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Mapping Human Capital Readiness for Digital Transformation in Disaster-Prone Regions: Evidence from West Sumatra

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Abstract

This study analyzes the distribution of the Human Capital Readiness Index (HCRI) among workers in disaster-prone areas of West Sumatra, focusing on Padang City and Pesisir Selatan Regency. The index, constructed through a Principal Component Analysis (PCA) of four dimensions digital competence, adaptability, information access, and sustainability planning – illustrates the workforce's readiness for post-disaster digital transformation. Based on responses from 384 workers, results show that 50.52% fall into the High Readiness category, 25.78% Moderate, 16.41% Very High, 6.77% Low, and only 0.52% Very Low. These findings indicate that most workers demonstrate a relatively strong readiness level, supported by increasing digital exposure and adaptive capacity, yet gaps remain in planning and information access. The results highlight the importance of targeted human capital interventions and digital capacity development to ensure equitable resilience across both formal and informal sectors in disaster-affected regions.

Keyword: Human Resource management, Workforce Resilience, Digital Transformation, Disaster-Prone Regions.

1. INTRODUCTION

The rapid acceleration of digital transformation has fundamentally reshaped organizational operations, learning, and competition in the global economy, particularly in the post-pandemic, disaster and climate-vulnerable era. Digitalization has emerged as a critical engine of productivity and a survival strategy for both organizations and governments. This transformation is driven by the need for strategic vision, adaptability, and a human-centric approach to create value and drive sustainable growth (Soto-Acosta, 2023). The following sections explore the multifaceted impact of digital transformation, its role in economic development, and the challenges and strategies for successful implementation. A resilient workforce is built through investment in employee development and engagement. This involves creating a supportive culture and diverse talent development approaches to facilitate smooth transitions into digitized ecosystems (Messer, 2021). The workforce plays a crucial role in managing recovery efforts post-disaster. However, disruptions can have ripple effects on interdependent systems, highlighting the need for strategies that ensure workforce continuity and resilience (Santos et al., 2014). For developing countries such as Indonesia, where natural disasters are recurrent and unevenly distributed, digital transformation must

be accompanied by efforts to strengthen human capital readiness the capability of individuals and institutions to adapt, learn, and perform effectively under disruptive conditions.

Within this context, human capital serves as a critical driver of resilience and innovation. Adaptive skills are essential for effectively utilizing new technologies and fostering innovation. These skills enable workers to navigate dynamic and uncertain environments, making them crucial for technological progress and economic development (Iyigun et al., 1999). In disaster-prone areas, human capital readiness goes beyond mere digital literacy; it includes emotional resilience, problem-solving skills, and access to digital infrastructure that enables sustained productivity even in crisis conditions. Prior studies have demonstrated that regions with strong human capital foundations tend to recover more quickly from disasters (Issa et al., 2025).

West Sumatra is a province in Indonesia that is vulnerable to natural disasters, including earthquakes and floods (Indah et al., 2018; Singh et al., 2010). These calamities inflict physical damage and interrupt economic and social activities (Noy & Vu, 2010). Historically, earthquakes in West Sumatra have resulted in considerable infrastructure destruction and economic losses (Musyarof & Qomari, 2022). Employees favor working in environments devoid of disaster threats, owing to the elevated stress associated with disaster-prone regions. Productivity in disaster-prone places exhibits different levels (Farlis & Riski, 2023). Disaster recovery encompasses decision-making processes and workforce preparedness (Haimes, 2012). In this context, workforce preparedness to adapt to the digital age is essential for maintaining competitiveness in the labor market. The Industrial Revolution 4.0 has initiated a new phase of digital transformation, necessitating a workforce proficient in the knowledge and abilities to understand and employ innovative technology. Competency-based and technology-driven human resource management solutions tackle difficulties and leverage opportunities presented by digital transformation (Nurani et al., 2024). In disaster prone regions such as West Sumatra, there are further obstacles to assuring workforce preparedness for digital transformation. Several studies have indicated that human capital readiness for digital transformation in disaster affected areas remains limited. Factors such as digital skills, access to technology, and policy support influence workforce readiness. However, there is a lack of empirical research specifically measuring workforce readiness in disaster-prone areas like West Sumatra.

Digital transformation has become a crucial component in achieving sustainable business and economic growth, particularly in regions vulnerable to natural disasters. Human resources in such regions are often forced to adapt to rapid changes brought by disaster shocks

while simultaneously responding to the increasing demands of digitalization. Prior studies highlight the importance of human capital in shaping organizational resilience and technological adoption (Douglas, 2021; Khuan, 2024). Despite the growing scholarly attention on digital transformation, few studies provide empirical insights into how human capital readiness can be systematically measured in disaster-prone areas. In the Indonesian context, particularly West Sumatra, recurrent natural disasters highlight the urgency of building resilient and digitally adaptive workforces. This study introduces a Human Capital Readiness Index (HCRI) constructed from weighted dimensions of digital competency, disaster adaptability, support and access to information, and sustainability planning, thereby offering a comprehensive framework to evaluate workforce preparedness for digital transformation.

The primary objective of this study is to analyze the distribution of the Human Capital Readiness Index (HCRI) among the workforce in disaster-prone regions of West Sumatra. Specifically, the study aims to: (1) describe the variation of readiness levels across categories of workers based on the HCRI distribution; (2) identify the proportion of workforce readiness within each category very low, low, moderate, high, and very high; and (3) interpret the implications of these patterns for strengthening digital transformation and workforce resilience in post-disaster contexts. By focusing on distributional analysis, this research provides empirical evidence for policymakers to design targeted human capital development strategies in disaster-prone regions, contributing to the broader discourse on sustainable workforce transformation in Indonesia.

2. METHOD

This study a quantitative approach with survey data collected from 384 respondents working in Padang City and Pesisir Selatan Regency, two disaster-prone areas in West Sumatra, Indonesia. Respondents were selected using stratified random sampling across different job types. It is optimal when each stratum is abundant, meaning it has a large number of data points (Lee & Park, 2015).

This study employed a quantitative approach using a structured questionnaire to measure the Human Capital Readiness Index (HCRI) across four key dimensions: Digital Competence (COMP), Adaptability (ADPT), Support and Access to Information (SUPP), and Planning and Sustainability (PLAN). The indicators for Digital Competence (COMP) were adapted from Pasuraman (2000) *Technology Readiness Index (TRI)*. The Adaptability dimension (ADPT) was constructed based on the organizational resilience framework introduced by Coutu (2002) and extended by Bardoel et al. (2014), emphasizing behavioral flexibility, coping capability, and the ability to adjust post-disruption. The Support and Access to Information

(SUPP) indicators were derived from the digital inequality model of Akpan et al., (2021), which conceptualizes access to institutional support and information systems as critical mediators of digital participation. The Planning and Sustainability dimension (PLAN) was formulated based on Armstrong and Taylor's (2020) principles of strategic human resource planning, which highlight future oriented preparedness, continuity, and long term workforce development.

Data were collected using a structured questionnaire comprising two sections: (1) demographic characteristics (gender, age, education, type of work, and sector), and (2) items measuring core HCRI dimensions digital competence (COMP), post-disaster adaptability (ADPT), support and information access (SUPP), and planning for sustainability (PLAN). Each dimension was operationalized through multi-item Likert-scale statements adapted from validated instruments in digital readiness and resilience studies. Kothari (2004) states that the Likert scale is constructed through item analysis, where each item distinguishes respondents with the highest and lowest scores. The scale measures attitudes through a set of statements rated numerically and summed to represent overall responses. According to Joshi et al. (2015), the interpretation of Likert data depends on whether the variables are treated as ordinal or interval, based on the research instrument. As stated by Nunnally and Bernstein (1994), a reliability coefficient above 0.60 is considered acceptable for questionnaire-based studies, with higher values reflecting stronger internal consistency.

A weighted index approach was applied to generate the Human Capital Readiness Index (HCRI), with scores normalized to a 0–100 scale. The Principal Component Analysis (PCA) approach was applied to generate composite scores representing the workforce's readiness for post-disaster digital transformation. PCA is commonly employed to derive weights for constructing composite indices and is particularly effective in reducing and summarizing complex information into a smaller number of representative variables (Herdiansah & Pangestuty, 2022). Data validity and reliability tests confirmed the robustness of the constructs data. Descriptive statistics were employed to explore the influence of demographic and contextual factors on HCRI levels. This analytical framework allows the study to highlight the proportional differences in workforce readiness and to provide empirical insights into digital transformation capacity across disaster-prone labor markets.

3. RESULTS AND DISCUSSION

Descriptive analysis utilized statistical measures to summarize and evaluate the gathered data. This method enhances comprehension of data distribution and variability,

including a summary of respondent attributes and the distribution of essential study variables. Descriptive analysis serves as a preliminary analytical phase, facilitating the identification of data patterns, the recognition of respondent trends, and the assurance of data quality before advancing to additional statistical testing. The distributions of demographics and variables among the respondents are provided as follows.

3.1 Work Location of Respondents

Table 1. Work Location of Respondents

Work Location	Freq.	Percent	Cum.
Kabupaten Pesisir Selatan	125	32.55	32.55
Kota Padang	259	67.45	100.00
Total	384	100.00	

Source: Processed with STATA 2025.

The distribution of respondents according to their place of employment reveals that 67.45% of them were working in Padang City, while 32.55 percent of them were employed in Pesisir Selatan Regency, resulting in a total of 384 respondents. This distribution illustrates the proportional workforce demographics in both regions, with Padang, the provincial capital, functioning as an urban economic center offering varied employment prospects, whereas Pesisir Selatan exemplifies a semi-rural locale characterized by increased disaster risk and inadequate digital infrastructure. Regional disparities are crucial for understanding variances in workforce preparedness, as urban employees often have superior access to technology and training opportunities than their rural counterparts. The digital divide further compounds these challenges, as rural areas typically have less access to information and communication technology (ICT) (Moreira et al., 2024). This composition guarantees that the sample effectively encompasses both urban and rural labor dynamics in disaster-prone areas of West Sumatra.

3.2 Gender of Respondents

Table 2. Gender of Respondents

Gender of Respondents	Freq.	Percent	Cum.
Male	198	51.56	51.56
Female	186	48.44	100.00
Total	384	100.00	

Source: Processed with STATA 2025.

With a total of 384 respondents, the gender distribution of respondents showed a virtually equal composition, with 51.56% of males and 48.44% of females participating in the survey. This nearly equal distribution indicates that both male and female workers are proportionately represented in the labor market of disaster-prone areas in West Sumatra. The discovery also indicates the growing involvement of women in diverse sectors, such as small-scale firms and service industries, which corresponds with recent national labor statistics

indicating a diminishing gender gap in worker participation. This study's balanced gender representation facilitates a thorough analysis of preparation disparities and underscores the significance of gender-sensitive capacity-building measures to improve digital transformation resilience in post-disaster labor markets.

3.3 Age of Respondents

Table 3. Age of Respondents

Age	Freq.	Percent	Cum.
20-29 years	143	37.24	37.24
30-39 years	86	22.40	59.64
40-49 years	75	19.53	79.17
50 years and above	38	9.90	89.06
< 20 years	42	10.94	100.00
Total	384	100.00	

Source: Processed with STATA 2025

Based on the age distribution of respondents, the 20–29 age group accounts for the highest proportion 37.24%, followed by the 30–39 age group 22.40% and the 40–49 age group 19.53%. Less than 20-year-old respondents comprise 10.94% of the total 384 participants, while those aged 50 and older comprise 9.90%. A large portion of the workforce in disaster-prone regions is composed of individuals in their productive years, particularly those between the ages of 20 and 40. This pattern suggests significant potential for digital adoption and adaptability in the labor market.

The prevalence of younger workers corresponds with demographic trends in Indonesia's labor market, where digital engagement and receptiveness to technological change are most pronounced among early-career persons. Younger responders often exhibit more digital literacy, adaptability to technological changes, and receptiveness to online education and creative programs. In contrast, older age demographics may have greater experiential knowledge but frequently have difficulties in adopting technology owing to skill deficiencies or limited access to digital infrastructure (Xu et al., 2024). Demographic composition is essential for comprehending the Human Capital Readiness Index (HCRI).

3.4 Education level

Table 4. Education level

Education level	Freq.	Percent	Cum.
diploma-level	23	5.99	5.99
postgraduate	26	6.77	12.76
elementary	2	0.52	13.28
senior high school	196	51.04	64.32
junior high school	22	5.73	70.05
Bachelor's degree	115	29.95	100.00
Total	384	100.00	

Source: Processed with STATA 2025

The educational background of respondents indicates that more than half of the workforce in disaster-prone areas hold a senior high school qualification 51.04%, followed by bachelor's degree holders 29.95%. Respondents with postgraduate education represent 6.77%, while those with diploma-level education constitute 5.99%. Only a small proportion completed junior high school 5.73% or elementary education 0.52%. This distribution suggests that most workers possess at least a senior high school education level, reflecting the general educational composition of the regional labor market in West Sumatra.

The dominance of respondents with senior high school and bachelor-level education indicates that the workforce in disaster-prone regions generally possesses moderate educational qualifications, accompanied by varying degrees of digital literacy. The substantial share of workers educated only up to senior high school highlights the urgency of implementing continuous digital competency enhancement and vocational training initiatives. This educational profile suggests that, although the region demonstrates a favorable foundation for digital transformation, strategic human resource development interventions remain vital to narrow digital capability disparities, especially among less-educated groups. Inclusive Education and Digital Tools. Digital transformation in inclusive schools enhances human resource development by providing interactive and adaptive training methods. However, challenges such as limited technological infrastructure and insufficient training need to be addressed to fully realize the benefits (Simatupang et al., 2024).

3.5 Type of Employment

Table 5. Type of Employment

Jenis Pekerjaan	Freq.	Percent	Cum.
regional-owned enterprises (BUMD)	6	1.56	1.56
state-owned enterprises (BUMN)	7	1.82	3.39
daily laborers or freelancers	80	20.83	24.22
Other	4	1.04	25.26
traders	68	17.71	42.97
private employees	65	16.93	59.90
contract employees	37	9.64	69.53
civil servants (PNS/ ASN)	40	10.42	79.95
micro, small, and home-based enterprises	77	20.05	100.00
Total	384	100.00	

Source: Processed with STATA 2025

The occupational distribution of respondents demonstrates a diverse composition across both formal and informal sectors. The largest proportion of workers are employed as daily laborers or freelancers (20.83%), followed closely by those engaged in micro, small, and home-based enterprises (20.05%), and traders (17.71%). A considerable number also work as private employees (16.93%), while civil servants (10.42%) and contract employees (9.64%)

make up smaller segments of the sample. Meanwhile, workers in state-owned (BUMN) and regional-owned enterprises (BUMD) represent a minor share, at 1.82% and 1.56%, respectively. This distribution suggests that the workforce in disaster-prone regions is dominated by individuals employed in flexible or self-managed occupations, reflecting the high prevalence of informal economic activities in the area.

3.6 Employment Classification

Table 6. Employment Classification

Employment Classification	Freq.	Percent	Cum.
Formal	155	40.36	40.36
Informal	229	59.64	100.00
Total	384	100.00	

Source: Processed with STATA 2025

The classification of respondents by employment type shows that 59.64% of the workforce are engaged in informal employment, while 40.36% hold formal jobs. This indicates that informal workers form the majority of the labor force in disaster-prone areas of West Sumatra. The high proportion of informal employment reflects the structural characteristics of the regional economy, where micro-enterprises, self-employment, and casual labor are prevalent. Such composition also mirrors national labor trends in Indonesia, where informal work continues to dominate, particularly in non-urban and vulnerable regions.

3.7 Descriptive Statistics

Table 7. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
COMP	384	3.682	.998	1	5
ADPT	384	4.053	.62	1	5
SUPP	384	3.249	.718	1.4	5
PLAN	384	4.048	.73	1.25	5
HCRI PCA	384	65.81	15.663	0	100

Source: Processed with STATA 2025

The descriptive analysis reveals meaningful variation across the four dimensions of human capital readiness. Digital Competence (COMP) shows a moderate-to-high mean score ($M = 3.68$, $SD = 0.99$), indicating that most respondents possess a functional level of digital literacy sufficient for basic work-related tasks. This finding is aligned with global trends showing increased exposure to digital technologies in developing economies, particularly among workers in urban and semi-urban settings. Meanwhile, Adaptability (ADPT) demonstrates the highest score across all dimensions ($M = 4.05$, $SD = 0.62$), suggesting that respondents exhibit strong behavioral flexibility and capacity for adjustment in disrupted environments. Such adaptability is consistent with research indicating that workers in mixed formal-informal labor markets tend to develop resilience in response to recurring uncertainty, whether driven by economic shifts or environmental disruptions. In contrast, Support and

Access to Information (SUPP) records a lower mean value ($M = 3.24$, $SD = 0.72$), pointing to disparities in institutional support, connectivity, and access to reliable information. This pattern mirrors longstanding evidence of digital inequality, where infrastructural and socioeconomic barriers shape the uneven distribution of technological benefits.

Equally notable is the strong performance of Planning and Sustainability (PLAN), which records a high mean score ($M = 4.04$, $SD = 0.73$). This suggests that respondents show considerable awareness of long-term preparedness and capability development—critical attributes for sustaining workforce resilience in uncertain or crisis-prone environments. When the four dimensions are integrated into the composite Human Capital Readiness Index (HCRI_PCA), the resulting mean score ($M = 65.81$, $SD = 15.66$) places the overall workforce within the High Readiness category. The wide score range (0–100), however, reveals substantial heterogeneity in individual readiness. This variation implies that while a significant portion of the workforce is well-positioned to engage in digital transformation initiatives, certain groups remain at risk of exclusion due to gaps in digital competence, limited access to information networks, or reduced opportunities for structured skill development. These disparities underscore the need for targeted interventions and differentiated policy strategies tailored to the distinct needs of various demographic and occupational segments in disaster-prone regions.

3.8 Cut-off Values for HCRI Categories

Table 8. Cut-off Values for HCRI Categories

Category	Score Range	Reference Framework
Very High	81-100	Exceptional digital readiness and adaptive capability
High	61-80	Above-average preparedness digital transformation
Moderate	41-60	Adequate but uneven readiness across dimensions
Low	21-40	Limited digital skills and adaptability
Very Low	0-20	Minimal readiness and digital exclusion

To facilitate meaningful interpretation of workforce readiness scores, this study employed cut-off values for the Human Capital Readiness Index (HCRI) based on the 0–100 scale derived through POMP standardization. Categorization of composite indices into graded readiness levels follows established practices in the construction of socio-economic and human development indices (Cohen et al., 1999). In this study, HCRI scores were classified into five readiness tiers Very Low (0–20), Low (21–40), Moderate (41–60), High (61–80), and Very High (81–100). These thresholds align with conventional composite index interpretation frameworks that distinguish minimal capability, emerging capability, adequate readiness, advanced readiness, and superior preparedness. Importantly, the wide dispersion of scores across these categories underscores the heterogeneity of readiness among workers

in disaster-prone regions, highlighting the necessity for differentiated policy responses targeted at specific readiness levels rather than uniform interventions. This structured cut-off approach therefore ensures methodological rigor and supports a more nuanced understanding of human capital readiness in the context of digital transformation.

3.9 Human Capital Readiness Index (HCRI)

Table 9. Human Capital Readiness Index (HCRI)

Distribution HCRI	Freq.	Percent	Cum.
High	194	50.52	50.52
Low	26	6.77	57.29
Moderate	99	25.78	83.07
Very High readiness	63	16.41	99.48
Very Low	2	0.52	100.00
Total	384	100.00	

Source: Processed with STATA 2025

The analysis of the Human Capital Readiness Index (HCRI) category (n = 384) indicates that the majority of respondents fall into the high readiness category (50.52%), followed by the moderate category (25.78%) and the very high category (16.41%). Only a small proportion of respondents fall within the low (6.77%) and very low (0.52%) readiness levels. This distribution pattern indicates that, overall, the workforce in disaster-prone areas of West Sumatra specifically Padang and Pesisir Selatan has achieved a relatively high level of digital readiness, suggesting strong progress in adapting to digital transformation and resilience practices after repeated disaster experiences. The findings align with the growing evidence that repeated exposure to disruptive events such as natural disasters can accelerate technological learning and adaptability (Miao, 2017).

The findings indicate a positive perspective for human capital development in disaster-prone regions of West Sumatra. A workforce demonstrating predominantly high and moderate readiness indicates an increase in digital literacy and adaptive skills across various sectors, especially among younger and moderately educated individuals. The presence of a small yet significant proportion of individuals in the low-readiness category highlights the ongoing issue of digital inequality, which is likely linked to restricted access to technology and training, particularly among informal workers and individuals with lower educational attainment. Strategic interventions, including community-based digital training, inclusive access to ICT tools, and targeted capacity-building programs, are essential for ensuring equitable distribution of digital transformation benefits across the labor market in disaster-affected regions.

4. CONCLUSION AND IMPLICATIONS

This study analyzed the distribution of the Human Capital Readiness Index (HCRI) among workers in disaster-prone areas of West Sumatra, focusing on demographic characteristics, employment types, and readiness categories. The findings indicate that the majority of respondents are concentrated in the productive age range (20–40 years) with a moderate level of education – mainly high school and undergraduate degrees – reflecting the general structure of the regional labor force. A significant proportion of workers are engaged in informal employment (59.64%), such as small business owners, traders, and freelancers, which dominates the local economic landscape.

In terms of readiness levels, more than half of the respondents fall into the High Readiness category (50.52%), followed by Moderate (25.78%) and Very High (16.41%). These results demonstrate that the workforce in disaster-prone regions possesses substantial digital adaptability and resilience potential. However, the presence of workers within the Low and Very Low readiness categories (7.29%) reveals existing disparities, particularly among older, less educated, and informal-sector workers who face structural barriers in accessing digital resources and training opportunities. Overall, the findings affirm that while the regional workforce shows encouraging readiness for digital transformation, gaps in education, employment formality, and access to capacity-building programs continue to shape uneven readiness levels across segments.

Implications

The empirical evidence generated from this study carries several theoretical and practical implications. From a theoretical perspective, the results reinforce the importance of integrating disaster resilience and digital transformation within the framework of human capital readiness. The HCRI approach offers a multidimensional assessment tool that captures the combined effects of digital competence, adaptability, information access, and sustainability planning. This contributes to the broader discourse in human resource management by emphasizing readiness as both a capability and a contextual response to external disruptions such as disasters.

From a policy and managerial perspective, the findings highlight the need for targeted interventions to enhance workforce readiness equitably across sectors. Policymakers should prioritize community-based digital literacy programs, vocational upskilling, and ICT infrastructure expansion, particularly for informal and low-educated workers. In addition, higher education institutions and local governments can collaborate to design tailored training initiatives that integrate disaster preparedness with digital capability development.

For organizations, investing in continuous learning ecosystems and inclusive human resource strategies can accelerate digital adoption and strengthen resilience in times of disruption.

In summary, fostering human capital readiness in disaster-prone regions requires a dual focus on capacity building and inclusion. Enhancing digital competencies while ensuring accessibility for all workforce segments will not only improve individual adaptability but also support the broader agenda of sustainable and resilient regional development.

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