, the current study helped extend the theory of UTAUT by using it in the context of leadership and health care performance instead of just the context of individual technology acceptance. Leadership 4.0 was viewed as social influence, digital readiness as environmental conditions, employee engagement as motivation and attitudes and organizational performance as results from their time well-spent on the digital platform (Venkatesh et al., 2003; Williams et al., 2015). This theoretical mapping provided an integrated explanation of how digital leadership and readiness conditions through high levels of transformative learning potential can run in parallel to each other in the healthcare sector.

1.8.2 Practical Significance

The results of the study were supposed to help hospital executives, HR managers, department heads, and decision makers develop leadership programs to create digital vision, change facilitation, collaborative decision making, innovation support, and employee empowerment. But to survive in the modern era, technology must be used to enhance performance, and for that to happen someone must be able to manage uncertainty, promote the benefits of digital systems and encourage staff to

gain digital competence (Cresswell & Sheikh, 2013; Greenhalgh et al., 2017; Kane et al., 2019).

The study was also meaningful to practices in employee engagement. Employee engagement can have an impact in healthcare organizations when it comes to patient care, inter departmental coordination, response time, service quality and operational efficiency in hospitals (Bailey et al., 2017; Harter et al., 2002; Knight et al., 2017). Through identified mediator—engagement, the study indicated a need for the implementation of Leadership 4.0 not only as a technological or strategic implementation, but also as a human resource and organizational behavior intervention.

1.8.3 Contextual Significance

The study was contextually significant as it targeted the healthcare sector of South Punjab, Pakistan, wherein there is a need for digital transformation but it has not built up in public and private healthcare institutions, in an equal manner. Analysis of the data from this context can contribute to the understanding of leadership practices, employee engagement and digital readiness in relation to one another within a developing country healthcare context. This evidence is useful as digital transformation models of advanced economies cannot fully capture the infrastructure, resources and skills availability of the hospitals in South Punjab (World Health Organization, 2021; Weiner, 2009).

1.9 Supporting Theory

Unified Theory of Acceptance and Use of Technology (UTAUT) introduced by Venkatesh et al. (2003) was the supporting theory of the study. Four main constructs of UTAUT include performance expectancy, effort expectancy, social influence and facilitating conditions, which explain technology acceptance and use. Performance expectancy is the extent to which an individual perceives efforts to use technology will result in improved performance. Effort expectancy is the same as

perceived ease of use. Social influence is the pressure or encouragement (felt) from significant others to use technology. Facilitating conditions includes the provision of resources, knowledge and support for the effective use of technology (Venkatesh et al., 2003; Williams et al., 2015).

Leadership 4.0 is seen as a form of social influence as the role of the leader contributes to how employees think about digital work, how they use digital systems, and how they act regarding technology and communicate about the value of performance and digital tools. Digital readiness, on the other hand, is a facilitating condition as the availability of the infrastructure, training, support and digital confidence affect the ability of employees to respond to leadership messages. In this study, employee engagement was considered as the employees' motivational and behavioral state in which the employees embraced and exercised digital transformation; organizational performance was regarded as the overarching institutional consequence of employee engagement and digitally-supported work behavior (Lokuge et al., 2019; Venkatesh et al., 2003; Williams et al., 2015).

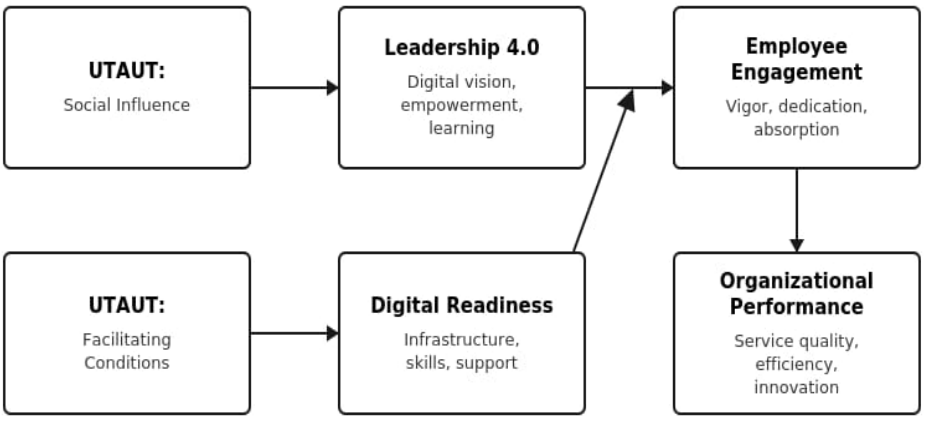


FIGURE 1.2: UTAUT-Based Theoretical Mapping of the Study Variables

Interpretation. The variables presented in the model were theoretically anchored as shown in the figure. Social influence was assessed by leadership 4.0, facilitating conditions by digital preparation, motivational response to technology enabled work through employee engagement, and the distal outcome by organizational performance.

This mapping resulted in the justification of using the theory of UTAUT as an explanatory theory for the leadership and performance model in digital healthcare.

1.10 Conceptualization of the Study Variables

Leadership 4.0 was thought to be a digital leadership orientation that could be reflected through five dimensions: vision, technological awareness, empowerment, collaboration and agility, innovation and continuous learning. Within healthcare, this type of leadership was expected to foster employee awareness of the importance of digital tools and to increase awareness of how technology can enhance work outcomes (Cortellazzo et al., 2019; Kane et al., 2019; Zeike et al., 2019).

Employee engagement was considered as a positive work-related state forming of vigor, dedication and absorption. Vigor was characterized by being energetic, resilient, unwilling to quit their jobs, Absorption was characterized by being focused on work, immersed in their work tasks (Schaufeli et al., 2002). Kahn (1990) and (Saks, 2006) suggested that the mechanism for Leadership 4.0 to manifest itself in organizational performance in this study would be through engagement.

Digital readiness was defined as the degree to which employees and hospitals had the materials, talent and systems and could work digitally. Lokuge et al. (2019) argued that this construct was suited to be analyzed as a moderator since it might be more effective in some hospitals and less effective in others (Weiner, 2009). Organizational performance was defined as the hospital's perceived performance in achieving elements of service quality, efficiency, innovation, productivity, patient satisfaction and strategic goals (Donabedian, 1988; Richard et al., 2009).

1.11 Scope and Delimitations of the Study

The study has been confined only to the Healthcare industry in Pakistan and particularly to the health employees from public and private hospitals.

Four constructs – Leadership 4.0, employee engagement, digital readiness, and organizational performance – were focused on in the study.

The unit of analysis was the individual healthcare employee as the model looked at employee's perceptions of leadership, readiness, engagement and performance.

The study design was quantitative non-experimental survey and did not involve experimental, ethnographic or longitudinal approaches.

Geographically, the study was limited to public and private hospitals located in Multan, Bahawalpur, Dera Ghazi Khan, Rahim Yar Khan, Muzaffargarh, and Vehari.

This study was delimited to a moderated mediation model. Other possible mediators such as psychological empowerment, organizational commitment, innovation behavior or change commitment were not included in the primary model.

Likewise, there are other moderators like organizational culture, technology anxiety/perceived organizational support that are not included in the scope of the study.

These boundaries aided in preserving coherence in theory and focus for analysis (Hayes, 2022; Preacher et al., 2007).

1.12 Operational Definitions

TABLE 1.2: Operational Definitions of Key Variables

Variable	**Role in Model**	**Operational Definitions**	**Key Sources**
Leadership 4.0	Independent variable	Perceived digital-era leadership behaviors, including digital vision, empowerment, collaboration, innovation support and technology-oriented learning.	Avolio, Kahai, and Dodge (2000); Cortellazzo et al. (2019); Zeike et al. (2019)

Table 1.2 continued from previous page

Variable	Role in Model	Operational Definition	Key Sources
Employee engagement	Mediating variable	A positive work-related state reflected in vigor, dedication and absorption.	Kahn (1990); Schaufeli et al. (2002); Saks (2006)
Digital readiness	Moderating variable	Availability of digital infrastructure, skills, confidence, support and organizational conditions required for digital work.	(Lokuge et al., 2019; Venkatesh et al., 2003; Weiner, 2009)
Organizational performance	Dependent variable	Perceived effectiveness of the healthcare organization in service quality, efficiency, innovation, productivity and goal attainment.	Donabedian (1988); Kaplan and Norton (1992); Richard et al. (2009)

Interpretation. The table was used to elucidate the use of each construct in the research. The definitions were tailored on the theoretical model, and the consistency between the literature review, instrument design and data analysis was maintained. Operational definitions also revealed that the study had been and included the perception of the staff as it had been the target of empirical data collection, which is a structured questionnaire.

1.13 Chapter Summary

This chapter has provided an introduction to the study and highlighted the relevance of Leadership 4.0 for digital transformation in healthcare organizations. It

suggested that Leadership 4.0 might positively affect organizational performance directly and indirectly through increased employee engagement, and that digital readiness might condition the relationship between Leadership 4.0 and employee engagement. The chapter also identified the theoretical and methodological gaps, research questions and objectives, significance, theoretical foundation and operational definitions. The subsequent chapter develops the study hypotheses in detail.

Chapter 2

Literature Review

2.1 Introduction

This chapter reviewed the literature related to Leadership 4.0, employee engagement, digital readiness and organizational performance in the healthcare sector. The chapter aimed to define these constructs, as well as to introduce the theory and empirical evidence to support the moderated mediation model proposed. The chapter then adopted a literature review style – starting with theory, and then moving to literature of the buildings, to literature of relationships and to the hypothesis. The key point to this was that Leadership 4.0 increases the performance of the organization by engaging employees and that digital readiness supports this process, giving the necessary enabling conditions for digital work (Cortellazzo et al., 2019; Hayes, 2022; Lokuge et al., 2019; Venkatesh et al., 2003). The chapter based upon six hypotheses were arranged. Leadership 4.0 to organizational performance, Leadership 4.0 to employee engagement and employee engagement to organizational performance were the first three hypotheses which were direct. The fourth hypothesis was related to the mediating variable of employee engagement. The fifth hypothesis was related to the moderating effect of digital readiness. The sixth hypothesis was a moderated mediation hypothesis, where we would expect the indirect pathway between Leadership 4.0 and organizational performance, through employee engagement, to depend on the level of Digital readiness (Edwards & Lambert, 2007; Preacher et al., 2007).

2.2 Unified Theory of Acceptance and Use of Technology

This study applies UTAUT as a theoretical lens since Leadership 4.0 is situated in a context of technology adoption, competencies with technology, and support technologies in the organizations. UTAUT has been created by Venkatesh et al. (2003), who combined several technology acceptance models and have determined that performance expectancy, effort expectancy, social influence and facilitating conditions serve as key factors in technology intentions and behavior. This theory has been extensively employed in studies related to the field of digital systems, as it incorporates the explanation of why people accept or refuse technology in an organizational setting (Dwivedi, Rana, Jeyaraj, Clement, & Williams, 2019; Williams et al., 2015).

UTAUT particularly applies to the healthcare sector as the implementation of digital systems can involve highly intricate work sets and rely on the willingness of employees or professionals to adopt them, which is influenced by factors such as self-efficacy, control over the system, job relevance, and response to technology.

People are likely to use digital technologies when they believe that it improves their work performance, is not overly difficult to use, organized influential actors lend their support and is accompanied with sufficient infrastructure and training, including within healthcare, doctors, nurses, technicians and administrative staff (Cresswell & Sheikh, 2013; Greenhalgh et al., 2017; Venkatesh et al., 2003).

UTAUT was extrapolated in this study towards a Leadership-Performance model. Leadership 4.0 was a social influence, as leadership created expectations of society as well as legitimate technology-led behavior. Digital readiness included facilitating conditions, and reflected infrastructure, skills and support. Employee engagement was a motivational condition that resulted in productive action in regard to the technology aspects of leadership.

There was a general level of engagement and digitally enabled in work that resulted in organizational performance (Lokuge et al., 2019; Venkatesh et al., 2003; Williams et al., 2015).

TABLE 2.1: Mapping of UTAUT Constructs with the Proposed Study Variables

UTAUT Construct	**Study Variable**	**Reason for Mapping**	**Expected Role in Model**
Social influence	Leadership 4.0	Leaders shaped digital norms, expectations and employee interpretation of technology.	Primary influence triggering engagement.
Facilitating conditions	Digital readiness	Digital infrastructure, skills, training and support enabled employees to act on leadership guidance.	Boundary conditions shaping the strength of leadership effects.
Performance expectancy and effort expectancy	Employee engagement	Employees were more likely to become engaged when digital work was perceived as useful and manageable.	Behavioral and motivational mechanism.
Use behavior / outcome	Organizational performance	Engaged and digitally supported employees contributed to service quality, efficiency and innovation.	Final outcome of the model.

Interpretation. The mapping showed that UTAUT can be logically used in the suggested moderated mediation model. The theory helped to explain why Leadership 4.0 alone was not enough, employees also needed "facilitating conditions" (digital readiness) to facilitate the change of leadership influence on engagement and performance.

2.3 Leadership 4.0

Leadership 4.0 is a leadership style related to the Fourth Industrial Revolution. Promotes digital vision, agility, technology awareness, data-driven decision making, collaborative work design, employees' empowerment, ethical use of technology and innovation and continuous learning (Cortellazzo et al., 2019; Kane et al., 2019; Zeike et al., 2019). Leadership 4.0 demands different leadership approaches that focus on providing workers with autonomy, learning opportunities and support for change; rather than on the hierarchy and control that are characteristic of more traditional approaches (Avolio et al., 2014; Schwab, 2016).

It is linked to the notion of e-leadership and digital leadership. E-leadership research emphasized that IT does not only produce and transmit a new way of communication content but also a new way of influence in organizations (Avolio et al., 2000, 2014). Leadership 4.0 gives continuity to this concept emphasizing the competencies required to a digitally intelligent organization such as being able to use data, to be an innovator, to support digital collaboration, to align human capabilities with technology systems (Cortellazzo et al., 2019; Sacavém et al., 2025; Vial, 2019).

Leadership 4.0 is applicable to healthcare because it involves managing multiple aspects such as patient care, operational efficiency, digital transformation, and employee wellness. Electronic health systems, diagnostic mechanisms, or digital tools for patient management are just some of the technologies needed to be implemented across a hospital that cannot be done without communication of the importance of the technology, support and encouragement of technologies as means by which employees learn to think differently (Cresswell & Sheikh, 2013; Greenhalgh et al., 2017). So, Leadership 4.0 is a technology-oriented leadership and human centered leadership behavior (Kane et al., 2019; Zeike et al., 2019).

There were multiple aspects of Leadership 4.0 that were applicable to this research. Digital vision" is the capability of a health care executive to communicate how technology can help improve health care outcomes. Empowerment is giving employees autonomy to tackle problems and greater involvement in Digital decisions.

Innovation Support: To promote experimentation and improvement. Learning orientation is the encapsulated aspect of training, feedback and ongoing learning. To work out efficiency and quality, data-driven decision making is the use of trusted data. These dimensions can combine to affect engagement and performance in a digital health environment (Cortellazzo et al., 2019; Vial, 2019; Zeike et al., 2019).

2.4 Organizational Performance in Healthcare

Organizational performance is a generic term that measures the efficiency and effectiveness of an organization in meeting its goals. For general management studies, performance could be a financial outcome, operational efficiency, innovation or productivity, growth and stakeholder satisfaction (Kaplan & Norton, 1992; Richard et al., 2009; Venkatraman & Ramanujam, 1986).

This is even more the case in healthcare, where hospital efficiency, patient experience, hospital safety, employee morale, ethical care and public value are all important considerations (Donabedian, 1988; Porter & Teisberg, 2006).

Healthcare surfaces frequently can be talked about in terms of structure, process and outcome. According to Donabedian (1988) the quality of care consists of the following: Structural conditions, Care processes and Patient outcomes.

Leadership and digital readiness can be regarded as structural and process enablers since they influence workers' behavior about using systems to coordinate jobs, document care and touch patients. Employee engagement is also a factor in performance because when employees are engaged, they are likely to focus, they will communicate and deliver a steady level of service (Bakker & Demerouti, 2008; Harter et al., 2002).

As for this research, the organizational performance was defined as perceived performance instead of audited clinical and/or financial measurements. In cases where there is a lack of objective performance data or where objective performance data are hard to compare across organizations, perceived performance measures are used (Delaney & Huselid, 1996; Richard et al., 2009). As part of the healthcare

industry, its workers are well-positioned to measure operational efficiency, innovation, satisfaction, coordination and goal fulfilment among the various hospital departments.

2.5 Leadership 4.0 and Organizational Performance

The leadership 4.0 will help to boost the organization's performance as digital-era leaders are able to coordinate with technology with their strategic thinking and have proficient abilities in motivating employees and promoting coordination and innovation.

However, in the digitalized world leaders are major players in establishing a digital culture, in facilitating collaborative processes among dispersed stakeholders (Cortellazzo et al., 2019).

This is particularly significant for the healthcare sector as coordination between departments, timely exchange of data, and patient-centered approach and decisions are integral to the performance of the hospital (Cresswell & Sheikh, 2013; Donabedian, 1988).

We can explain the relationship between Leadership 4.0 and organizational performance in several ways. For one, digital leaders help to define strategic priorities and make sure that staff understand the value of technology in performance. This extends performance expectancies along with a lack of uncertainty (Venkatesh et al., 2003; Williams et al., 2015).

Secondly, Leadership 4.0 fosters employee learning, which decreases the effort expectancy and increases the probability that employees will use digital system effectively (Kane et al., 2019; Zeike et al., 2019). Thirdly, digital leaders facilitate innovation and continuous improvement, and thus contribute to increasing efficiency, the level of service and adaptability (Vial, 2019; Verhoef et al., 2021). Empirical literature on digital leadership points towards the importance of leadership to digital transformation outcomes. Several studies on leadership in digitalized

organizations have emphasized the need for leadership to develop digital culture, foster collaboration, address ethical concerns, and promote innovation (Cortellazzo et al., 2019; Sacavém et al., 2025). Site-based factors, such as leadership support, are a common hurdle to successful implementation of digital technologies, as employees may need support and resources to adapt to change (Cresswell & Sheikh, 2013; Greenhalgh et al., 2017). Thus, Leadership 4.0 will probably be positively correlated with the organizational performance in hospitals.

H1: Leadership 4.0 has a positive and significant impact on organizational performance.

2.6 Leadership 4.0 and Employee Engagement

Leadership has a powerful impact on employee engagement, as it drives work meaning and impacts psychological safety, autonomy, support and recognition. Kahn (1990) proposed that for employees to be engaged, they need to feel "safe and available" as well as feel "meaningful. Leadership 4.0 can improve these psychological conditions through: having a clear digital purpose; fostering participation; lessening fear of technology and supporting continuous learning (Avolio et al., 2014; Cortellazzo et al., 2019). If they are convinced that digital transformation has a meaningful purpose and provide them with the resources to achieve it, employees will be more likely to put in effort and focus on their work (Bakker & Demerouti, 2008; Saks, 2006).

Leadership 4.0 also impacts engagement by empowering employees. Change and transition in the digital transformation process can lead to uncertainty and anxiety, especially when workers are afraid of losing their job, being monitored or having more work. When leaders make sure to engage employees in digital decisions, train and model constructive technology use, it can minimize resistance and increase engagement (Kane et al., 2019; Vial, 2019; Zeike et al., 2019). This is particularly pertinent to the healthcare sector, where workers are expected to engage with digital tools while simultaneously handling challenging care and administration tasks (Cresswell & Sheikh, 2013; Greenhalgh et al., 2017).

U.T.A.U.T. also can be used to interpret the relationship. Leadership 4.0 is social because it conveys digital systems are important and expected. With leaders communicating in relation to the benefits of the technology and providing support, employees might consider technology as more beneficial and manageable thereby increasing their willingness to engage with digital work (Venkatesh et al., 2003; Williams et al., 2015). Hence, Leadership 4.0 is anticipated to reinforce the employee's engagement in healthcare organizations.

H2: Leadership 4.0 has a positive and significant impact on employee engagement.

2.7 Employee Engagement and Organizational Performance

One of the most popular constructs in the study of motivational aspects in organizational behavior is employee engagement. High energy, dedication and absorption by engaged employees can lead to improved task performance, organizational citizenship behavior, innovation (Bakker & Demerouti, 2008; Christian et al., 2011; Schaufeli et al., 2002) and reduced turnover intentions. In the context of healthcare, engagement is also crucial as employees' effort and attentiveness contribute to the quality of services and communications with patients, safety and reliable operations (Bailey et al., 2017; Knight et al., 2017).

The concept of engaged employees comes from the idea that engaged employees apply their cognitive, emotional and physical capabilities to their jobs (Kahn, 1990). When your workforce is in prime condition, they're capable of holding up in challenging landscapes. Dedicated when they give significance to their job and work organization objectives. When absorbed, their focus is deep into the tasks that they are performing. These types of engagements can have a positive effect on performance in the organization (Harter et al., 2002; Bakker & Demerouti, 2008; Macey & Schneider, 2008) they promote productivity and service to others and engagement responsiveness. Digital enablers need to be used, and, in the context of digitally transforming healthcare organizations, engagement might be even more

crucial. Employees that are engaged tend to be more willing to accept new systems, are more willing to share information about the company, like websites, and are more likely to use it in their jobs, to take part in improvement projects and to learn a new system (Saks, 2006; Venkatesh et al., 2003). Thus, employee engagement is expected to have a positive effect on the organization's performance.

H3: Employee engagement has a positive and significant impact on organizational performance.

2.8 Employee Engagement as a Mediator between Leadership 4.0 and Organizational Performance

The mediator that was proposed was employee engagement as the response must come on the employee level to see if this could be the connection between how leadership acts and the results of an organization. Employees execute the results of the strategies and vision and systems, by responding to patients and delivering high-quality service and fostering innovation (Saks, 2006; Avolio et al., 2014). In this regard, engagement serves as a behavioral and motivational pathway to achieve organizational performance and success within Leadership 4.0. Leadership 4.0 makes things digital and meaningful, and supportive employees translate the influence of this leadership into behavior that leads to better performance (Kahn, 1990; Schaufeli et al., 2002).

This mediating role of "engagement" is in line with social exchange theory and engagement theory. Employees may respond to leader support, digital skill development and empowering employees to manage change with increased engagement and performance, as well (Saks, 2006). Leadership 4.0 offers resources like information, autonomy, support for learning and psychological security that can contribute to strengthen engagement. This, in turn, boosts employee commitment towards organizational goals and digital change (Bakker & Demerouti, 2008; Christian et al., 2011).

The mediating effect of engagement is likely especially true in healthcare, where teamwork across different departments, and in relation to patients, and employee discretion, are crucially tied to the outcomes of employee performance. Although a digitally competent leader may start out new systems, it is a requirement that workers must utilize such systems with commitment and care.

Unless you also help employees apply technology and leadership to their work, improvements in performance will not necessarily occur. Leadership 4.0 can result in better quality of service, efficiency and innovation if employees will be engaged (Bailey et al., 2017; Cresswell & Sheikh, 2013; Greenhalgh et al., 2017).

H4: Employee engagement mediates the relationship between Leadership 4.0 and organizational performance.

2.9 Digital Readiness

Digital readiness is an individual or organization's ability to adopt, use and gain value from digital technologies. It involves technical infrastructure, digital skills, training, accessibility of the systems, managerial support, and digital culture and confidence in digital technology (Lokuge et al., 2019; Weiner, 2009). Readiness matters as technology implementation is often unsuccessful when organizations introduce technology without getting ready, structuring, processes and capabilities (Greenhalgh et al., 2017; Vial, 2019).

Digital readiness is on an organizational scale and on an individual level. Organizational readiness entails having digital infrastructure, technical support, leadership commitment, and policy and process alignment. Readiness at the individual level includes digital literacy, self-efficacy, perceived ease of use, willingness to learn and perceived confidence in the technology supported work (Lokuge et al., 2019; Venkatesh et al., 2003). Both are important in healthcare as workers might want to use a digital system but not if connectivity is limited, systems are prone to failure or there is incomplete training. Likewise, whilst hospital may have the infrastructure to gain any performance from this, it can only be achieved when

employees have confidence and motivation (Cresswell & Sheikh, 2013; Greenhalgh et al., 2017).

Theoretically speaking, (facilitating conditions) concept is supported in the UTAUT model in digital readiness topic. Facilitating conditions are the extent to which people feel there is organizational support for technology use and technology implementation, and technical infrastructure (Venkatesh et al., 2003). Encouragement of technology use translates to behavior if conditions for use are strong. In the context of facilitation, if conditions are not conducive, employees can view technologies as difficult to use, unwelcome or risky (Williams et al., 2015).

2.10 Digital Readiness as a Moderator between Leadership 4.0 and Employee Engagement

Digital readiness was proposed as a moderator because the extent to which Leadership 4.0 translates into employee engagement may vary according to employees' and hospitals' preparedness for digital work. Leadership can communicate vision, empowerment and support, while digital readiness reflects the availability of functioning systems, skills, training and technical assistance. Differences in these facilitating conditions can therefore alter how employees respond to the same leadership behaviors across healthcare settings (Lokuge et al., 2019; Weiner, 2009).

This moderate logic is consistent with UTAUT. Leadership 4.0 represents social influence, whereas digital readiness reflects facilitating conditions. UTAUT suggests that behavioral responses to social influence occur within a wider context of resources and support for technology use (Venkatesh et al., 2003; Williams et al., 2015). Accordingly, the present study tests whether the Leadership 4.0-employee engagement relationship changes across levels of digital readiness without prescribing a particular direction for the interaction effect.

Healthcare organizations differ in the reliability of information systems, training for electronic records, technical support, digital workflow protocols and managerial support. Such variation provides a theoretical basis for moderation because

employees may interpret and respond to Leadership 4.0 differently depending on the readiness conditions available in their work environment (Cresswell & Sheikh, 2013; Greenhalgh et al., 2017).

H5: Digital readiness significantly moderates the relationship between Leadership 4.0 and employee engagement.

2.11 Digital Readiness and the Moderated Mediation Effect

Moderated mediation is a conditional indirect effect in which the strength of the mediation process depends on the level of the moderating variable (Edwards & Lambert, 2007; Hayes, 2022; Preacher et al., 2007). In this study, it was hypothesized that the indirect relationship between Leadership 4.0 and organizational performance through employee engagement would vary across levels of digital readiness. The model therefore examines both how Leadership 4.0 influences performance and whether the magnitude of that indirect mechanism differs according to readiness conditions.

The moderated mediation logic recognizes that employees experience digital leadership within different organizational readiness conditions. Infrastructure, training, support and digital confidence can change how employees interpret and act on leadership guidance, so the Leadership 4.0-engagement pathway may not have the same strength at every level of digital readiness (Lokuge et al., 2019; Venkatesh et al., 2003; Williams et al., 2015). This provides a non-directional theoretical basis for testing the conditional indirect effect.

As employee engagement increases, employees are expected to contribute to organizational performance through improvements in service quality, responsiveness, innovation and coordination. In the proposed conditional process model, digital readiness conditions the first-stage relationship between Leadership 4.0 and engagement and, consequently, may condition the indirect relationship between Leadership 4.0 and organizational performance. This model is theoretically richer

than a simple direct-effect model because it assesses both the psychological mechanism and the contextual readiness conditions (Hayes, 2022; Preacher et al., 2007).

2.12 Conceptual Framework and Hypotheses

The conceptual framework tested in this study is presented in Figure 1.1 in Chapter 1 and is restated here for reference.

Interpretation. Figure 1.1 depicts a moderated mediation model with a first-stage moderator.

This leadership 4.0 affected organizational performance in both direct and indirect pathways by means of employee engagement.

The mediation effect of Digital readiness regulated the linkage between Leadership 4.0 and employee engagement; this means that the mediation effect was different for low and high levels of readiness.

This model is the same as Hayes PROCESS Model 7 in which the moderator is situated on the first step of the mediation pathway.

TABLE 2.2: Literature Matrix of Key Studies Supporting the Proposed Model

Author(s)	**Context / Focus**	**Major Contribution**	**Relevance to Present Study**
Venkatesh et al. (2003)	Technology acceptance	Developed UTAUT with performance expectancy, effort expectancy, social influence and facilitating conditions.	Provided the theoretical foundation for digital leadership and readiness.
Cortellazzo et al. (2019)	Digital leadership review	Identified leadership as central in building digital culture and collaboration.	Supported the relevance of Leadership 4.0.

Table 2.2 continued from previous page

Author(s)	Context / Focus	Major Contribution	Relevance to Present Study
(Zeike et al., 2019)	Digital leadership skills	Linked digital leadership skills with employee-related outcomes.	Supported digital leadership as a measurable leadership orientation.
Kahn (1990)	Engagement theory	Defined engagement through psychological meaningfulness, safety and availability.	Supported employee engagement as a mediator.
(Schaufeli et al., 2002)	Work engagement	Conceptualized engagement as vigor, dedication and absorption.	Provided the engagement construct.
(Bailey et al., 2017)	Engagement review	Synthesized antecedents and outcomes of engagement.	Supported the engagement-performance relationship.
(Lokuge et al., 2019)	Digital readiness	Developed organizational readiness for digital innovation construct.	Supported digital readiness as a moderator.
(Hayes, 2022)	Conditional process analysis	Provided methodological logic for mediation, moderation and moderated mediation.	Guided the proposed analysis model.

Interpretation. The literature matrix reveals that the study borrows from a mix of literature within the technology acceptance theory, digital leadership research,

employee engagement literature and digital readiness research and conditional process methodology. This blend warranted the built-in formulation of the present model and the order of hypotheses.

TABLE 2.3: Summary of Hypotheses

Hypothesis	**Statement**	**Relationship Type**
H1	Leadership 4.0 has a positive and significant impact on organizational performance.	Direct effect
H2	Leadership 4.0 has a positive and significant impact on employee engagement.	Direct effect
H3	Employee engagement has a positive and significant impact on organizational performance.	Direct effect
H4	Employee engagement mediates the relationship between Leadership 4.0 and organizational performance.	Mediation
H5	Digital readiness significantly moderates the relationship between Leadership 4.0 and employee engagement.	Moderation
H6	Digital readiness moderates the indirect relationship between Leadership 4.0 and organizational performance through employee engagement.	Moderated mediation

Interpretation. The hypotheses have been developed in a logical manner taking us from direct effects to mediation to moderation and moderated mediation. This design helped the study examine the influence of Leadership 4.0 on performance,

the mediation role of engagement in this relationship, and the moderation of digital readiness.

2.13 Chapter Summary

Literature regarding Leadership 4.0, employee engagement, digital readiness, organizational performance and UTAUT was reviewed in this chapter. It established Leadership 4.0 as a relevant leadership construct in the digital era in healthcare, employee engagement as a plausible mediator, and digital readiness as a facilitating condition that may shape the strength of digital leadership effects. Six hypotheses were formulated from the reviewed literature. The next chapter presents the methodology adopted to test the proposed model.

Chapter 3

Research Methodology

3.1 Introduction

The methodology that was adopted to analyze the impact of Leadership 4.0 on organizational performance through employee engagement under the moderating role of digital readiness is provided in this chapter. The research philosophy, approach, research design, population, sampling strategy, data collection procedure, measurement instruments, data screening, reliability and validity procedure, common method bias control, data analysis plan and ethical consideration are explained in the chapter. To examine the direct, statistical mediation, statistical moderation, and moderated mediation hypotheses in a statistically rigorous fashion (Creswell & Creswell, 2018; Hair, Black, Babin, & Anderson, 2019; Hayes, 2022).

3.2 Research Philosophy and Approach

The study presumed a post-positivist approach since it was used to address theoretical testing of relationships between "measurable" constructs using quantitative data. Post-positivism acknowledges that social phenomena can be studied through observable indicators but will recognize that evidence is only tentative and not determined (Creswell & Creswell, 2018; Saunders, Lewis, & Thornhill, 2019). This

philosophy was suitable as it used standardized question items that focused on employee perceptions of Leadership 4.0, employee engagement, digital readiness and organizational performance.

A deductive research approach was used. The study started with theory and literature, were followed by hypothesis development from resultant theories such as UTAUT, engagement theory and literature of digital leadership and was then followed by testing the hypothesis through the use of empirical data.

The studies employed the deductive approach because the relationships between the variables are specified in advance of data collection and it was to examine if their proposed model will hold in the healthcare sector of South Punjab, Pakistan (Saunders et al., 2019; Sekaran & Bougie, 2016).

TABLE 3.1: Methodological Choices Adopted in the Study

Methodological Element	**Choice Adopted**	**Justification**
Research philosophy	Post-positivism	The study tested measurable relationships while recognizing that findings were probabilistic.
Research approach	Deductive	Hypotheses were derived from theory and tested empirically.
Research design	Quantitative explanatory survey	The model required statistical testing of direct, indirect and conditional effects.
Time horizon	Cross-sectional	Data were collected from respondents at one point in time.
Unit of analysis	Individual healthcare employee	The constructs were measured through employee perceptions.

Table 3.1 continued from previous page

Methodological Element	Choice Adopted	Justification
Data source	Primary questionnaire data	Standardized responses were needed for hypothesis testing.

Interpretation. The study design as seen in the table was matched to the goal of hypothesis testing. The research was quantitative and cross-sectional/survey-based that also seems to be a suitable choice, since the analyses concerned relationships among latent variables, but not 'qualitative' meaning and/or intervention effects.

3.3 Research Design and Type of Study

The research design was quantitative in nature with an explanatory approach. This study was designed to be quantitative due to the need for the numerical measurement of the latent variables and statistical analysis of the hypothesized relationship between them, as suggested by Creswell and Creswell (2018). The research design was explanatory, as the study was expected to explain how Leadership 4.0 influenced organizational performance via employee engagement with the consideration of digital readiness. The study was also correlational in nature as it examined the relationships between variables and no condition was manipulated.

A cross-section survey design was adopted. Information was gathered from the healthcare workers in selected hospitals (public and private) at one point in time. In organizational behavior and management research, cross-sectional studies are popular owing to their efficiency and ability to have a relatively large number of respondents submit perceptions for the study (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Sekaran & Bougie, 2016). The cross-sectional design was appropriate for the research aim and the statistical analysis planned. Longitudinal data

would have been more informative for causal inference but weren't necessary for the purpose of this research.

3.4 Population, Unit of Analysis and Sampling Frame

The subjects who responded to the questionnaire were employees of the health care sector of public and private hospitals of South Punjab, Pakistan.

These were all the relevant employee categories: doctors, nurses, allied health professionals, technicians, administrative staff, and IT/health informatics staff who had contact with hospital processes and digital systems.

The groups chosen were selected because they adapted to leadership practices, used or were impacted by digital systems, and affected organizational performance by providing service and/or coordinating or administrative support (Cresswell & Sheikh, 2013; Greenhalgh et al., 2017).

The sampling frame was restricted to hospitals in Multan, Bahawalpur, Dera Ghazi Khan, Rahim Yar Khan, Muzaffargarh, and Vehari, representing the South Punjab region.

The individual health care worker was used as the unit of analysis. This was fitting as the study was conducted with regards to personal perception of Leadership 4.0, employee engagement, readiness to the Digital Era and organizational performance.

Although organizational performance can be observed at the institutional level, organizational research frequently relies on employee perceptions of that performance, particularly where objective performance measures are unavailable, inconsistently maintained across institutions, or not comparable between public and private hospitals (Delaney & Huselid, 1996; Richard et al., 2009).

Interpretation. The sampling frame focused on employees who had opportunities for seeing leadership behaviors and were impacted by digital transformation in

their job. The respondent groups included varied distribution of clinical, technical/administrative sections within the hospital's activities which aided in the collection of perceptions from all areas.

Table 3.2: Hospital Sampling Frame

Respondent Group	**Reason for Inclusion**	**Expected Relevance to Variables**
Doctors	Doctors were directly involved in clinical decision-making and patient care.	They experienced digital leadership through clinical systems, EHRs and decision-support tools.
Nurses	Nurses coordinated patient care and documentation across shifts.	They contributed to engagement and service quality outcomes.
Administrative staff	Administrative staff handled patient registration, billing, reporting and coordination.	They interacted with hospital information systems and performance processes.
IT/Health informatics staff	IT and health informatics staff maintained hospital information systems and supported digital workflows.	They were relevant to employee engagement and digital readiness initiatives.
Radiology / laboratory staff	These employees used digital imaging and diagnostic systems.	They were directly affected by digital infrastructure and readiness conditions.
Technicians and support employees	Support staff contributed to operational continuity and system-dependent workflows.	Their responses reflected practical readiness and implementation challenges.

3.5 Sample Size and Sampling Technique

The target sample for the study was 350-400 respondents, and more than 400 questionnaires were circulated in order to achieve it. This sample interval was deemed appropriate for a moderated mediation model testing multiple latent constructions and interactions. Bigger samples mean higher significance statistics and lower standard errors and more stable estimates in PROCESS analysis and regressions in papers that require that kind of analysis (Cohen, 1992; Faul, Erdfelder, Buchner, & Lang, 2009; Hair et al., 2019; Hayes, 2022).

A non-probability convenience sampling technique was used because of the practical difficulties in accessing the hospitals, hospital permission, staff availability and time. Convenience sampling is often employed in the organizational context where the sampling frame is not known, and it has to rely on the institutional consent to get access to the sample members (Sekaran & Bougie, 2016; Saunders et al., 2019). As the inclusion criteria for samples, the respondents had to be those who were working in the health care sector and had been exposed enough to the work systems and leadership practices in the selected hospitals to render the samples relevant.

3.6 Data Collection Procedure

Structured questionnaire method was used for data collection of the Primary data. In cases where it was required, permission was sought from the relevant authorities or departmental heads of the hospital prior to the data collection. Respondents were told the academic nature of research, that there was no requirement to participate, answers were confidential and the length of time it would take to complete the questionnaire. The questionnaire was sent in printed or web format based on the access of the hospital and convenience of respondents. Data collection was conducted exclusively in selected public and private hospitals situated in Multan, Bahawalpur, Dera Ghazi Khan, Rahim Yar Khan, Muzaffargarh, and Vehari.

The questionnaire started with the informed consent statement and then included the demographic questions and scale items of Leadership 4.0, employee engagement, digital readiness, and organizational performance. Respondents were asked to answer objectively in the light of the perception they had in their workplace. We did not ask for details to identify a person. Completed questionnaires were checked for missing answers, straight lining and careless response patterns, prior to statistical analysis (Podsakoff et al., 2003; Saunders et al., 2019).

3.7 Research Instrument and Measures

The study instruments were a structured questionnaire. The questionnaire was divided into 5 sections. Demographic variables were obtained in Section A: gender, age group, professional qualification, hospital type, city of posting, job position, department, work experience, monthly income and whether the respondent had received formal training on the digital systems used in the organization. Leadership 4.0 was measured in Section B. Employee engagement was measured in Section C. Digital readiness was measured in section D. Organizational performance was measured in section E. Each of the main items in the construct was determined by a five-point Likert scale from 1 = strongly disagree to 5 = strongly agree.

Leadership 4.0 items were based on items from digital leadership literature and Leadership 4.0. materials, especially items related to digital vision and digital culture, empowerment and innovation, and Leadership 4.0 item technology enabled leadership behavior (Avolio et al., 2014; Cortellazzo et al., 2019; Zeike et al., 2019). The employee engagement items are adapted from the Utrecht Work Engagement Scale, which includes the items vigor, dedication and absorption (Schaufeli et al., 2002; Schaufeli, Bakker, & Salanova, 2006). Digital readiness items were adapted from the literature on organizational readiness and digital innovations readiness (Lokuge et al., 2019; Weiner, 2009). Organizational performance measures were drawn from related literature related to perceived organizational performance which includes service quality, efficiency, innovation and goal achievement (Delaney & Huselid, 1996; Richard et al., 2009).

TABLE 3.3: Measurement Sources and Construct Dimensions

Construct	**Role**	**Indicative Dimensions**	**Primary Sources**
Leadership 4.0	Independent variable	Digital vision, empowerment, innovation support, agility, data-driven orientation and learning support.	Avolio et al. (2014); Cortellazzo et al. (2019); Zeike et al. (2019)
Employee engagement	Mediator	Vigor, dedication and absorption.	(Kahn, 1990; Schaufeli et al., 2002, 2006)
Digital readiness	Moderator	Infrastructure, digital skills, training, confidence, technical support and digital culture.	(Lokuge et al., 2019; Weiner, 2009)
Organizational performance	Dependent variable	Service quality, efficiency, innovation, productivity, patient orientation and goal attainment.	Delaney and Huselid (1996); Richard et al. (2009)

Interpretation. It can be observed from the table that all the constructs were measured using items that were developed based on the related literature. The measurement structure was in line with the conceptualization and enabled the model to be tested by means of a latent variable analysis and conditional process regression analysis.

3.8 Pilot Testing

A pilot test was carried out prior to collecting the data. Pilot test was conducted with small group of employees in the health care sector similar to the target respondents. The goal for conducting the pilot test was to explore item clarity, length of questionnaire, wording, and response format and preliminary reliability. Questions that were ambiguous were refined by feedback from pilot participants, and to ensure all items were understandable in the healthcare setting (Creswell & Creswell, 2018; Sekaran & Bougie, 2016).

Cronbach's alpha was used to determine reliability of pilot. It was deemed as good internal consistency if scores were .70 or higher, but scores just below .70 were considered acceptable in an exploratory context if demonstrating a theoretical basis (Hair et al., 2019; Nunnally & Bernstein, 1994). To test items that decreased reliability or seemed conceptually inconsistent were screened out prior to distributing the final questionnaire. All items were found reliable.

3.9 Data Screening

Before testing the hypothesis, data was screened. Complete response patterns, absence of response items, outliers, normality, multicollinearity and coding mistakes were checked. Records where too much data was missing were dropped and wherever not much data was missing, suitable process was adopted based on the nature of missingness. However, straight-lining and very short completion times were considered potentially indicators of careless responding (Hair et al., 2019; Tabachnick & Fidell, 2019).

Skewness, kurtosis and visual inspection were used to check normality. Because the hypotheses were tested using ordinary least squares regression and percentile bootstrap confidence intervals in the PROCESS macro, strict multivariate normality was not required; bootstrapping makes no distributional assumption about the sampling distribution of the indirect effect. Screening for normality nevertheless remained necessary to understand the data and to confirm that the parametric

regression estimates were not distorted by severe skews or extreme cases (Hayes, 2022; Tabachnick & Fidell, 2019). The variance inflation factor was used to test multicollinearity, with values below 5.0 treated as acceptable for regression-based analysis (Hair et al., 2019; Tabachnick & Fidell, 2019).

Table 3.4: Data Screening Criteria

Screening Area	**Procedure Used**	**Acceptable Criterion / Decision Rule**
Missing values	Frequency analysis and item-level inspection	Cases with excessive missing data were removed; minor missingness was treated cautiously.
Outliers	Standardized values and Mahalanobis distance where applicable	Extreme cases were reviewed and retained or removed based on statistical and substantive judgment.
Normality	Skewness, kurtosis and visual inspection	Values within acceptable ranges were considered suitable for parametric analysis and bootstrapping.
Multicollinearity	Variance inflation factor (VIF)	VIF values below common thresholds indicated no serious collinearity problem.
Careless responses	Straight-lining and response pattern review	Unengaged or inconsistent cases were excluded from final analysis.

Interpretation. Due to the screening procedure, it was established that the data set was clean and appropriate for analyses. This served to bolster confidence in the

results, as measurement and structural tests can be biased due to missing data, sloppy measurement, or extreme multicollinearity.

3.10 Reliability and Validity

Reliability was assessed in SPSS using Cronbach's alpha, supplemented by composite reliability calculated manually from the factor loadings obtained in exploratory factor analysis. Cronbach's alpha indicates the internal consistency of a set of items, while composite reliability relaxes the assumption of equal item loadings and therefore provides a second, less restrictive estimate of scale reliability (Hair et al., 2019; Nunnally & Bernstein, 1994).

Values equal to or greater than .70 were treated as acceptable, and values above .95 were examined for item redundancy.

Convergent validity was examined through exploratory factor analysis in SPSS. Each construct was subjected to a separate single-factor principal axis factoring extraction, and average variance extracted (AVE) was computed as the mean of the squared loadings.

Items with loadings below .70 were retained where they were theoretically important and where composite reliability remained acceptable. AVE values of .50 or above were treated as the conventional benchmark, on the basis that a construct should explain at least half of the variance of its indicators (Fornell & Larcker, 1981; Hair et al., 2019). A separate four-factor principal component analysis with varimax rotation was also run across all forty items to confirm that the items grouped onto the four intended constructs.

Discriminant validity was examined using the Fornell-Larcker criterion, which requires the square root of a construct's AVE to exceed that construct's correlation with every other construct in the model (Fornell & Larcker, 1981). The rotated factor structure obtained from the four-factor principal component analysis provided supporting evidence, in that each item was expected to load on its own construct without substantial cross-loading onto the remaining three.

3.11 Common Method Bias

Common method bias was dealt with using procedural as well as statistical measures since the same respondents were used and the same questionnaire was used. In terms of procedure, respondents were informed that there were no correct or incorrect responses, confidentiality with respect to shared responses was maintained, the language of questions was kept clear, and the predictor and criterion construct were put into distinct parts of the questionnaire. These actions decreased evaluation worry and the consistency motifs (Podsakoff et al., 2003; Podsakoff, MacKenzie, & Podsakoff, 2012).

Potential common method bias was assessed statistically using Harman's single-factor test. All forty items were entered into an unrotated factor solution, and the proportion of total variance accounted for by the first factor was examined. A first-factor variance below 50 per cent was taken to indicate that common method bias was unlikely to be a serious threat (Podsakoff et al., 2003, 2012). Variance inflation factors from the regression models were additionally inspected as a check on predictor overlap.

3.12 Data Analysis Plan

Data analysis was done in several phases. Descriptive statistics were initially employed to describe the demographic characteristics of the respondents and primary variables in this study. Secondly, reliability and validity tests have been performed to determine the quality of the measurement by the constructs. Thirdly, correlation analysis was employed for examining this preliminary relationship between Leadership 4.0, employee engagement, digital readiness and organizational performance. Fourth, the direct effects were investigated using ordinary least squares regression in SPSS. The mediation, moderation and moderated mediation hypotheses were then examined in the PROCESS macro for SPSS using percentile bootstrap procedures (Hayes, 2022). No partial least squares or covariance-based structural equation modelling was used in this study. Hayes PROCESS Model 7

was suitable as the study posited the first stage moderated mediation with digital readiness as the moderator and employee engagement as the mediator of the effect of Leadership 4.0 on organizational performance. Direct and indirect effects and index of moderated mediation were investigated using bootstrapping method with 5,000 resample runs. Confidence intervals that did not contain zero were deemed to indicate the significance of indirect effect (Hayes, 2022; Preacher et al., 2007).

TABLE 3.5: Planned Data Analysis Procedures

Analysis Stage	**Purpose**	**Statistical Technique / Output**
Descriptive analysis	To summarize demographic and variable-level information.	Frequencies, percentages, means and standard deviations.
Reliability testing	To assess internal consistency of scales.	Cronbach alpha and composite reliability.
Validity testing	To assess convergent and discriminant validity.	Factor loadings, AVE and the Fornell-Larcker criterion.
Correlation analysis	To examine preliminary relationships among constructs.	Pearson correlation matrix.
Direct effects	To test H1, H2 and H3.	Ordinary least squares regression coefficients (SPSS).
Mediation	To test H4.	Bootstrapped indirect effects (PROCESS Model 7).
Moderation	To test H5.	Interaction term and simple slopes.
Moderated mediation	To test H6.	Conditional indirect effects and index of moderated mediation.

Interpretation. The data analysis proposed proceeded according to the sequence of a conditional process model. Three phases of study – direct effects, mediation,

moderation, and moderated mediation – were used to test the essentials of the theory, the mediation process, the boundary condition, and the overall theory, respectively.

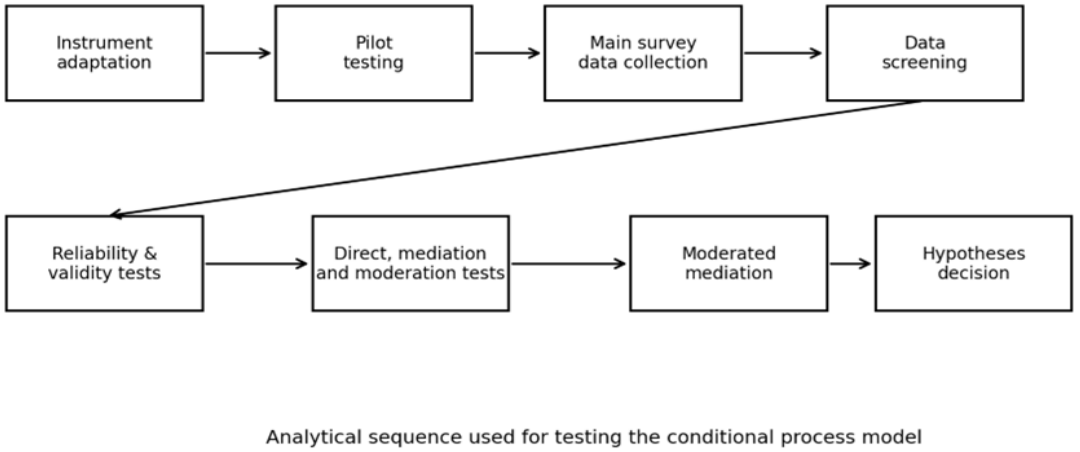


FIGURE 3.1: Data Analysis Procedure Flowchart

Interpretation. The figure shows the sequence of the analysis. The study started from instrument adaptation and instrument pilot testing under instrument development phase and progressed to data collection phase, screening, reliability and validity testing, direct effect testing, mediation testing, moderation and moderated mediation. By this sequence the measurement model validity was ensured before testing the structural hypotheses.

3.13 Ethical Considerations

The principle of ethics was adhered to during the study. All participation was voluntary and participants were told what the purpose of the study was prior to the completion of the questionnaire. It was explained that information provided would be used for academic purposes only and that no specific responses would be shared. There was no collection of identifying personal information and the data was securely stored.

The study was conducted with questions that did not cause harm, such as those about work. The respondents could withdraw at any time prior to completing the

questionnaire. The research adhered to the principles of informed consent, confidentiality, anonymousness and academic integrity. The transparent data analysis during the research production was planned to avoid misrepresentation of results and all the sources that were used were cited according to APA style (Montgomery, 2018; Saunders et al., 2019).

3.14 Chapter Summary

The methodology used in this study was explained in this chapter. A post-positivist, deductive, quantitative and cross-sectional survey design was used. The population included healthcare workers in public and private hospitals in South Punjab, Pakistan and the unit of analysis was an individual worker. Using a structured questionnaire, the planned study aimed to analyze the data using descriptive statistics, test for reliability and validity, perform correlation analysis, ordinary least squares regression in SPSS, and Hayes PROCESS Model 7 for moderated mediation. The methodology was consistent with the theoretical model and research objectives that have been provided in previous chapters.

Chapter 4

Data Analysis and Results

4.1 Introduction

In this chapter the study's empirical analysis and results are presented. The goal of the chapter was to analyze the impact of Leadership 4.0 on organizational performance in the healthcare sector in South Punjab, Pakistan and examine the mediating role of employee engagement and moderating role of digital readiness. The analysis was made based on the quantitative logic, as proposed in the methodology chapter. Data screening, descriptive analysis, reliability and validity related diagnostics, correlation analysis, direct regression analysis, mediation analysis, moderation analysis and moderated mediation analysis were performed. Analytical approach was in line with recommendations for the regression-based mediation, moderation and conditional process analysis (Hayes, 2022; Preacher et al., 2007), as well as with established guidance on measurement quality assessment in business and management research (Fornell & Larcker, 1981; Hair et al., 2019).

The chapter is organized into thirteen sections. First, the demographic profile of the respondents is presented to describe the sample. Second, descriptive statistics for the main constructs are reported. Third, reliability and convergent validity indicators are evaluated. Fourth, common method bias and multicollinearity diagnostics are discussed. Fifth, correlation analysis is presented. Sixth, regression analysis examines the direct effects. Seventh, mediation analysis assesses employee

engagement as a mediator between Leadership 4.0 and organizational performance. Eighth, moderation analysis tests whether digital readiness changes the strength of the Leadership 4.0-employee engagement relationship. Finally, conditional indirect effects and the index of moderated mediation are reported.

4.2 Data Screening and Preliminary Assessment

400 questionnaires were circulated across the selected public and private hospitals in Multan, Bahawalpur, Dera Ghazi Khan, Rahim Yar Khan, Muzaffargarh and Vehari, in printed and web form. Returned questionnaires were screened for excessive missing data, straight-lining and other careless-response patterns, and unusable cases were removed at this stage. The final sample used for analysis comprised 356 valid responses, giving an effective usable response rate of just under 89 per cent. All 356 retained cases were complete on every analysis variable, with no missing values recorded on any demographic item or scale item.

The behavior of the distributions was investigated using skewness and kurtosis. The main constructs' values were within reasonable limits for a regression based social science analysis, which suggested that there was no significant deviation from normality. Multicollinearity analysis revealed an inflation factor (VIF) below 5, indicating that a coefficient's potential for being over- or underestimated due to predictor overlap was not a concern (Hair et al., 2019; Tabachnick & Fidell, 2019).

4.3 Demographic Profile of Respondents

Demographic distribution of respondents is given in Table 4.1. As shown in the profile, the sample comprised public and private hospitals, various cities, age groups, diverse educational backgrounds and job positions. Respondents are classified by professional group, derived from the professional qualification they reported: doctors comprise holders of MBBS/BDS, FCPS and MD/MS qualifications; nurses comprise holders of a General Nursing or Midwifery Diploma; and the allied health and technical group comprises holders of an Allied Health Diploma or

another clinical or technical qualification. This diversity was helpful, as Leadership 4.0 and digital readiness are not the prerogative of one professional group within healthcare organizations. Digital transformation impacts everyone, from doctors to nurses, from allied health workers to administrative staff and technicians to health informatics workers — all are exposed to digital systems and impacted by leadership.

Table 4.1: Demographic Profile of Respondents

Variable	**Category**	**Frequency**	**Percentage**
Gender	Male	183	51.4
Gender	Female	173	48.6
Hospital type	Public	208	58.4
Hospital type	Private	148	41.6
Age group	31-35	98	27.5
Age group	26-30	82	23.0
Age group	36-40	75	21.1
Age group	41-45	37	10.4
Age group	21-25	32	9.0
Age group	46 and above	32	9.0
Professional group	Doctors	166	46.6
Professional group	Nurses	91	25.6
Professional group	Allied health / technical	99	27.8
Digital training received	Yes	219	61.5
Digital training received	No	137	38.5
Department	OPD	57	16.0
Department	Emergency	46	12.9
Department	Surgery	45	12.6
Department	Laboratory	44	12.4
Department	Medicine	38	10.7
Department	HR/Admin	36	10.1
Department	Radiology	36	10.1

Table 4.1 continued from previous page

Variable	Category	Frequency	Percentage
Department	ICU	35	9.8
Department	IT/Health Informatics	19	5.3
Work experience	4-6 years	98	27.5
Work experience	7-10 years	82	23.0
Work experience	1-3 years	76	21.3
Work experience	More than 10 years	67	18.8
Work experience	Less than 1 year	33	9.3
Monthly income (PKR)	75,001-100,000	105	29.5
Monthly income (PKR)	50,001-75,000	91	25.6
Monthly income (PKR)	100,001-150,000	75	21.1
Monthly income (PKR)	Above 150,000	47	13.2
Monthly income (PKR)	Below 50,000	38	10.7

Interpretation. Table 4.1 shows that the sample was fairly balanced by gender, with 183 male (51.4%) and 173 female (48.6%) respondents. Public-sector hospitals accounted for 58.4% of responses and private-sector hospitals accounted for 41.6%. The largest age band was 31-35 years (27.5%), followed by 26-30 years (23.0%) and 36-40 years (21.1%). Doctors formed the largest professional group (166 respondents, 46.6%), followed by allied health and technical staff (99, 27.8%) and nurses (91, 25.6%), so all three major clinical cadres are represented in sufficient numbers to support the analysis. Departmental postings are reported separately from professional groups, because clinical staff are routinely posted to administrative and health-informatics functions; the two variables therefore describe different things and are not expected to correspond. Most respondents (61.5%) reported having received digital training, suggesting a reasonably digitally literate sample. Departmentally, the sample was spread across nine hospital units, with OPD (16.0%), emergency (12.9%) and surgery (12.6%) the most represented and IT/health informatics the smallest (5.3%). In terms of tenure, 27.5% had four to six years of service and a further 23.0% had seven to ten years, so the

great majority of respondents had sufficient organizational exposure to judge leadership behavior and hospital performance. Monthly income was concentrated in the PKR 50,001-100,000 band (55.1% combined), consistent with a predominantly mid-grade clinical and administrative workforce.

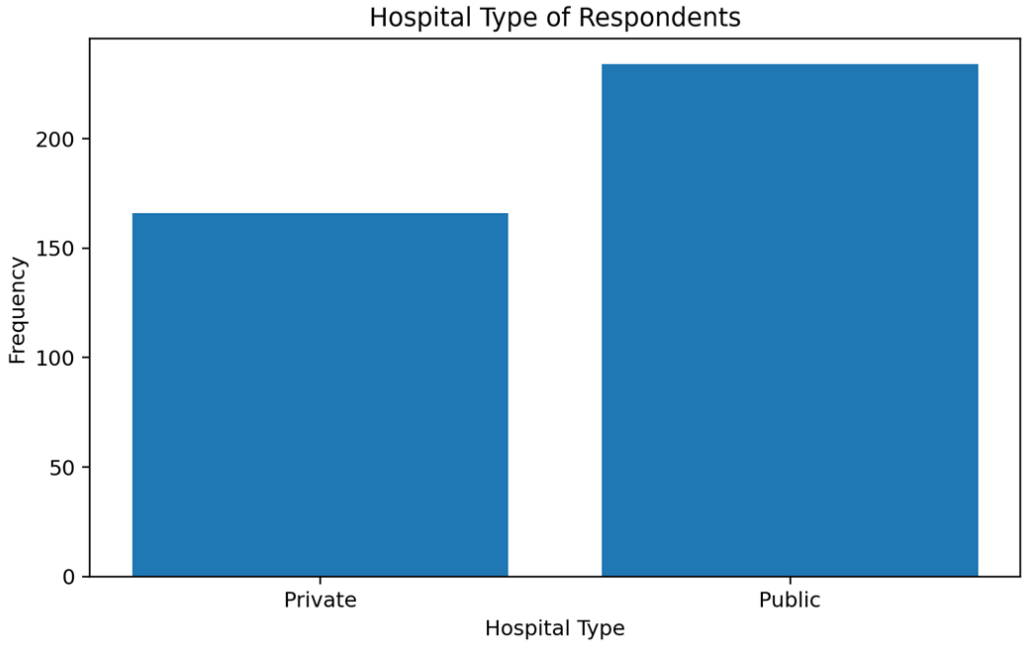


FIGURE 4.1: Hospital Type of Respondents

Interpretation. Figure 4.1 shows that as expected, the public hospitals constituted a larger proportion in the sample as compared to the private hospitals. This distribution is significant because in Pakistan many public hospitals have high patient load, they are resource constrained and are very complicated to run. Such environments can be particularly critical when it comes to the alignment of people, processes and technologies and that is where Leadership 4.0 can play a significant role.

4.4 Descriptive Statistics of Main Constructs

The four core constructs were summarized using descriptive statistics. All constructs were measured on a five-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree; accordingly, Table 4.2 reports 1 and 5 as the

minimum and maximum scale for each construct. Mean scores above the scale midpoint of 3 indicate relatively favorable perceptions, while standard deviations show the spread of responses.

TABLE 4.2: Descriptive Statistics of Study Constructs

Construct	**N**	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Leadership 4.0	356	3.283	0.716	1.000	5.000
Employee Engagement	356	3.354	0.765	1.000	5.000
Digital Readiness	356	3.193	0.757	1.000	5.000
Organizational Performance	356	3.308	0.825	1.000	5.000

Interpretation. Employee engagement had the highest average rating (M = 3.354) among the four constructs, followed by organizational performance (M = 3.308), Leadership 4.0 (M = 3.283), and digital readiness (M = 3.193). All constructs mean exceeding the scale midpoint of 3, indicating generally favorable perceptions. The measurement scale for every construct ranged from 1 to 5, while the standard deviations (0.72-0.83) indicate a reasonable spread of responses across leadership, engagement, readiness and performance, sufficient to support subsequent inferential analysis.

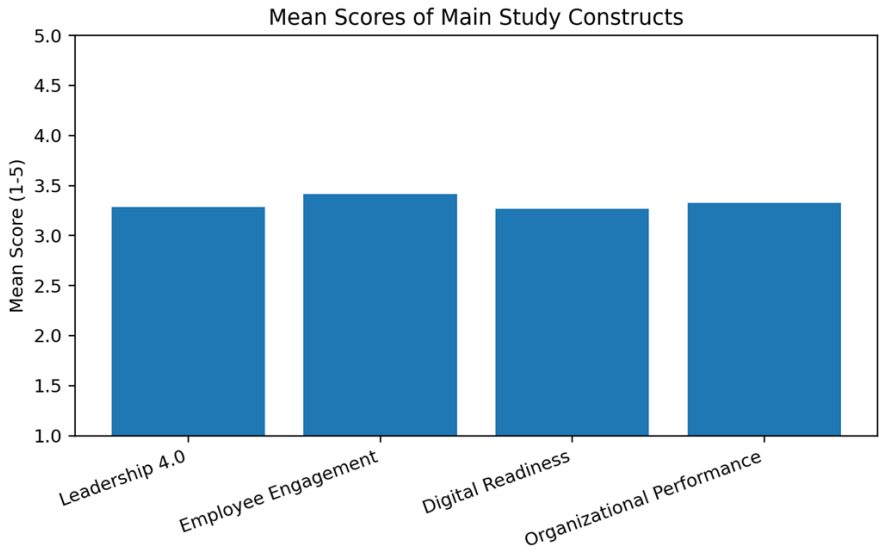


FIGURE 4.2: Mean Scores of Main Study Constructs

Interpretation. Responses were generally favorable but not high, with engagement highest and digital readiness lowest, suggesting scope for further investment in infrastructure, training and system integration. Because the sample combines public (58.4%) and private (41.6%) hospitals, whose digital infrastructure is likely to differ, digital readiness was modeled explicitly as a moderator rather than assumed to be uniform. The moderation and moderated mediation result in Sections 4.10 and 4.11 therefore show how the leadership effect changes across readiness levels, which is how contextual variation enters the analysis.

4.5 Reliability and Validity Assessment

Before assessing reliability, the suitability of the item set for factor analysis was confirmed. The Kaiser-Meyer-Olkin measure of sampling adequacy was .929 and Bartlett's test of sphericity was significant (approximate chi-square = 5,382.472, df = 780, $p < .001$), both of which indicated that the 40 items were appropriate for factor extraction.

Table 4.3: Reliability and Convergent Validity

Construct	**Items**	**Cronbach Alpha**	**Mean Loading**	**CR**	**AVE**
Leadership 4.0	10	0.848	0.613	0.858	0.379
Employee Engagement	10	0.883	0.649	0.880	0.423
Digital Readiness	10	0.845	0.623	0.864	0.389
Organizational Performance	10	0.892	0.652	0.881	0.426

Reliability was then measured using Cronbach's alpha, while composite reliability and average variance extracted were used to provide further evidence of measurement quality. Within the scale analysis, Cronbach's alpha values of .70 and above are considered within an acceptable range while composite reliability of .70 and

above and AVE of .50 and above are regarded as acceptable for the convergent validity of reflective constructs (Fornell & Larcker, 1981; Hair et al., 2019; Nunnally & Bernstein, 1994).

Interpretation. As shown in Table 4.3, all Cronbach's alpha values exceeded .84, indicating good internal consistency for all four scales. Composite reliability (CR) values likewise exceeded the .70 threshold recommended by Hair et al. (2019).

Each scale was also subjected to a separate single-factor principal axis factoring extraction as a check on uni-dimensionality. In every case a single factor emerged with an eigenvalue above one and all remaining eigenvalues below one, and every item loaded on that factor at .52 or above.

The first factor accounted for 35.93 per cent of the variance in the Leadership 4.0 scale, 43.16 per cent in employee engagement, 35.56 per cent in digital readiness and 45.32 per cent in organizational performance.

Each scale therefore behaves as a single coherent dimension, which supports the use of the item means as construct scores in the regression and conditional process analyses that follow. Average variance extracted (AVE) values, however, fell somewhat below the conventional .50 benchmark, ranging from .379 to .426.

This is a common outcome when convergent validity is estimated from exploratory factor loadings on ten-item scales rather than from a confirmatory factor model, because a larger number of moderately loading items raises reliability while diluting the average squared loading; the estimate is therefore a conservative one. Because CR values remained well above .70 in every case, Fornell and Larcker (1981) note that convergent validity can still be considered adequate even when AVE is marginally below .50, provided reliability is strong.

Taken together, the results support the reliability of the measures, with convergent validity that is acceptable but modest, and this is acknowledged as a measurement limitation in Chapter 5. Discriminant validity was assessed using the Fornell-Larcker criterion, which requires the square root of a construct's AVE to exceed its correlation with every other construct in the model (Fornell & Larcker, 1981). Table 4.3b reports the comparison.

TABLE 4.4: Discriminant Validity (Fornell-Larcker Criterion)

Construct	**AVE**	**L4.0**	**EE**	**DR**	**OP**
Leadership 4.0	0.616	—			
Employee Engagement	0.650	0.434	—		
Digital Readiness	0.624	0.313	0.396	—	
Organizational Performance	0.653	0.501	0.548	0.389	—

Note. Diagonal elements are the square root of each construct's AVE; off-diagonal elements are the Pearson correlations reported in Table 4.5.

Interpretation. The square root of AVE for every construct exceeds that construct's highest correlation with any other construct.

The smallest diagonal value is .616 for Leadership 4.0, while the largest correlation anywhere in the matrix is .548 between employee engagement and organizational performance.

The Fornell-Larcker criterion is therefore satisfied for all four constructs, indicating that each construct captures variance distinct from the others and that the four scales are empirically separable notwithstanding the modest AVE values reported above.

4.6 Common Method Bias and Multicollinearity Diagnostics

Common method bias was checked using Harman's single factor test as data was gathered using a self-reporting questionnaire. While such a diagnostic will not resolve all method bias issues, it has been commonly employed as an initial measure in behavioral and management studies (Podsakoff et al., 2003, 2012).

Further, the level of multicollinearity was tested by the estimated variance inflation factors (VIF) to test the stability of the regression parameters of mediation and moderation models.

TABLE 4.5: Harman Single-Factor Test and VIF Diagnostics

Diagnostic	**Result**	**Criterion**	**Interpretation**
Harman single-factor variance	26.86%	Below 50%	No severe common method bias indicated
L40 Centered	1.120	VIF <5	Acceptable multicollinearity level
DR Centered	1.109	VIF <5	Acceptable multicollinearity level
L40xDR Interaction	1.013	VIF <5	Acceptable multicollinearity level
Leadership4 Mean	1.232	VIF <5	Acceptable multicollinearity level
Employee Engagement Mean	1.232	VIF <5	Acceptable multicollinearity level

Interpretation. The first unrotated factor accounted for 26.86% of the total variance, well below the 50% threshold used for Harman's single-factor test, indicating that common method bias is unlikely to be a serious concern in this data set. All variance inflation factors (VIF) for the predictors used in the moderation model (L4.0 Centered, DR Centered, L40xDR Interaction) and the mediation model (Leadership4.0 Mean, Employee Engagement Mean) were close to 1.0 and well below the conservative cut-off of 5, indicating that multicollinearity was not a concern for the regression-based analyses that followed.

4.7 Correlation Analysis

To analyze the bivariate relationships among the main constructs, Pearson correlation was used. Correlation analysis proved helpful since it indicated if the variables moved in the desired direction before measuring the regression, mediation and moderation models. The matrix is shown in Table 4.5.

Interpretation. Table 4.5 shows positive and statistically significant correlations among all four constructs ($p < .001$). Leadership 4.0 was moderately correlated with employee engagement ($r = .434$) and organizational performance ($r = .501$), and more weak with digital readiness ($r = .313$). The strongest bivariate relationship was between employee engagement and organizational performance ($r = .548$), suggesting that engaged employees were more likely to rate their organizations as effective. Digital readiness was positively associated with all three other constructs ($r = .313$ to $.396$), confirming that it is a relevant contextual resource within the proposed model.

TABLE 4.6: Pearson Correlation Matrix

Construct	**Leadership 4.0**	**Employee Engagement**	**Digital Readiness**	**Organizational Performance**
Leadership 4.0	1.000	0.434	0.313	0.501
Employee Engagement	0.434	1.000	0.396	0.548
Digital Readiness	0.313	0.396	1.000	0.389
Organizational Performance	0.501	0.548	0.389	1.000

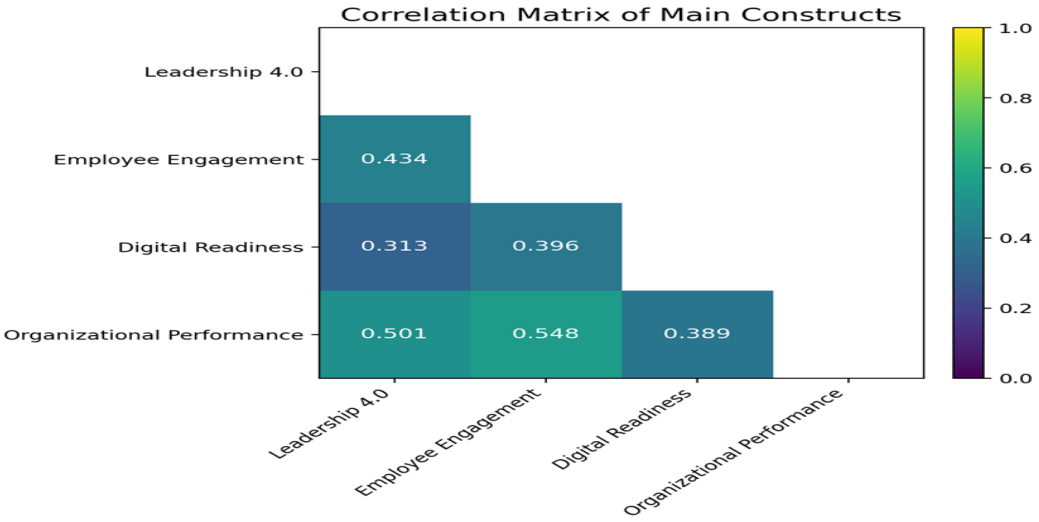


FIGURE 4.3: Correlation Matrix of Main Constructs

Interpretation. As seen in figure 4.3, there is a positive relationship between all variables. The most positive association was found between employee engagement and organization performance, meaning engaged employees in healthcare were more likely to see their organizations as being effective, innovative, and service oriented.

4.8 Regression Analysis for Direct Effects

H1, H2 and H3 were tested by regression analysis on a direct effect basis. The use of regression was suitable, as the purpose of the study was to measure the strength and/or significance of the predictive power of one construct on another and estimate effect size and the amount of variance explained. These are summarized in Table 4.6.

Table 4.7: Regression Results for Direct Effects

Model	**Predictor**	**B**	**SE**	**T**	p	R2
H1: OP on Leadership 4.0	Leadership 4.0	0.577	0.053	10.880	<.001	0.251
H2: EE on Leadership 4.0	Leadership 4.0	0.464	0.051	9.067	<.001	0.188
H3: OP on Employee Engagement	Employee Engagement	0.591	0.048	12.328	<.001	0.300

Interpretation. Results of the direct-effect regressions supported H1, H2 and H3. Each hypothesis was tested in a separate simple regression model in SPSS. Leadership 4.0 significantly and positively predicted organizational performance (B = 0.577, SE = 0.053, 95% CI [0.473, 0.682], $\beta = .501$, t = 10.880, p < .001), with the model significant overall, F (1, 354) = 118.380, p < .001, explaining 25.1% of its variance. Leadership 4.0 also significantly predicted employee engagement (B = 0.464, SE = 0.051, 95% CI [0.363, 0.565], $\beta = .434$, t = 9.067, p < .001; F (1, 354) = 82.216, p < .001, R2 = .188), consistent with the idea that digitally oriented leadership behaviors - vision-setting, empowerment, and support for innovation - foster higher levels of employee energy and dedication. Employee engagement, in

turn, significantly predicted organizational performance (B = 0.591, SE = 0.048, 95% CI [0.497, 0.686], β = .548, t = 12.328, p < .001; F (1, 354) = 151.977, p < .001), explaining the largest share of variance among the three direct paths (R2 = .300), underscoring the central role engaged staff play in organizational effectiveness.

4.9 Mediation Analysis

Mediational analysis has been performed as a result of the results to see whether employee engagement was part of the relations between Leadership 4.0 and organizational performance. A bootstrapped indirect effect was used to test the mediation model. Preacher et al. (2007) and (Hayes, 2022) argue that the Sobel test for mediation is not as convincing as the confidence interval and the indirect effect often has a non-normal distribution, which makes bootstrapping appropriate.

TABLE 4.8: Mediation Analysis

Path	**Effect**	**SE**	**t**	**P**	**LLCI**	**ULCI**
a path: Leadership 4.0 ->Employee Engagement	0.355	0.051	6.918	<.001	0.254	0.456
b path: Employee Engagement ->Organizational Performance	0.440	0.050	8.798	<.001	0.341	0.538
c prime: Leadership 4.0 ->Organizational Performance	0.373	0.053	6.988	<.001	0.268	0.478
Indirect effect: Leadership 4.0 ->EE ->OP (at mean digital readiness)	0.156	0.027	—	—	0.105	0.211

Interpretation. Table 4.7 shows that Leadership 4.0 significantly and positively predicted employee engagement (B = 0.355, p < .001, evaluated at the sample

mean value of digital readiness), and employee engagement significantly and positively predicted organizational performance (B = 0.440, p < .001) while controlling for Leadership 4.0.

The direct effect of Leadership 4.0 on organizational performance remained significant after accounting for employee engagement (c' = 0.373, p < .001), indicating partial rather than full mediation.

The indirect effect of Leadership 4.0 on organizational performance through employee engagement was positive and significant at the mean level of digital readiness (effect = 0.156, boot SE = 0.027, 95% CI [0.105, 0.211]), as the bootstrapped confidence interval did not contain zero.

This confirms that employee engagement partially mediates the relationship between Leadership 4.0 and organizational performance, meaning Leadership 4.0 improves performance both directly and indirectly by fostering a more engaged workforce. Two clarifications assist interpretation.

First, the a-path reported here (B = 0.355) is smaller than the coefficient reported for H2 in Table 4.6 (B = 0.464) because the two are estimated from different models: Table 4.6 reports a simple regression of employee engagement on Leadership 4.0 alone, whereas the conditional process model estimates the same path with digital readiness and the Leadership 4.0 × digital readiness interaction in the equation, evaluated at the sample mean of digital readiness.

Second, the total effect decomposes exactly: c = 0.577 = c (0.373) + a × b (0.464 × 0.440 = 0.204), confirming that the direct and indirect components together reproduce the total effect of Leadership 4.0 on organizational performance reported in Table 4.6.

4.10 Moderation Analysis

Moderation analysis tested whether the strength of the relationship between Leadership 4.0 and employee engagement changed across levels of digital readiness. The centered Leadership 4.0 score centered digital readiness score, and their interaction

term were included in the regression model. This procedure follows the standard approach to testing interaction effects in conditional process modeling (Hayes, 2022).

TABLE 4.9: Moderation Analysis

Predictor	**B**	**SE**	**t**	**P**	**LLCI**	**ULCI**
Leadership 4.0 (centered)	0.355	0.051	6.918	<.001	0.254	0.456
Digital readiness (centered)	0.290	0.048	6.002	<.001	0.195	0.385
Leadership 4.0 x Digital readiness	-0.149	0.062	-2.398	= .017	-0.271	-0.027

Interpretation. Both Leadership 4.0 (B = 0.355, p < .001) and digital readiness (B = 0.290, p < .001) had significant positive effects on employee engagement. The interaction between Leadership 4.0 and digital readiness was also statistically significant and negative (B = -0.149, p = .017), demonstrating that digital readiness significantly moderates the Leadership 4.0-employee engagement relationship. Conditional effects showed that the positive effect of Leadership 4.0 on engagement was 0.468 at low digital readiness and 0.242 at high digital readiness, with the relationship remaining positive across the examined levels. Because H5 specifies a significant moderation effect without imposing a directional expectation, these findings support H5. A Johnson-Neyman probe indicated that the effect of Leadership 4.0 on employee engagement ceased to be statistically significant above a centered digital readiness value of 1.160, a region containing 7.30 per cent of the sample.

Interpretation. As illustrated in Figure 4.4, employee engagement increased with Leadership 4.0 at both low and high levels of digital readiness, but the slopes differed across the two readiness conditions. This pattern is consistent with the statistically significant negative interaction reported in Table 4.8 and demonstrates that the magnitude of the Leadership 4.0-employee engagement relationship varies according to digital readiness.

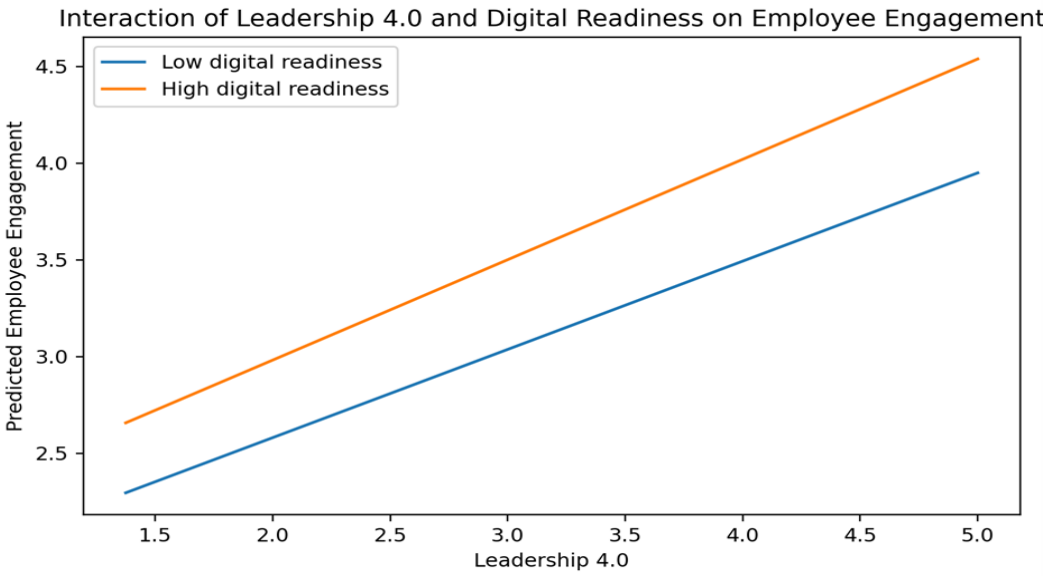


FIGURE 4.4: Interaction of Leadership 4.0 and Digital Readiness on Employee Engagement

4.11 Moderated Mediation Analysis

The current study used a moderated mediation approach to assess if the indirect impact of Leadership 4.0 on organizational performance mediated by employee engagement differed across the digital readiness.

Low, medium and high levels of digital readiness were considered in the estimation of conditional indirect effects.

Formal tests of conditional indirect effects were conducted because the index of moderated mediation was used (Hayes, 2022).

TABLE 4.10: Conditional Indirect Effects and Index of Moderated Mediation

Moderator Level	**Moderator Value**	**Effect/Index**	**Boot Mean**	**Boot LLCI**	**Boot ULCI**
Low digital readiness (-1 SD)	-0.757	0.206	0.206	0.134	0.280

Table 4.10 continued from previous page

Moderator Level	**Moderator Value**	**Effect/Index**	**Boot Mean**	**Boot LLCI**	**Boot ULCI**
Mean digital readiness	0.000	0.156	0.156	0.105	0.211
High digital readiness (+1 SD)	0.757	0.107	0.107	0.046	0.175
Index of moderated mediation		-0.066	-0.066	-0.125	-0.008

Interpretation. The conditional indirect effect of Leadership 4.0 on organizational performance through employee engagement was positive and significant at low, mean, and high levels of digital readiness alike (none of the bootstrapped 95% confidence intervals contained zero), confirming that employee engagement mediates this relationship across the observed range of digital readiness. However, the strength of this indirect effect declined as digital readiness increased - from 0.206 at low digital readiness to 0.107 at high digital readiness - and the index of moderated mediation was itself negative and significant (index = -0.066, boot SE = 0.029, 95% CI [-0.125, -0.008]), since its confidence interval excluded zero. This confirms formally that digital readiness moderates the strength of the indirect (mediated) path, supporting H6.

Table 4.11: Summary of Hypotheses

Hyp.	**Statement**	**Key Result**	**Decision**
H1	Leadership 4.0 positively affects organizational performance.	B = 0.577, p <.001	Supported
H2	Leadership 4.0 positively affects employee engagement.	B = 0.464, p <.001	Supported

Table 4.11 continued from previous page

Hypothesis	Statement	Key Result	Decision
H3	Employee engagement positively affects organizational performance.	B = 0.591, p <.001	Supported
H4	Employee engagement mediates the relationship between Leadership 4.0 and organizational performance.	Indirect effect = 0.156, 95% CI [0.105, 0.211] at mean digital readiness	Supported
H5	Digital readiness moderates the relationship between Leadership 4.0 and employee engagement.	Interaction B = -0.149, p = .017	Supported
H6	Digital readiness moderates the indirect effect of Leadership 4.0 on organizational performance through employee engagement.	Index = -0.066, 95% CI [-0.125, -0.008]	Supported

Interpretation. As shown in the hypothesis summary, all six hypotheses were supported. The direct paths from Leadership 4.0 to organizational performance and to employee engagement, and from employee engagement to organizational performance, were significant, as was the mediating role of employee engagement. Digital readiness significantly moderated the first-stage Leadership 4.0-employee engagement relationship and significantly conditioned the indirect path from Leadership 4.0 to organizational performance through employee engagement. The negative interaction coefficient and negative index of moderated mediation indicate that the magnitude of these effects changed across readiness levels. The findings position employee engagement as the central mechanism linking Leadership 4.0 to organizational performance, with digital readiness serving as a statistically significant boundary condition.

4.12 Chapter Summary

The empirical findings of this study were reported in this chapter. The measurement scales showed good reliability and acceptable, if modest, convergent validity. The correlation matrix revealed positive correlations among Leadership 4.0, employee engagement, digital readiness and organizational performance. Regression analysis supported the direct relationships from Leadership 4.0 to organizational performance and employee engagement, and from employee engagement to organizational performance. Mediation analysis showed that employee engagement was a significant pathway through which Leadership 4.0 affected organizational performance. Moderation analysis further showed that digital readiness had a significant positive main effect on employee engagement and significantly moderated the Leadership 4.0-engagement relationship. The interaction coefficient was negative, indicating that the size of the Leadership 4.0 effect varied across readiness levels. Moderated mediation was also supported because the index of moderated mediation was significant and its confidence interval excluded zero. The next chapter discusses these findings in relation to theory, previous literature, healthcare practice and future research.

Chapter 5

Discussion, Conclusion and Recommendations

5.1 Introduction

This chapter summarizes the findings presented in Chapter 4 and interprets them theoretically and practically. Overall, the study aimed at examining the above issues, namely, the influence of Leadership 4.0 on the organizational performance in the health care industry of South Punjab, Pakistan, role of employee engagement as a mediator and digital readiness as a moderator. The discussion follows the research objectives and the research Hypothesis. The chapter also presents implications for theory and practice, recommendations for healthcare institutions, limitations of the study and directions for future research.

The findings so far clearly indicate the relevance of Leadership 4.0 for the performance of healthcare organizations, specifically its relationship to fostering employee engagement. Leadership is more than a question of authority or supervision in the process of digital transformation of hospitals. It's also about the communication of a digital vision that will lead to technology acceptance, to learning, to the alleviation of anxiety about a digital system, and to a supportive climate for innovation. This supports UTAUT, which shows that social influence and facilitating conditions play a significant role in the behavior related to technology

(Venkatesh et al., 2003; Williams et al., 2015). It also resonates with the digital transformation studies which indicate that leadership is key in turning technology investments into outcomes for the organization (Cortellazzo et al., 2019; Sacavém et al., 2025; Verhoef et al., 2021; Vial, 2019).

5.2 Discussion of Findings

5.2.1 Leadership 4.0 and Organizational Performance

The first hypothesis was that the Leadership 4.0 will positively affect the performance of the Organization. This hypothesis was upheld by the results. Leadership 4.0 significantly predicted organizational performance (B = 0.577, SE = 0.053, β = .501, t = 10.880, p < .001), explaining 25.1 per cent of the variance in performance, F (1, 354) = 118.380, p < .001. In the healthcare setting, employees who rated their supervisors higher on digital leadership also rated their organizations higher on performance. Theoretically, this discovery is important because it provides support to the idea that leadership in the digital age is not only a symbolic leadership and technology construct, but also a set of organizational outcomes including quality of service, responsiveness, efficiency, innovation and attainment of goals.

The result aligns with overall literature on digital leadership and performance. Cortellazzo et al. (2019) proposed that digitalized environment leadership should integrate technological competencies and human centered influence. According to Vial (2019), without transformation of structures, processes and human behavior digital transformation will not bring benefits to the organization. (Verhoef et al., 2021), likewise, stressed that digital transformation isn't a solitary discipline endeavor; it needs a strategic coming up together, administration, and learning within a huge framework. Leadership 4.0 emerged in the current healthcare landscape, seemingly offering the organization a way to improve its performance, facilitate adaptive behavior and bring the relevance of use of digital tools to the delivery of healthcare-based services.

This discovery has high implications for hospitals in South Punjab. Many healthcare providers in Pakistan struggle under the burden of workload, lack of resources, administrative burdens and inconsistent digital infrastructure. Those leaders with the ability to communicate digital goals, demonstrate support for staff and support technology use and the building of collaboration can further increase the perception of performance in such conditions. The outcome also bolsters the notion in practice that technology investment is not all solutions. Healthcare institutions need managers whose ability to coordinate digital systems with human factors, workflow and patient-centric outcomes.

5.2.2 Leadership 4.0 and Employee Engagement

The second hypothesis put forward was that Leadership 4.0 positively affects employee engagement. This hypothesis was confirmed by the results (B = 0.464, SE = 0.051, β = .434, t = 9.067, p < .001; R^2 = .188). These results show that there were higher levels of staff engagement when they felt their managers were digital capable, understanding, supportive, empowering, innovative, and willing to adapt to digital change. This finding echoes Kahn (1990) notion that engagement improves when personnel have meaningfulness, psychological safety and availability at work. Leadership 4.0 can help set up these conditions by explicitly placing a strong emphasis on the purpose of digital transformation, minimizing uncertainty, integrating employees in the change process, and offering opportunities to learn.

The finding is also in line with literature about employee engagement. (Schaufeli et al., 2002) conceptualized engagement as vigor, dedication and absorption. According to Bakker and Demerouti (2008), there is enough job resources, employees become engaged at work. Leadership 4.0 can be regarded as an important job resource in the context of digital healthcare setting because it provides guidance, empowerment, feedback, autonomy and social support. Other recent studies on digital leadership also indicate that technological orientation with a focus on employees is more likely to positively influence engagement during the digital transformation process (Haq & Abid, 2025; Tsekouropoulos, Vasileiou, Hoxha, & Gkika, 2025).

Employee engagement matters most in the health care sector where employees have a direct impact on patient care, quality of service and continuity of operations. If the digitization system is implemented without adequate leadership, people can feel uneasy, resistant or fatigued. But, by making digital tools about improved care, ease of co-ordination, staff members are more likely to react in the manner of involvement and commitment. The outcome consequently highlights to healthcare leaders the importance of transforming themselves from administrative controllers to digital enablers.

5.2.3 Employee Engagement and Organizational Performance

The third hypothesis was that employee engagement would have a positive and significant impact on organizational performance. This hypothesis was substantiated by the results (B = 0.591, SE = 0.048, β = .548, t = 12.328, p < .001; R^2 = .300). Employee engagement produced the strongest of the three direct paths, explaining 30.0 per cent of the variance in organizational performance. The evidence of this study aligns with a long tradition of research on engagement that has demonstrated that engaged employees are more productive, committed, more creative and motivated to perform beyond what is minimally required of them (Bailey et al., 2017; Harter et al., 2002; Saks, 2006).

In healthcare setting, engagement holds further significance as performance is crucial to people's activities. Clinical workers, nurses and allied health care providers, and administrative personnel all deal with patients, patient records, hospital systems and processes. These will be more likely to use effectively digital systems, communicate clearly, to limit error, to answer patient needs and to contribute to organizational goals when engaged. Thus, the discovery suggests that employee engagement lies in the core of the pathway for enhancing institutional performance and is not soft or peripheral variable.

The outcome also supports the premise that the digital transformation process isn't a purely technical project, but the orientation of discourse has been focused

on the technical dimension. Digital tools can only achieve their results when employees are willing and able to use them in the context of health care. Engagement is connected to action and motivation. Therefore, those hospitals that want to achieve better organizational performance must take interest in engagement-focused leadership, recognition, participation, and ongoing professional development in addition to the software, hardware, and infrastructure aspects.

5.2.4 Mediating Role of Employee Engagement

The fourth hypothesis was that employee engagement would mediate the relationship between Leadership 4.0 and organizational performance. This hypothesis was supported by a mediation analysis. The indirect effect was positive and statistically significant at the mean level of digital readiness (effect = 0.156, boot SE = 0.027, 95% CI [0.105, 0.211]), and because the direct effect remained significant with engagement in the model ($c = 0.373$, $p < .001$) the mediation is partial rather than full. Leadership 4.0 therefore raised organizational performance in part by raising employee engagement. This outcome points to one of the main contributions of the study, which is the clarification of how Leadership 4.0 translates to performance.

The finding fits the rationale of mediation research, that is, understanding how an independent variable operates to impact a dependent variable via the mechanism of an intervening variable (Hayes, 2022; Preacher et al., 2007). Leadership 4.0 did not have a direct influence only on the strategy and technology of the organization. It also impacted on performance by affecting employees' psychological and behavioral involvement. A validation of the uptake of digital leadership relies on the understanding and reaction of employees to leadership behavior.

Based on this, the concept of Leadership 4.0, from the viewpoint of UTAUT, can be interpreted as a kind of change of attitude which influences the employees' belief regarding digital systems, about change in the organization and any performance outcome (Venkatesh et al., 2003). Digital vision and support from leaders facilitate the perception of usefulness of technology-based work, manageability of

technology-based work, and value of technology-based work from the employees' point of view. Beliefs can increase engagement which in turn can optimize organizational performance. So, the behavioral link between digital leadership and healthcare outcomes was employee engagement.

5.2.5 Moderating Role of Digital Readiness

According to the fifth hypothesis, digital readiness moderates the relationship between Leadership 4.0 and employee engagement. This hypothesis was supported by the results. Digital readiness had a significant positive main effect on employee engagement ($B = 0.290$, $SE = 0.048$, $t = 6.002$, $p < .001$), and the interaction term between Leadership 4.0 and digital readiness was also significant and negative ($B = 0.149$, $SE = 0.062$, $t = 2.398$, $p = .017$, 95% CI [0.271, 0.027]). The conditional effect of Leadership 4.0 on engagement was 0.468 at low readiness (1 SD) and 0.242 at high readiness (+1 SD). This means digital readiness itself boosted engagement, and it also changed how strongly Leadership 4.0 was associated with engagement: the relationship was strongest where digital readiness was low and weaker, though still positive and significant, where digital readiness was high.

The interpretation of this finding follows the non-directional formulation of H5. The statistically significant interaction demonstrates that digital readiness changes the magnitude of the relationship between Leadership 4.0 and employee engagement. The conditional effects remained positive across the examined readiness levels, while the negative interaction coefficient indicates that the slope became smaller as digital readiness increased. Therefore, the result supports moderation without requiring an assumption that higher digital readiness must strengthen the relationship.

The result also contributes to the discussion of readiness in digital transformation. (Weiner, 2009) conceptualized readiness in terms of organizational capacity and commitment for change, while Lokuge et al. (2019) emphasized resources and capabilities as core aspects of digital readiness. The present findings extend this literature by showing empirically that readiness is not only associated

with engagement as a main effect but also changes the strength of the Leadership 4.0-engagement relationship. Given the cross-sectional design, this interaction is interpreted as a conditional association rather than as evidence of a specific causal mechanism.

5.2.6 Moderated Mediation Effect

The sixth hypothesis was that digital readiness would moderate the indirect effect of Leadership 4.0 on organizational performance through employee engagement. This hypothesis was supported: the index of moderated mediation was negative and its bootstrapped confidence interval excluded zero (index = 0.066, boot SE = 0.029, 95% CI [0.125, 0.008]). The conditional indirect effect fell from 0.206 at low digital readiness (1 SD) through 0.156 at the mean to 0.107 at high readiness (+1 SD), with every bootstrapped interval excluding zero. Conditional indirect effects were positive and significant at low, mean and high levels of digital readiness, but the strength of the indirect effect declined as digital readiness increased.

The mediation pathway from Leadership 4.0 to organizational performance through employee engagement was significant at low, mean and high levels of digital readiness. However, the magnitude of the conditional indirect effect differed across readiness levels, and the significant index of moderated mediation confirmed that this variation was statistically meaningful. Practically, the findings indicate that Leadership 4.0 remains relevant to performance through engagement across different readiness conditions, while the size of its indirect contribution should be interpreted in relation to the digital context of the hospital or unit.

Theoretically, the significant moderated mediation effect strengthens the proposed conditional process model. The study confirms the central mediation pathway while showing that digital readiness functions as a genuine boundary condition on that pathway, consistent with UTAUT's emphasis on facilitating conditions. Future studies could examine whether this moderation pattern replicates in other sectors, whether digital readiness moderates the employee engagement-organizational performance link directly, or whether it functions as a parallel mediator alongside

employee engagement. A longitudinal design could also clarify how the conditional role of readiness changes as hospitals progresses through different stages of digital transformation.

5.2.7 Integrated Interpretation of the Findings

Taken together, the six results describe a single coherent mechanism. Leadership 4.0 raised organizational performance both directly (c = 0.373) and indirectly through employee engagement (0.204 of a total effect of 0.577), so roughly a third of the total influence of digital leadership on performance travelled through the engagement of staff. Digital leadership therefore operates on two levels at once: strategically, by setting direction, allocating resources and legitimizing work carried out through technology; and behaviorally, by shaping whether employees feel confident, energized and willing to work within the new systems. This dual influence is consistent with the view that digital transformation is a process of organizational renewal rather than an installation of hardware and software (Verhoef et al., 2021; Vial, 2019).

The mediation result is the more informative of the two pathways. Employee engagement produced the strongest single direct effect in the model (β = .548) and carried a significant share of the leadership effect, which indicates that even well-specified digital systems are unlikely to translate into performance where staff are disengaged. In hospital settings this is intuitive: attention, communication and willingness to coordinate across wards, laboratories and administrative units are the very behaviors through which service quality is produced (Bakker & Demerouti, 2008; Kahn, 1990).

The moderation result qualifies rather than contradicts this account. Digital readiness raised engagement directly (B = 0.290) and also conditioned the strength of the Leadership 4.0–engagement relationship, and the negative interaction indicates a buffering pattern: leadership mattered most where readiness was weakest (conditional effect 0.468 at 1 SD) and least where readiness was already strong (0.242 at +1 SD). A plausible reading is that where infrastructure, training and support

are already adequate, staff draw less on leadership to make sense of digital work, whereas where those conditions are thin, the leader becomes the substitute for them. This is consistent with the uneven digital infrastructure of South Punjab's public and private hospitals, where digital leadership may carry the most weight in the settings that are least equipped. The relationship never turned negative across the observed range, so this is a difference of magnitude rather than of direction.

The pattern maps cleanly onto UTAUT. Leadership 4.0 functions as social influence, communicating that digital transformation is expected and valued; digital readiness functions as facilitating conditions, supplying infrastructure, training and support; employee engagement is the motivational response; and organizational performance is the institutional outcome. The significant interaction and index of moderated mediation extend UTAUT beyond individual technology use to an organization-level leadership–performance model, and support treating digital readiness as a boundary condition within that model rather than only as an independent predictor (Venkatesh et al., 2003; Williams et al., 2015).

5.3 Theoretical Implications

The study makes four theoretical contributions; each tied directly to a tested relationship.

First, it extends the Leadership 4.0 literature into a new geography and sector. The construct remains relatively new and has been examined largely in developed economies and in generic organizational settings. Evidence from 356 healthcare employees in South Punjab, Pakistan shows that Leadership 4.0 predicts organizational performance in a resource-constrained public and private hospital system ($\beta = .501$), which establishes the construct as travelling beyond the contexts in which it was developed.

Second, it positions employee engagement as an explanatory mechanism rather than a parallel outcome. The significant partial mediation connects Leadership 4.0 to the established engagement tradition of Kahn (1990); Schaufeli et al. (2002); Saks (2006) and Bakker and Demerouti (2008), and supports the argument that

leadership influences performance in part through the psychological and behavioral states of employees rather than through strategy and technology alone.

Third, it offers a UTAUT-based reading of digital leadership. Mapping Leadership 4.0 to social influence, digital readiness to facilitating conditions, employee engagement to a motivational response and organizational performance to an institutional outcome extends a theory built to explain individual technology acceptance into an organization-level performance model (Venkatesh et al., 2003; Williams et al., 2015). The empirical results are consistent with that mapping at every path.

Fourth, it contributes to conditional process research by testing boundary conditions formally rather than assuming that context operates uniformly. Both the moderation and the moderated mediation hypotheses were supported, and the negative interaction and negative index of moderated mediation together demonstrate that the magnitude of a leadership effect can depend systematically on the organizational conditions surrounding it. This is an argument for specifying and testing facilitating conditions explicitly in leadership–performance models rather than controlling for them.

Methodologically, the study also demonstrates the value of regression-based conditional process analysis for questions of this shape. Testing not only whether Leadership 4.0 predicts performance but how and under what conditions it does so produce a more precise account than a direct-effects model could have supported.

5.4 Practical Implications

The results carry four practical implications for hospital executives, human resource teams and digital transformation leads.

First, Leadership 4.0 should be treated as a defined competency rather than an individual style. Because digital leadership predicted both engagement and performance, hospitals have reason to build it deliberately in senior and middle management: digital vision, technological awareness, data-informed decision making,

employee empowerment, support for innovation, communication through change and commitment to continuous learning. Defining these competencies allows them to be built into leadership development, appraisal and promotion criteria, which institutionalizes the capability instead of leaving it to individual disposition. Development should extend beyond technical content to communication, coaching and change management.

Second, employee engagement should be managed as a performance lever, not only as a staff-satisfaction measure. The mediation result establishes engagement as a mechanism through which leadership reaches performance, which makes it worth measuring and acting directly through participative decision making, role clarity, recognition of contribution, supportive supervision, feedback channels and the removal of unnecessary workload. Involving frontline staff in digital programs helps technology read as a shared undertaking rather than something imposed.

Third, digital readiness warrants sustained investment, and the buffering result sharpens where that investment matters most. Readiness raised engagement in its own right, and leadership mattered most precisely where readiness was weakest.

Departments with thin infrastructure, limited training or poor system integration are therefore where strong digital leadership does the most work, and where readiness investment would relieve the greatest burden on it.

Because readiness varies across hospital types and across wards, laboratories, administrative offices and specialist units, it should be assessed at departmental level, with public and private hospitals prioritizing basic infrastructure and training or system integration and analytics according to their starting point. Priorities include stable hospital information systems, electronic health records, digital communication platforms, data security, help-desk support and continuing digital skills training.

Fourth, the three capabilities should be developed together. Leadership, engagement and readiness were interdependent in the model rather than substitutes for one another, so digital strategy is better treated as a people-management undertaking than as a standalone information technology project. Policymakers can support this through institutional policy, investment and capacity development;

the World Health Organization (2021) has similarly emphasized that digital health should strengthen health systems rather than operate alongside them.

5.5 Recommendations

i. Hospital executives, department heads, nursing managers and administrative supervisors should be the prime targets of Leadership 4.0 development programs by healthcare organizations. The programs should emphasis on Digital Vision, Technology Adoption, Innovation Culture, Data Informed Decision Making and Employee-centric Change leadership.

ii. Hospitals need to incorporate the evaluation of digital readiness into strategic planning. These evaluations should include infrastructure, the user-friendliness of software, access to employee training, system integration, and awareness about cybersecurity and confidence in digital tools.

iii. Continuous feedback and surveys should be conducted to monitor employee engagement. When evaluating engagement data, it's important to look for departments with low employee engagement levels, low leadership support and engagement, and generally less engagement.

iv. Healthcare employees on the "front lines" should be part of Digital transformation teams. Inclusion offers ways of enhancing acceptance, minimizing resistance and making sure that the actual digital processes in wards, laboratories, outpatient departments, emergency units and administrative offices match up.

v. The training should not be a single shot; it should be continuously carried out. Employees require ongoing learning experiences and technical assistance as HIS and digital health technology grows and improves.

vi. Leaders must get the word out that digital solutions create value in patient care for the hospital. When staff members will see how technology enhances the quality of service, accuracy, coordination and patient safety, they will be more likely to use the device.

5.6 Research Questions Revisited

The first research question involved whether Leadership 4.0 had a significant direct effect on organizational performance in the healthcare sector in South Punjab, Pakistan. Based on the findings the answer to this question is yes.

Significantly predicting organizational performance, Leadership 4.0 facilitated employees to perceive better hospital performance if their leaders underwent the four dimensions of Leadership 4.0, namely digital competency of the Leader, innovative Leader, supportive Leader and everyone's perception.

This discovery is significant because it shows that leadership is vital in health care even though it's getting more digital. Technology does not obviate the need for leadership, rather it reinforces the need for those leaders to match the digital capabilities to organizational objectives, patient needs and employee skills.

The second research question examined whether employee engagement intervened between Leadership 4.0 and organizational performance. The results indicated a positive answer. The effect was mediated by employee engagement to a significant extent indicating that Leadership 4.0 helps to enhance the organizational performance partly through boosting employee engagement. These findings shed light on the manner in which leadership affected performance. As well as digital vision or technology-oriented leadership, it was how this kind of leadership impacted on employees' psychological involvement. In the hospitals, it is the employees who are involved to make the service quality to be dependent on their energy, attention and commitment.

The fifth research question asked whether digital readiness moderated the relationship between Leadership 4.0 and employee engagement. The findings provide a positive answer. Digital readiness had a significant positive main effect on employee engagement, and the Leadership 4.0 x digital readiness interaction was statistically significant (B = -0.149, p = .017). Thus, the strength of the Leadership 4.0-engagement relationship varied across levels of digital readiness, supporting the moderation hypothesis.

The sixth research question asked whether digital readiness moderated the indirect effect of Leadership 4.0 on organizational performance through employee engagement. The results also provide a positive answer. The index of moderated mediation was significant because its bootstrapped confidence interval excluded zero, while the conditional indirect effects remained positive and significant at low, mean and high digital readiness. Therefore, digital readiness significantly conditioned the strength of the indirect Leadership 4.0-performance pathway through employee engagement.

Taken together, the research questions support the conceptual model. The relationships among Leadership 4.0, employee engagement and organizational performance were significant, and digital readiness also played a statistically significant conditional role. The findings therefore show that digital readiness should be developed as an organizational capability while also being considered when evaluating how strongly Leadership 4.0 translates into engagement and performance.

The practical progression of improvement is also another area that the research questions address. First, to enhance engagement and performance, hospitals have to start with improving Leadership 4.0. Given this, they should then develop engagement practices since engagement is the mechanism by which leadership can impact upon performance. Ensure that digital readiness and engagement are built simultaneously as it directly helps with engagement and would provide the base for digital work. This process presents an achievable roadmap for health care organizations aiming to maximize performance in a digital transformation environment.

5.7 Limitations of Study

There are several limitations in this study. First, this study had been conducted with cross sectional design. Thus, due care should be used in interpreting causal relationships as the data were taken at a single point in time.

Second, this was a study based on self-report measures. For the self-reported data of the study, a diagnostic test was used for common method bias, and the

results did not suggest that there was a significant issue; however, it remains that perception, social desirability or response style may still affect the data.

Third, the study was only on Healthcare Organizations of South Punjab, Pakistan. Though this context is relevant, the results might not be as generally applicable as would be desired, to other sectors or countries. Fourth, the measurement scales showed strong reliability but modest convergent validity: average variance extracted fell between .379 and .426, below the conventional .50 benchmark, although composite reliability exceeded .70 for every construct and the Fornell-Larcker criterion for discriminant validity was satisfied throughout. Fifth, the professional qualification item on the questionnaire offered only clinical and allied-clinical response categories, so respondents in administrative and health-informatics roles had no exact matching option; the instrument should be revised to include non-clinical qualification categories before reuse. Sixth, digital readiness was tested only as a first-stage moderator, and public and private hospitals were pooled rather than analyzed separately, so differences between the two hospital types remain untested.

5.8 Future Research Directions

This study could be extended in several directions, each following from a specific feature of the present design.

First, longitudinal designs could test whether Leadership 4.0 predicts change over time in employee engagement and organizational performance, since digital transformation is a process rather than an event and the relative importance of leadership may shift between its early and later stages.

Second, mixed-method designs combining survey data with interviews could explain the buffering result. Qualitative evidence would help establish why the Leadership 4.0–engagement relationship weakens as readiness rises, and whether staff in well-resourced units genuinely rely less on their leaders or simply experience that reliance differently.

Third, digital readiness could be modelled as a mediator or as an antecedent rather than only as a first-stage moderator. Leaders often control training budgets, infrastructure decisions and communication, so it is plausible that Leadership 4.0 builds readiness, which in turn drives engagement and performance. Comparing moderation, mediation and serial mediation specifications would establish which best represents the role of readiness.

Fourth, multi-level designs would allow leadership to be modelled at the level at which it actually operates. This study measured individual employee perceptions, whereas leadership climate and readiness both vary across departments and hospitals; multi-level models could test whether hospital-level readiness amplifies individual-level leadership effects.

Fifth, objective performance data would strengthen the outcome measure considerably. Combining perceptual ratings with patient waiting times, system usage logs, error rates, service turnaround times or departmental productivity indicators would allow the model to be tested against behavior as well as perception.

Sixth, comparative work across public and private hospitals, and across provinces or South Asian health systems, would test whether ownership and context change the effectiveness of Leadership 4.0. Hospital type was recorded in the present sample but was not modelled, so this remains an open question.

Finally, additional mediators such as digital trust, psychological safety, innovation climate or change commitment, and additional moderators such as digital literacy, top management support, workload or job autonomy, could be introduced, ideally with larger samples and confirmatory structural equation modelling of the measurement and structural paths in parallel.

5.9 Conclusion

Overall, the study concluded that Leadership 4.0 is an important determinant of organizational performance in the healthcare sector of South Punjab, Pakistan. Leadership 4.0 had significant direct and indirect effects on organizational performance through employee engagement, confirming engagement as an important

mechanism linking digital leadership with performance. Digital readiness also had a significant positive association with employee engagement and significantly moderated the Leadership 4.0-engagement relationship. In addition, the significant index of moderated mediation showed that digital readiness conditioned the indirect Leadership 4.0-organizational performance relationship through employee engagement. These findings indicate that healthcare organizations should develop Leadership 4.0, employee engagement and digital readiness together as interconnected capabilities for performance during digital transformation. The study contributes to healthcare management, digital leadership and organizational performance literature and provides practical insight for hospitals in South Punjab seeking to improve performance in the digital transformation era.

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Appendix A Research Questionnaire

The following questionnaire was used to measure demographic characteristics and the four main constructs of the study. Responses to scale items were measured on a five-point Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

Leadership 4.0

Appendix Table A1: Items for Leadership 4.0

Code	**Item Statement**
L40_1	My supervisor communicates a clear digital vision for the organization.
L40_2	My supervisor encourages employees to use digital technologies for improving work performance.
L40_3	My supervisor supports innovative ideas in the workplace.
L40_4	My supervisor motivates employees to adapt to technological change.
L40_5	My supervisor provides guidance when employees face difficulties in using digital systems.
L40_6	My supervisor promotes teamwork and collaboration through digital communication tools.
L40_7	My supervisor encourages continuous learning and digital skill development.

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Code	Item Statement
L40_8	My supervisor uses data and technology to support decision-making.
L40_9	My supervisor empowers employees to participate in digital transformation initiatives.
L40_10	My supervisor creates a work environment that supports change, innovation, and technology use.

Employee Engagement

Appendix Table A2: Items for Employee Engagement

Code	**Item Statement**
EE_1	I feel energetic while performing my work.
EE_2	I am enthusiastic about my job.
EE_3	I feel proud of the work I do in my organization.
EE_4	I am highly involved in my work.
EE_5	I am willing to put extra effort into my job.
EE_6	I feel dedicated to achieving organizational goals.
EE_7	I feel motivated to contribute to better healthcare services.
EE_8	I remain focused and committed while performing my duties.
EE_9	I feel emotionally connected with my work.
EE_10	I actively participate in activities that improve organizational performance.

Digital Readiness

Appendix Table A3: Items for Digital Readiness

Code	**Item Statement**
DR_1	My organization provides adequate digital tools for work.
DR_2	Employees in my organization have the required skills to use digital systems.
DR_3	My organization provides training for using digital technologies.
DR_4	I feel confident in using digital systems at work.
DR_5	Technical support is available when employees face digital problems.
DR_6	My organization has a culture that supports digital transformation.
DR_7	Digital systems in my organization help employees perform their work effectively.
DR_8	My organization is ready to adopt new healthcare technologies.
DR_9	Employees are encouraged to learn and use new digital healthcare systems.
DR_10	My organization provides sufficient resources for successful digital transformation.

Organizational Performance

Appendix Table A4: Items for Organizational Performance

Code	**Item Statement**
OP_1	My organization provides high-quality healthcare services.
OP_2	My organization achieves its operational goals effectively.
OP_3	My organization responds efficiently to patient needs.
OP_4	My organization uses resources efficiently.
OP_5	My organization encourages innovation in healthcare services.
OP_6	My organization maintains a good level of employee productivity.
OP_7	My organization has improved its digital healthcare services.
OP_8	My organization achieves its strategic objectives successfully.

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Code	**Item Statement**
OP_9	My organization maintains patient satisfaction through effective service delivery.
OP_10	My organization performs better compared with similar healthcare organizations.

Appendix B: Measurement Codebook

Appendix Table B: Measurement Codebook

Variable	**Type**	Coding / Description
Response_ID	Identifier	Unique respondent ID
City	Categorical	Bahawalpur, Dera Ghazi Khan, Rahim Yar Khan, Muzaffargarh, Vehari, Multan
Hospital Name	Categorical	names of the sampled hospitals in the six selected districts
Hospital Type	Categorical	Public = public/teaching/government hospital; Private = private hospital
Gender	Categorical	Male, Female
Age Group	Ordinal	21-25, 26-30, 31-35, 36-40, 41-45, 46 and above
Professional Qualification	Categorical	MBBS/BDS, MD/MS, FCPS, General Nursing/Midwifery Diploma, Allied Health Diploma, Other Clinical/Technical Qualification
Job Position	Categorical	Doctor, Nurse, Technician, Administrative Staff, Allied Health Professional, IT/Health Informatics Staff
Department	Categorical	Emergency, OPD, ICU, Surgery, Medicine, Radiology, Laboratory, HR/Admin, IT/Health Informatics

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Variable	**Type**	Coding / Description
Experience	Ordinal	Less than 1 year, 1-3 years, 4-6 years, 7-10 years, More than 10 years
Monthly Income	Ordinal	Below 50,000, 50,001-75,000, 75,001-100,000, 100,001-150,000, Above 150,000
Digital training Received	Categorical	Yes or No
L40_1 to L40_10	Likert item	Leadership 4.0 items, 1 = Strongly Disagree to 5 = Strongly Agree
EE_1 to EE_10	Likert item	Employee Engagement items, 1 = Strongly Disagree to 5 = Strongly Agree
DR_1 to DR_10	Likert item	Digital Readiness items, 1 = Strongly Disagree to 5 = Strongly Agree
OP_1 to OP_10	Likert item	Organizational Performance items, 1 = Strongly Disagree to 5 = Strongly Agree
Leadership4_Mean	Computed scale	Average of L40_1 to L40_10
Employee Engagement Mean	Computed scale	Average of EE_1 to EE_10
Digital Readiness Mean	Computed scale	Average of DR_1 to DR_10
Organizational Performance Mean	Computed scale	Average of OP_1 to OP_10
L40_Centered	Computed variable	Leadership4_Mean centered at sample grand mean
Recentered	Computed variable	Digital Readiness Mean centered at sample grand mean

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Variable	**Type**	Coding / Description
L40xDR_Interaction	Computed variable	Centered interaction term for moderation analysis

Appendix C: Consent Form

Dear Respondent,

you are invited to participate in an academic research study on Leadership 4.0, employee engagement, digital readiness and organizational performance in the healthcare sector of South Punjab, Pakistan. Your participation is voluntary. The information collected will be used only for academic purposes. Your identity and institutional information will remain confidential, and responses will be reported in aggregate form only. You may withdraw from participation at any time without any penalty. By completing the questionnaire, you indicate your informed consent to participate in the study.

Appendix D: Ethical Considerations Checklist

Appendix Table D: Ethical Considerations Checklist

Ethical Area	**Procedure**
Voluntary participation	Respondents were informed that participation was voluntary.
Informed consent	Participants were informed about the study purpose before completing the questionnaire.
Confidentiality	No identifying personal information was reported in the research.
Anonymity	Responses were analyzed in aggregate form.
Academic integrity	All external sources were acknowledged through APA-style citations.

Appendix E: Additional Statistical Output Summary

The statistical analysis used construct mean scores for Leadership 4.0, employee engagement, digital readiness and organizational performance. The main model decisions were as follows: the direct effects, mediation, moderation and moderated mediation hypotheses were supported. Employee engagement operated as a significant explanatory mechanism between Leadership 4.0 and organizational performance; the Leadership 4.0 x digital readiness interaction was significant (B = -0.149, p = .017); and the index of moderated mediation was significant because its 95% bootstrap confidence interval [-0.125, -0.008] excluded zero.