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Digital Technology as a Strategic Driver of Competitive Advantage Hospital: Evidence from the Mediating Role of Digital Infrastructure

(*Teknologi Digital sebagai Penggerak Strategis Keunggulan Kompetitif Rumah Sakit: Bukti dari Peran Mediasi Infrastruktur Digital*)

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Abstract :
Hospitals in Bukittinggi face growing competition and rising patient expectations. Digital transformation plays a crucial role in enhancing operational efficiency, service quality, and clinical process speed. However, many hospitals still struggle with limited technological infrastructure, low digital literacy among healthcare workers, unintegrated digital systems, and resistance to change, leading to less optimal service performance

Objective : This study examines the impact of digital technology use and digital infrastructure on hospital competitive advantage in Bukittinggi City, West Sumatra.

Methodology : Using a quantitative approach with the Structural Equation Modeling (SEM-PLS) method, the research tests direct and indirect variable effects.

Research Results : The findings reveal that digital technology and infrastructure significantly influence hospital competitiveness through improved service efficiency and innovation.

Keywords : Technology, Infrastructure, Competitive Advantage, SEM PLS

1. Introduction

In the era of digital transformation, hospitals in Indonesia are required to improve their competitiveness and operational efficiency through the application of innovative technologies and the development of reliable digital infrastructure, as well

as to create effective, efficient, and highly competitive services through the utilisation of digital technologies and the strengthening of reliable digital infrastructure (Tahir et al. 2023) . The competitive advantage of hospitals is no longer determined solely by physical facilities and human resources, but also by the institution's ability to adopt and manage digital systems strategically and in an integrated manner. However, the reality on the ground shows that many hospitals in Indonesia, especially those in rural areas or small cities, still face various obstacles in achieving these goals. Digital transformation in the health sector is being promoted by the Indonesian government through the National Health Digital Transformation policy launched by the Ministry of Health in 2022. The main objective of this policy is to create an integrated and sustainable health ecosystem through the implementation of electronic medical records, telemedicine, and data integration between health service facilities (Ministry of Health of the Republic of Indonesia 2022).

The development of information and communication technology (ICT) has become a major force driving transformation in various sectors, including the health sector. The application of digital technology, such as electronic medical record systems, telemedicine, and other digital service platforms, has been proven to improve operational efficiency, service quality, and expand the accessibility of health services (T1, Liu et al. 2020). Globally, various studies show that the integration of digital technology can accelerate service processes, minimise medical errors, and increase patient satisfaction (T2, WHO 2021). The successful implementation of this technology depends not only on technological innovation but is also greatly influenced by the readiness of adequate digital infrastructure. A robust digital infrastructure includes a stable and fast internet network, up-to-date hardware and software, and a reliable data security system to protect patient privacy (Chang and Ting 2022). Without adequate infrastructure support, various digital innovations will not run optimally due to technical constraints and high data security risks. In addition, the level of digital usage by healthcare professionals and service users is a key factor in achieving competitive advantage. Effective use will increase service effectiveness and create competitive differentiation, both locally and nationally (T4, Nayak et al. 2020). Conversely, istance to technology, low digital literacy, and lack of

training are major obstacles that hinder the optimisation of digital technology use in healthcare (Zhang et al. 2021). Several previous studies have proven that the positive relationship between strong digital infrastructure, technology usage levels, and competitive advantage has been empirically proven in the context of hospitals and other healthcare organisations (Oliveira et al. 2022). For example, a study by (Almunawar, Saggaf, and Anshari 2020) states that the success of healthcare service digitalisation is largely determined by infrastructure factors and user adoption levels, which can directly strengthen an organisation's competitive position.

2. Literature

2.1 Digital Technology

Digital technology has transformed the structure of modern healthcare systems by enabling hospitals to improve efficiency, accuracy, and patient-centered care. According to (Laudon and Laudon 2022), digital technologies such as Electronic Health Records (EHR), clinical decision support systems (CDSS), and telemedicine systems play a crucial role in accelerating diagnosis, reducing clinical errors, and enhancing service coordination. The World Health Organization (WHO 2021) stresses that digital transformation in healthcare enhances service accessibility, ensures continuity of care, and strengthens clinical data management.

This technology has been proven to accelerate the diagnosis and decision-making processes (Laudon and Laudon 2022). Digital technologies such as Electronic Health Records (EHR), telemedicine, and decision support systems have been proven to improve hospital operational efficiency and service quality (Rahman et al. 2021). Digital Technology (X1): The Role of Digital Technology Digital technology in the healthcare sector encompasses various innovations such as hospital management information systems (SIMRS), electronic medical records (EMR), clinical decision support systems, telemedicine, and other digital-based applications.

2.2 Digital Infrastructure

Digital Infrastructure (Z) Digital Infrastructure components include hardware (computer devices, servers, internet networks), software (operating systems, applications), as well as reliable data security and network connectivity systems. Good infrastructure is the foundation for the effective and efficient implementation of digital technology.

The Role of Digital Infrastructure in Technology Implementation Research by (Albar and Hoque 2019) emphasized that the successful implementation of digital systems depends on the readiness of the infrastructure. Inadequate infrastructure will cause frequent system downtime, data cannot be accessed quickly, and data security is threatened, all of which have the potential to hinder the benefits of digital technology.

Infrastructure as the Foundation of Organizational Excellence, according to WHO (2025), digital infrastructure must meet the criteria of interoperability, scalability, and reliability. Strong infrastructure will support the diversity of applications and systems used, and ensure the continuity of digital health services. Infrastructure Quality and Its Achievements Hardware and network quality are crucial to ensure data security, access speed, and system interoperability. Robust infrastructure also increases patient and healthcare worker confidence in the digital technology used in hospitals. Linkage to Innovation and Efficiency Adequate digital infrastructure. Digital infrastructure includes servers, communication networks, data security systems, and cloud computing. Without adequate infrastructure, the use of digital technology will not be optimal (Yoon and Kim 2020).

3. Research Methodology

This study employs a quantitative research design using a causal–associative approach, which aims to examine the direct and indirect effects among the variables in the model. This design is appropriate because the research focuses on testing causal relationships between Digital Technology (X1), Digital Infrastructure (Z), and Hospital Competitive Advantage (Y). The analytical method applied is Structural Equation Modeling (SEM) using the Partial Least Squares (PLS) approach. SEM-PLS is

selected because it can test complex structural relationships, including mediation and moderation effects, and does not require strict data distribution assumptions. It is also highly suitable for studies with a large number of respondents and latent variables measured by multiple indicators.

The main characteristics of the research design include:

1. Data are collected in numerical form using Likert-scale questionnaires and analyzed with inferential statistical techniques.
2. Causal–Associative Design: The design aims to examine how independent variables (X1) influence the dependent variable (Y) throught mediating variable (Z), both directly and indirectly. Use of SEM-PLS Method**,** this method allows :
    a. Testing of measurement models (outer model)
    b. Testing of structural relationships (inner model)
    c. Calculation of direct, indirect, and total effects
    d. Instrument validity and reliability assessment
3. From the large sample size, 326 samples were obtained for each hospital. The criteria for respondents in this study included: respondents must have worked in a hospital, been involved in the use or management of hospital digital information systems, and had an understanding or experience of the implementation of hospital technology infrastructure, as well as being willing to participate and provide valid data by completing the questionnaire.
4. The types of data used are: Primary Data: Obtained through the distribution of questionnaires to respondents, and Secondary Data: Obtained from hospital documents, annual reports, and literature studies related to information systems and competitive advantages, as well as relevant scientific literature
5. Structured Research Instrument: A 4-point Likert questionnaire tested for validity and reliability. Location and Units of Analysis: Six hospitals in Bukittinggi City, with respondents including medical staff, administrators,

managers, and IT personnel. Thus, the research design ensures strong methodological rigor and supports accurate assessment of the impact of digital technology and infrastructure on hospital competitive advantage.

To assess the impact of digital technology usage and infrastructure on the competitive advantage of hospitals in Bukittinggi City, this study utilizes a structured questionnaire as the primary data collection instrument. This questionnaire is designed to gather quantitative data from respondents, including healthcare personnel and hospital management staff. The instrument employs a 4-point Likert scale, enabling respondents to express their level of agreement or frequency regarding each statement with clarity and precision. The use of a well-constructed questionnaire ensures accurate and reliable measurement of the key variables under investigation. Components of the Research Instrument,

The instrument is divided into several key sections:

1. Respondent Demographic Data: This section collects basic information about the respondents, such as their full name, contact details, work unit, gender, age, division or role within the hospital, and length of employment. These demographic variables help characterize the sample and ensure diversity, facilitating more comprehensive data analysis.
2. Main Variables and Indicators: Digital Technology (X1) This dimension measures the extent to which hospitals have implemented digital technologies in their services and operations. Items may include the presence and functionality of Electronic Medical Records (EMR), telemedicine systems, data analytics, and overall system integration. Digital Infrastructure (Z) This measures the quality and capacity of the infrastructure supporting digital systems. Items cover internet speed, hardware availability, system security, and data protection measures, Competitive Advantage of the Hospital (Y) This variable evaluates the hospital's ability to compete effectively in the healthcare sector. Indicators include service speed, degree of personalization, innovation in service delivery, patient satisfaction levels, and differentiation from competitors, User Satisfaction (Mediating Variable) An additional set of items

assesses user satisfaction with digital services, which may mediate the relationship between infrastructure and competitive advantage.

To analyze the data and validate the proposed model, the study utilizes Structural Equation Modeling (SEM) and allows for the simultaneous examination of multiple relationships among observed and latent variables, and it is particularly well-suited for mediation analysis (Hair et al. 2020).

4. Result

Based on respondent characteristics, the majority were female (58.0%), while males accounted for 42.0%. In terms of gender distribution, the majority of the respondents were female, totaling 189 individuals (58.0%), while male respondents amounted to 137 individuals (42.0%). This composition reflects the general workforce structure within hospitals where nurses and administrative personnel professions largely dominated by women play significant roles in operating hospital information systems.

Based on job categories, the largest group of respondents consisted of nurses (23.3%), followed by administrative personnel (19.6%) and doctors (18.4%). Smaller proportions were represented by pharmacy staff (2.8%), IT/technology personnel (3.4%), management or unit heads (5.5%), and other categories (0.9%). This distribution indicates that most respondents are the main users of digital hospital systems such as SIMRS, EMR, digital service applications, and supporting digital infrastructure.

Based on the research data, the length of employment of respondents in the hospital varies. Out of the total respondents, 53 people (16.25%) have less than 1 year of work experience. Meanwhile, 47 people (14.42%) have been working for 1 to 3 years. Respondents with 4 to 6 years of experience total 85 people (26.07%), while the majority, 141 people (43.25%), have worked for more than 6 years.

Overall, the demographic profile demonstrates that the study involved the appropriate and relevant groups of hospital personnel to accurately measure digital

technology usage, Digital Usage, and digital infrastructure readiness. The dominance of respondents from productive age groups and clinical/administrative roles reinforces the validity of the data, as these individuals are directly involved in daily hospital operational processes using digital systems.

4.1 Result Discriminant Validity Testing

4.1.1 Discriminant Validity with Cross Loading

Discriminant validity of the measurement model with reflective indicators is assessed based on cross loading of the measurement with the construct. It is expected that each latent variable measured is compared with indicators for other latent variables. The cross-loading calculation results are presented in Table 1.

Tabel 1. Discriminant Variables with *Cross-Loading*

Indikator	Competitive Advantage	Digital Infrasctructure	Digital Technology
CA	0,951	0,278	0,122
DC	0,956	0,295	0,116
HS	0,148	0,894	0,573
IQ	0,151	0,573	0,876
LT	0,091	0,611	0,879
NC	0,159	0,902	0,638
OE	0,464	0,890	0,590
SQ	0,118	0,544	0,843
SS	0,080	0,608	0,888

Source : Primary Data 2025

Table 1 shows that the correlations between constructs and their dominant indicators are higher than the correlations between indicators and other constructs, and *the cross-loadings* of all research variable indicators are above 0.70, indicating that all indicators are valid. Based on *cross-loading* measurements. It can be seen that overall, the indicators from all dimensions on all variables produce loadings on their dimensions (bold font) that are greater than the loading values on other dimensions.

For further clarification, see Figure 3.2 (yellow). Thus, it can be stated that each indicator is capable of measuring the latent dimension corresponding to the indicator.

4.1.2 Discriminant Validity using the Fornell-Lacker criteria

Tabel 2. Discriminant Variables with Fornell-Lacker Criteria

Variable	Competitive Advantage	Digital Infrasctructure	Digital Technology
Competitive Advantage	0,954		
Digital Infrasctructure	0,301	0,896	
Digital Technology	0,125	0,671	0,871

Source : Primary Data 2025

Discriminant validity testing can also be conducted by examining the AVE root for each construct, which must be greater than the correlation value with other constructs in the model in order to be considered to have good discriminant validity (Fornell and Larcker 1981), as shown in Table 2.

4.1.3 Reliability Testing

Reliability indicates the accuracy, consistency, and precision of a measuring instrument in performing measurements. Reliability testing in PLS can use two methods, namely *Cronbach's alpha* and *composite reliability*. *The rule of thumb is that Cronbach's alpha* or *composite reliability* values should be greater than 0.7, although a value of 0.6 is still acceptable. The composite reliability test results are as follows :

Tabel 3. Construct Reliability

Variable	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Competitive Advantage	0,900	0,903	0,952	0,909

Digital Infrasctructure	0,877	0,886	0,924	0,802
Digital Technology	0,894	0,897	0,927	0,759

Source : Primary Data 2025

Table 3. shows that the variables have a *Cronbach's Alpha* or *Composite Reliability* value > 0.70, so all variables are reliable. With relatively long work experience (>6 years), which can contribute to the stability and quality of hospital services. In addition, the proportion of employees with less than 3 years of experience indicates the presence of new staff with potential for career development and learning in the hospital environment.

4.1.4 Results of analysis using the Structural Equation Modelling (*SEM*) method Competitive Advantages of Hospitals

In this analysis result, the *observed* variable data in the invalid outer model has been eliminated, yielding the path coefficient values in the inner model.

Tabel 4. Path Coefficient Results and Significance Level

Hypotesis	Original sample	T statistics	P values	Description
Digital Technology -> Digital Infrasctructure	0,671	18,633	0,000	Accept
Digital Infrasctructure -> Competitive Advantage	0,301	6,167	0,000	Accept

Source : Primary Data 2025

Based on Table 4, the results of testing the research model hypothesis can be concluded :

a. The influence of Digital Technology (X1) on Digital Infrastructure (Z)
   Based on the results of the path analysis statistical test using the SEM method, *a T-value of* 18.633 was obtained with a confidence level of 95%. The value 18.633 > 1.96. Therefore, Ho is rejected. This indicates that *digital technology*

has a significant effect on *digital infrastructure. Digital Technology* has a path coefficient (β) of 0.671 on *digital infrastructure.* This indicates that the better *the digital technology*, the better *the digital infrastructure* by 67.1%, and vice versa.

b. The Effect of Digital Infrastructure (Z) on the Competitive Advantages of Hospitals (Y)

Based on the results of the path analysis statistical test using the SEM method, *a T-value* of 6.167 was obtained with a 95% confidence level. The value of 6.167 is greater than 1.96. Therefore, Ho is rejected. This indicates that *digital infrastructure* has a significant effect on *the competitive advantages of hospitals*. *Digital Infrastructure* has a path coefficient (β) of 0.423 on *the Competitive Advantages of Hospitals.* This indicates that the better *the digital infrastructure*, the better *the Competitive Advantages of Hospitals* in creating superior value compared to competitors by 42.3%.

After obtaining the overall results diagram, a path analysis was conducted that only considered the significant levels for the dependent variable, thereby forming paths between variables. The paths formed are as follows:

4.1.5 Path analysis results with path coefficient values and significance levels (*T-value)* for Competitive Advantages of Hospitals

Tabel 5. Significance level and path coefficient results using the structural equation modelling (SEM) method

Hypotesis	Original sample	T statistics	P values
Digital Technology -> Competitive Advantage	**0,202**	**5,593**	**0,000**

Based on Table 5, a path analysis was formed using the *Structural Equation Modelling* (SEM) method. Therefore, an interpretation was carried out to interpret the results of the path analysis so that it could provide information from the path analysis as follows :

a. Digital Technology (X1)

The indirect effect of Digital Technology (X1) on the Competitive Advantages of Hospitals (Y) through Digital Infrastructure (Z) = 0.202. Based on the path analysis results using the SEM method, it was found that digital technology has an indirect effect on the competitive advantages of hospitals through the digital infrastructure path, with a total overall effect of 0,202.

4.2 Discussion

Digital Technology then influences Digital Infrastructure with a coefficient value of 0,671. This value indicates that the better the digital system, the stronger the hospital's digital infrastructure capacity. This is in line with Bharadwaj's (2000) IT Capability theory, which states that information technology capabilities which include infrastructure, human capabilities, and IT processes will strengthen an organisation's capacity for further technology integration.

Digital Infrastructure itself is formed by three indicators: HS, NC, and OE, which represent important aspects of infrastructure readiness, such as hardware support, network capability, and operational efficiency. The results show that these three components contribute significantly to shaping digital infrastructure readiness. In the context of hospitals, strong digital infrastructure is the backbone for ensuring smooth operations, medical data integration, and support for IoT-based services and telemedicine.

Digital Infrastructure then has a significant influence on the Competitive Advantage of Hospitals, with a path value of 0,301. This means that the more mature the hospital's digital infrastructure is, the higher the hospital's ability to create superior services that differentiate it from its competitors. Barney's (1991) Resource-Based View (RBV) theory supports this finding, emphasising that valuable, scarce, and difficult-to-imitate resources such as advanced digital infrastructure will strengthen an organisation's competitive position. On the right side of the model, the Competitive Advantage variable is formed by two indicators, CA and DC. These indicators likely represent customer advantage and differentiation capability, which describe the

extent to which hospitals are able to provide added value to patients and differentiate themselves from competitors. In the field, this competitive advantage can be seen in the form of fast, accurate, personalised services, integrated medical record systems, and operational efficiency.

When linked to the actual conditions of hospitals in Indonesia, digital transformation is an urgent necessity to overcome challenges such as high patient loads, limited healthcare personnel, and administrative complexity. Thus, the model in the figure reflects field conditions where the success of digital implementation is determined not only by technology alone, but also by the quality of use and infrastructure readiness. Overall, this model provides a comprehensive overview that Digital Technology → Digital Infrastructure → Competitive Advantage is the dominant influence, while Digital Usage is the main enabler that accelerates the achievement of competitive advantage. The integration of theory, empirical findings, and field conditions confirms that digitalisation is not merely a tool, but a long-term strategy to improve the competitiveness and quality of hospital services.

5. Conclusion

The conclusion that can be drawn from this study is that based on the results of data analysis using the Structural Equation Modelling (SEM) approach and an in-depth analysis of the research findings, it can be concluded that the application of digital technology and the development of adequate digital infrastructure have a significant impact on the competitive advantage of hospitals in Bukittinggi. These findings support the concept that the success of a hospital in competing in the healthcare market is not only determined by traditional factors such as service quality and medical facilities, but is increasingly reinforced by the role of integrated digital strategies.

Empirically, the data shows that the digital infrastructure variable plays the most dominant role in shaping the competitive advantage of hospitals. Indicating that the relationship is very strong and significant. This finding confirms that the quality and readiness of digital infrastructure, such as data networks, system integration,

information security, and technological capacity, are the main foundations for hospitals to improve competitiveness, service efficiency, and the quality of patient experience.

The model results also show that digital technology contributes significantly to the formation of digital infrastructure. This means that investment in technologies such as clinical information systems, digital applications, and technology-based medical devices will strengthen the digital infrastructure of hospitals.

Therefore, overall, it shows that the SEM model used has very strong construct indicators with high loading values and large T-values. Thus, it can be concluded that the success of hospitals in achieving competitive advantage is largely determined by the readiness of digital infrastructure, while digital technology and its level of use serve as factors that strengthen this infrastructure. Competitive advantage does not only depend on the use of technology, but is far more influenced by how digital infrastructure is able to integrate, support, and facilitate all technology-based service processes.

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