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Human Readiness for Sustainable Digital Transformation in Industrial Regions: A Fuzzy-Based Assessment of Behavioural Readiness Using Situational Judgement Tests from the Copper Basin

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ABSTRACT

Sustainable digital transformation increasingly depends not only on technological infrastructure but also on the behavioural readiness of individuals to function effectively in dynamic and digitally transformed work environments. This study examines behavioural readiness among young people at different stages of education in the Copper Basin, a highly industrialised region undergoing intensive technological transformation.

The study involved 2,118 respondents representing upper-secondary and university education. Behavioural readiness was assessed using Situational Judgement Tests (SJTs) covering five domains: communication, teamwork, adaptability to change, emotional regulation, and conflict resolution. Based on expert content analysis and fuzzy logic modelling, the Human Digital Sustainability Index (HDSI) was developed as an exploratory fuzzy-based indicator providing a synthetic representation of behavioural readiness within the analysed sample.

The results indicate a mean HDSI value of 0.741 (SD = 0.047), with substantial differences observed across individual domains. Adaptability to change showed the highest mean fuzzy score, followed by conflict resolution and teamwork, whereas communication showed the lowest mean score within the adopted HDSI framework. The findings also reveal that similar overall HDSI levels may be associated with different configurations of behavioural readiness across domains.

The study contributes to research on the human dimension of sustainable digital transformation by proposing an exploratory framework for analysing behavioural responses to changing work environments. The findings highlight the importance of examining not only overall readiness but also its internal behavioural structure. Further psychometric and cross-context validation of the HDSI is required before the index can be interpreted as a standardised measure of behavioural readiness.

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Introduction

Digital transformation and sustainable development currently constitute two key vectors shaping the functioning of contemporary enterprises. Digital transformation has become a strategic development priority, reshaping economic activity, organisational processes, public services, and the competencies required for effective participation in an increasingly digital society [1]. This is particularly evident in highly industrialised regions, which face the challenge of simultaneously implementing advanced digital technologies, complying with increasingly stringent environmental requirements, and maintaining socio-economic stability. In this context, it is increasingly emphasised that the success of digitalisation and the achievement of sustainability goals depend not only on the availability of technology, but to a large extent on people's ability to operate effectively in complex, dynamic, and risk-laden organisational environments [2,3].

Existing research on digital transformation has predominantly focused on technological, infrastructural, and organisational aspects, such as process automation, the deployment of information systems, and data management. Considerably less attention has been devoted to the individual perspective, particularly to the issue of human readiness to adapt under conditions of intensive digitalisation combined with sustainability pressures. Within management and information systems literature, the concept of "readiness" is most often applied to organisations or technologies, while individual readiness is frequently reduced to declaratively measured soft skills or personality traits [2-4].

Such an approach entails important methodological limitations, especially in relation to young people entering the labour market. Self-report measures of individual attributes may be affected by methodological limitations, including common method biases, and do not necessarily provide direct information about how individuals respond to specific decision-making and task-related situations [5].

In response to these limitations, behavioural approaches that focus on analysing actual or simulated decisions made by individuals in defined situational contexts have gained increasing prominence.

One such approach involves the use of Situational Judgement Tests (SJTs), which enable the assessment of preferred responses in realistic social and organisational scenarios. SJTs present respondents with realistic work-related situations and ask them to indicate preferred or likely responses, thereby providing a situationally contextualised assessment of behavioural response tendencies [16,18].

At the same time, analysing data generated through SJTs requires analytical methods capable of capturing the fuzzy, continuous, and context-dependent nature of behavioural decisions. Classical psychometric approaches, based on linear scales and the assumption of unequivocal responses, prove insufficient in this regard. An alternative is offered by fuzzy logic, which enables the modelling of graded assessments and the aggregation of qualitative information into synthetic readiness indicators [7,8].

Industrial regions characterised by high levels of digitalisation and environmental pressure provide a particularly relevant context for analysing behavioural readiness. One such region is the Copper Basin, marked by a strong concentration of extractive and processing industries, advanced automation processes, and increasing sustainability requirements. Functioning in such an environment demands from future employees not only technical competencies, but above all the ability to act adaptively and responsibly within complex socio-technical systems [9,10].

Previous research conducted among final-year students in the same industrial region identified pragmatic orientations focused on self-realisation, strong interest in entrepreneurship, and a pronounced focus on practical career considerations [11]. These findings provided a regional empirical context for the present attempt to conceptualise and analyse behavioural readiness in a more structured manner.

The aim of this article is to assess the behavioural readiness of young people to function under conditions of sustainable digital transformation in industrial regions, using the Copper Basin as an empirical case. The study employs Situational Judgement Tests (SJTs) combined with fuzzy logic modelling, leading to the construction of a synthetic indicator referred to as the Human Digital Sustainability Index (HDSI). The article addresses four research questions concerning the overall level and distribution of behavioural readiness, its internal domain structure, differences across HDSI readiness bands, and variation across educational pathways.

Theoretical Framework and Literature Review

Digital Transformation and Sustainability in Industrial Regions

Digital transformation constitutes one of the most significant processes shaping contemporary enterprises and regional economies. In the literature, it is most often described as the implementation of digital technologies aimed at improving operational efficiency, integrating organisational processes, and enabling new business models. In industrial regions, however, digital transformation acquires a distinctive character, as it unfolds in environments marked by high operational pressure, strong process interdependencies, and elevated levels of social and environmental responsibility [4].

Increasingly, digital transformation is analysed in conjunction with the concept of sustainability. In this context, sustainability extends beyond environmental considerations to encompass the long-term viability of organisational solutions, the resilience of socio-technical systems, and the capacity of organisations and regions to adapt over time. In industrial settings, this implies the need to balance technological advancement with process safety, workforce stability, and societal acceptance of change [3,12,13].

Despite this broader perspective, existing research has largely prioritised technological and organisational dimensions of digital transformation, focusing on information system maturity, IT infrastructure, and process architecture. Considerably less attention has been paid to how individuals function within digitally transformed environments, particularly in industrial regions where the consequences of maladaptation may be especially pronounced [2].

Human Readiness as a Condition for Sustainable Digital Transformation

Within the digital transformation literature, the concept of readiness is typically associated with technological or organisational preparedness, understood as the availability of infrastructure, system-level capabilities, and formal procedures enabling digital implementation. While these dimensions are undoubtedly important, they overlook a critical aspect of transformation: the readiness of people to operate effectively under changing conditions [2].

This human-centred perspective is also reflected in international approaches to digital transformation, which emphasise that technological development should remain aligned with human capabilities, needs, and well-being.

Human readiness has increasingly been recognised as a key determinant of successful digital transformation. It refers to individuals' capacity to adapt to change, collaborate within teams, make decisions under uncertainty, and regulate emotional responses in high-pressure environments. A lack of such readiness may result in resistance to change, reduced quality of collaboration, and underutilisation of technological potential, even in organisations that are technologically advanced [10]. This perspective is consistent with social cognitive theory, which emphasises the reciprocal interaction between individual factors, behaviour, and environmental conditions in shaping human functioning [14].

From a sustainability perspective, human readiness performs a stabilising function within socio-technical systems. The long-term success of digital transformation depends not only on the implementation of new technologies, but also on individuals' ability to function sustainably in new organisational arrangements without excessive psychosocial costs. In this sense, human readiness represents a crucial link between digitalisation and sustainability.

From Soft Skills to Behavioural Readiness

In research on human capital, human readiness is frequently conceptualised through the lens of soft skills, such as communication, teamwork, or emotional intelligence. These competencies are commonly treated as relatively stable individual attributes and are typically measured using self-report scales. However, such an approach raises important methodological concerns, particularly when analysing behaviour in dynamic and uncertain work environments [5].

First, declarative measures of soft skills do not necessarily reflect how individuals actually behave in situations requiring rapid decision-making and cooperation under pressure. Second, treating competencies as static traits limits the ability to capture the situational and contextual nature of behaviour, which is central to functioning in digitally transformed workplaces. Finally, possessing a given competency does not automatically imply that it will be activated or applied effectively in organisational practice [15].

An alternative to the trait-based perspective is the concept of behavioural readiness, which focuses on preferred strategies of action in specific social and task-related situations. From this perspective, the key question is not what competencies individuals declare, but how they respond when confronted with realistic decision-making scenarios. Behavioural readiness thus offers a more adequate framework for analysing human functioning in digital environments, where behaviour emerges from the interaction between technological demands, organisational structures, and social dynamics [6,16].

Research Gap and Study Objectives

Despite the growing interest in human readiness within the context of digital transformation, there remains a lack of empirical studies that systematically examine behavioural readiness among young people entering the labour market, particularly in industrial regions. Existing research rarely integrates a behavioural perspective with analytical approaches capable of capturing the gradual and context-dependent nature of readiness to function in digitally and sustainably transformed environments.

This article seeks to address this gap by proposing a behavioural conceptualisation of human readiness and by empirically analysing the behavioural readiness of young people in an industrial region. The study employs Situational Judgement Tests (SJTs) combined with fuzzy logic modelling to construct a synthetic indicator the Human Digital Sustainability Index (HDSI)-designed to assess individuals' preparedness to function under conditions of sustainable digital transformation [3,17].

Based on the conceptual framework outlined above, the study examines behavioural readiness as both an overall construct and a multidimensional configuration of behavioural responses. Given the exploratory character of the HDSI framework, the study does not assume predetermined normative levels of readiness but focuses on the distribution, internal structure, and differentiation of behavioural response patterns within the analysed sample. Accordingly, the following research questions were formulated:

- RQ1. What is the overall level and distribution of behavioural readiness as represented by the Human Digital Sustainability Index (HDSI) within the analysed sample?
- RQ2. How is behavioural readiness differentiated across the five domains of communication, teamwork, adaptability to change, emotional regulation, and conflict resolution?
- RQ3. How does the internal configuration of behavioural readiness domains differ across the distribution-based HDSI readiness bands?
- RQ4. How does behavioural readiness vary across educational pathways in terms of both the overall HDSI and its domain-level structure?

Research Methodology

Methodological Positioning of the Study

The study is grounded in a behavioural research paradigm, which assumes that individuals' readiness to function in digitally transformed work environments is primarily manifested through preferred strategies of action in specific situations, rather than through declared traits or self-assessed competencies. This approach departs from classical trait-based measurement and instead focuses on how individuals make decisions and respond to realistic social and task-related challenges [15]. The study adopts a behavioural and situational perspective, focusing on individuals' preferred responses to defined social and task-related situations rather than relying exclusively on self-assessed attributes [16,18].

From the perspective of management and information systems research, such a methodological positioning allows for a more accurate examination of the interaction between human behaviour and organisational contexts characterised by digital technologies, operational pressure, and interdependent processes. The adopted approach enables the analysis of behavioural readiness as a graded and context-sensitive construct, avoiding binary classifications and oversimplified interpretations.

Research Sample and Data Collection Procedure

The empirical study was conducted on a large and heterogeneous sample of young individuals at different stages of education and transition towards professional life. In total, data were collected from over 2,118 respondents, providing a substantial empirical basis for descriptive and comparative analyses. An overview of the sample structure is provided in Table 1.

Table 1: Structure of the Research Sample by Educational Pathway and Level (N = 2,118)

Educational status	Educational pathway	N	%
1st grade students	General secondary school	241	11.4
1st grade students	Technical school	267	12.6
Upper-secondary graduates	General secondary school	566	26.7
Upper-secondary graduates	Technical school	525	24.8
University students	Engineering programmes	113	5.3
University students	Bachelor programmes	264	12.5
University students	Master programmes	142	6.7
Total		2,118	100.0

The sample included upper-secondary school students (general secondary schools and technical schools) as well as undergraduate and postgraduate university students. All respondents were drawn from an industrial region characterised by a high level of industrialisation and intensive digitalisation processes. The sampling strategy was purposeful and context-driven, enabling the results to be interpreted within a specific socio-economic environment.

Data were collected using a standardised procedure that ensured anonymity and voluntary participation. Respondents completed the questionnaire independently, without time constraints, which was intended to reduce situational pressure and allow for reflective decision-making. The use of an identical procedure across all respondent groups ensured the comparability of the collected data.

Research Instrument: Situational Judgement Tests (SJTs)

Behavioural readiness was assessed using a questionnaire based on Situational Judgement Tests (SJTs). The instrument was designed to identify preferred behavioural strategies in typical social and task-related situations encountered in work environments undergoing digital transformation [6].

The questionnaire consisted of five short scenarios describing realistic situations related to communication, teamwork, adaptation to change, responding to feedback, and conflict resolution. Each scenario offered several alternative responses, representing different courses of action. All response options were constructed as plausible and contextually rational, differing primarily in their degree of adaptiveness within complex organisational settings.

The use of SJTs provides a situationally contextualised assessment of behavioural response tendencies rather than relying exclusively on declarative self-assessment [16,18]. In the present study, the selected responses are therefore interpreted as preferred behavioural responses to defined scenarios, rather than as direct observations of actual workplace behaviour.

Data Analysis Procedure and Construction of the HDSI

Data analysis was conducted using fuzzy logic modelling, which is well suited to phenomena characterised by ambiguity, gradual transitions, and non-binary distinctions [7,19]. The analysis assumed that behavioural strategies identified through Situational Judgement Tests are not unequivocally ‘correct’ or ‘incorrect’, but may differ in the degree to which they support adaptive functioning in digitally and sustainably transformed work environments.

The Human Digital Sustainability Index (HDSI) was developed as an exploratory fuzzy-based indicator of behavioural readiness. Its purpose was to provide a synthetic representation of how respondents tend to respond to situations related to functioning in digitally transformed and sustainability-oriented work environments. At this stage of model development, the HDSI should be interpreted as a pre-validation analytical framework, rather than as a fully validated psychometric measure of competence.

The construction of the HDSI was based on five behavioural readiness domains derived from the situational judgement scenarios: communication, teamwork, adaptability to change, emotional regulation, and conflict resolution. Each domain represented a distinct aspect of behavioural functioning relevant to digitally transformed work environments. An overview of the behavioural domains, corresponding situational contexts, and their role in the aggregation logic of the HDSI is presented in Table 2.

Table 2: Behavioural Readiness Domains and Aggregation Logic of the Human Digital Sustainability Index (HDSI)

Behavioural readiness domain	Situational context (SJT scenario)	Core behavioural focus	Role in HDSI construction
Communication	Providing and receiving information in digitally mediated work situations	Clarity, openness, responsiveness in communication	Captures interpersonal effectiveness under digital coordination
Teamwork	Cooperation within task-oriented and interdependent teams	Collaboration, shared responsibility, mutual support	Reflects ability to function in digitally enabled team environments
Adaptability to change	Responding to new procedures, technologies, or task requirements	Flexibility, learning orientation, tolerance of uncertainty	Represents behavioural adjustment to dynamic digital conditions
Emotional regulation	Managing stress, feedback, and emotional reactions under pressure	Self-control, emotional awareness, resilience	Indicates capacity for sustainable functioning in high-pressure environments
Conflict resolution	Handling disagreement and interpersonal tension in work-related situations	Constructive problem-solving, negotiation, respect	Reflects ability to maintain social stability within socio-technical systems
Synthetic index (HDSI)	Aggregation of all SJT-based domains	Integrated behavioural readiness profile	Provides a continuous, fuzzy-based indicator of overall behavioural readiness

Based on expert content analysis, each response option was assigned a fuzzy membership value $\mu \in [0,1]$, representing the degree to which the selected response reflected adaptive behaviour within a given situational context. These values were defined locally for each scenario and were therefore interpreted within the behavioural meaning of the specific situation rather than as universal competence scores.

For each respondent, fuzzy scores were calculated for the five behavioural readiness domains and subsequently aggregated into a synthetic HDSI score. The index takes values from 0 to 1 and provides a relative measure of behavioural readiness within the adopted exploratory framework.

Given the fuzzy and exploratory nature of the indicator, the interpretation of HDSI scores was comparative rather than normative. Distribution-based banding was used to distinguish respondents with relatively lower, moderate, and higher levels of behavioural readiness without introducing fixed normative thresholds [8]. The resulting categories should therefore be understood as relative positions within the analysed sample rather than as diagnostic classifications.

The HDSI framework requires further psychometric, external, and cross-context validation before it can be interpreted as a standardised measure of behavioural readiness.

Results

Level and Distribution of Behavioural Readiness (HDSI)

The first stage of the analysis focused on examining the overall distribution of behavioural readiness as represented by the Human Digital Sustainability Index (HDSI). The analysis was conducted on a sample of N = 2,118 respondents, following data cleaning and the exclusion of cases with incomplete responses to the situational judgement tasks. Descriptive statistics for the HDSI are presented in Table 3.

The observed HDSI values ranged from 0.60 to 0.85, with a mean of 0.741 (SD = 0.047). The median value was 0.74, indicating that the distribution was centred close to the observed mean within the adopted exploratory framework. The interquartile range (P25 = 0.71; P75 = 0.77) indicates that the central 50% of respondents were concentrated within a relatively narrow range of HDSI values, while meaningful individual variation remained observable. As illustrated in Figure 1, behavioural readiness forms a continuous spectrum rather than a simple binary distinction between readiness and non-readiness.

Given the exploratory and fuzzy-based nature of the HDSI and the absence of externally validated normative thresholds, the results were interpreted comparatively rather than diagnostically. Distribution-based banding was applied using the lower and upper quartiles to distinguish respondents with relatively lower, moderate, and relatively higher behavioural readiness within the analysed sample. Because multiple respondents obtained identical HDSI values at the quartile boundaries, the resulting group proportions do not correspond exactly to a 25%–50%–25% distribution.

Table 3: Descriptive Statistics of the Human Digital Sustainability Index (HDSI)

Statistic	Value
Minimum	0.60
Maximum	0.85
Mean	0.741
Standard deviation	0.047
Median	0.74
25th percentile (P25)	0.71
75th percentile (P75)	0.77

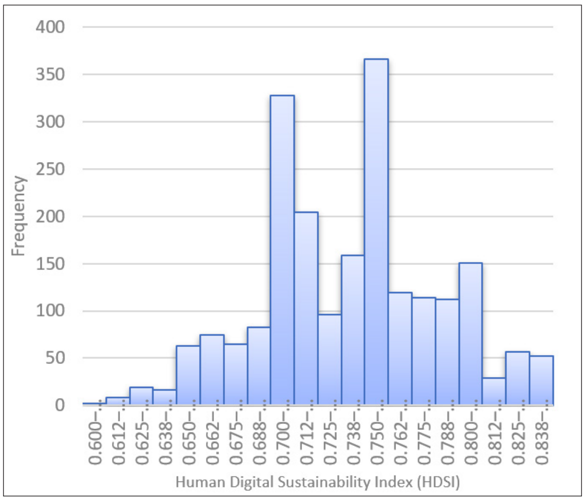

Figure 1: Distribution of the Human Digital Sustainability Index (HDSI)

Using this distribution-based classification, 27.2% of respondents were assigned to the lower-readiness group, 44.3% to the moderate-readiness group, and 28.5% to the higher-readiness group. These proportions should be interpreted as relative positions within the analysed sample rather than as normative or diagnostic categories. The observed distribution further supports the treatment of behavioural readiness as a continuous and differentiated construct and provides the basis for examining its internal domain structure in the subsequent analyses.

Structure of Behavioural Readiness Domains

The next stage of the analysis involved decomposing the HDSI into five behavioural readiness domains corresponding to different aspects of functioning in digitally transformed work environments: communication, teamwork, adaptability to change, emotional regulation, and conflict resolution. Mean fuzzy scores for the five domains are presented in Table 4.

Table 4: Mean Values of Behavioural Readiness Domains

Behavioural readiness domain	Mean value
Communication	0.626
Teamwork	0.756
Adaptability to change	0.813
Emotional regulation	0.734
Conflict resolution	0.776

As illustrated in Figure 2, the five domains show a differentiated pattern of mean fuzzy scores. Adaptability to change recorded the highest mean value (M = 0.813), followed by conflict resolution (M = 0.776), teamwork (M = 0.756), emotional regulation (M = 0.734), and communication (M = 0.626). Within the adopted exploratory HDSI framework, adaptability to change therefore emerged as the domain with the highest relative score, while communication showed the lowest mean value.

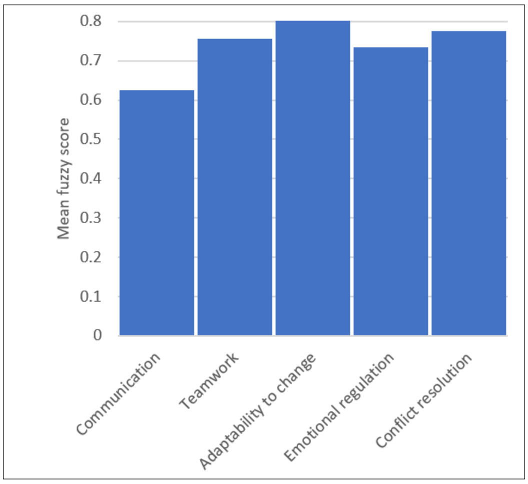

Figure 2: Domain-Level Structure of Behavioural Readiness

The comparatively higher score for adaptability to change suggests that, within the situational contexts included in the instrument, respondents more frequently selected behavioural responses associated with adjustment to new procedures, technologies, or changing task requirements. Conflict resolution and teamwork also showed comparatively higher mean fuzzy scores, indicating comparatively adaptive response patterns in situations involving interpersonal disagreement and collaborative task performance.

Emotional regulation occupied an intermediate position in the observed domain structure. Although its mean score was lower than those for adaptability to change, conflict resolution, and teamwork, it remained substantially above the mean score observed for communication. Communication therefore represents the most distinctive lower-scoring domain in the present HDSI framework and warrants particular attention in interpreting the behavioural structure of the analysed sample.

Importantly, these differences should not be interpreted as direct evidence that respondents possess objectively 'high' or 'low' levels of the corresponding competencies. The domain values represent relative fuzzy scores derived from responses to specific situational judgement scenarios within the exploratory HDSI framework. They therefore describe patterns of behavioural response rather than validated competence levels.

Overall, the results indicate that behavioural readiness is internally differentiated across domains. This domain-level variation also suggests that similar overall HDSI scores may conceal different configurations of behavioural responses, providing a rationale for examining domain configurations across HDSI readiness bands in the subsequent analysis.

Domain Profiles Across HDSI Readiness Bands

To examine how the internal structure of behavioural readiness varies across different levels of the HDSI, respondents were divided into three distribution-based readiness bands: relatively lower, moderate, and relatively higher readiness. Mean fuzzy scores for the five behavioural domains within each HDSI band are presented in Table 5.

Table 5: Behavioural Readiness Domain Profiles Across HDSI Bands

Behavioural readiness domain	Lower readiness	Moderate readiness	Higher readiness
Communication	0.498	0.603	0.783
Teamwork	0.703	0.766	0.792
Adaptability to change	0.796	0.815	0.827
Emotional regulation	0.702	0.723	0.779
Conflict resolution	0.724	0.784	0.812

The results show a clear increase in most domain scores across the three HDSI bands. Communication displays the largest differentiation, increasing from 0.498 in the lower-readiness group to 0.603 in the moderate-readiness group and 0.783 in the higher-readiness group. Emotional regulation also increases systematically, from 0.702 to 0.723 and 0.779, respectively.

Teamwork and conflict resolution follow a similar pattern. Teamwork increases from 0.703 in the lower-readiness group to 0.766 in the moderate-readiness group and 0.792 in the higher-readiness group, while conflict resolution increases from 0.724 to 0.784 and 0.812. These differences indicate that higher overall HDSI values are associated with more consistently elevated fuzzy scores across interpersonal and self-regulatory domains.

Adaptability to change shows a different pattern. Its mean fuzzy score is relatively high in all three readiness bands, increasing only from 0.796 in the lower-readiness group to 0.815 in the moderate-readiness group and 0.827 in the higher-readiness group. Within the exploratory HDSI framework, adaptability therefore contributes less to differentiation between the three readiness bands than communication and several of the other domains.

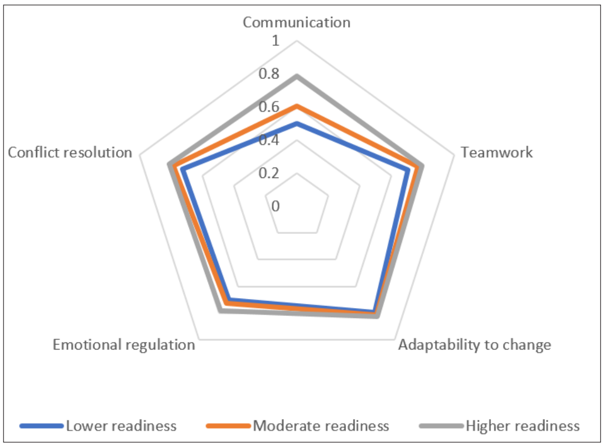

Figure 3: Behavioural Readiness Domain Profiles Across HDSI Bands

As illustrated in Figure 3, the lower-readiness group is not characterised by uniformly low scores across all behavioural domains. Instead, its most distinctive feature is the combination of a relatively high adaptability-to-change score with a substantially lower communication score. In the higher-readiness group, by contrast, the five domain scores are more evenly distributed, indicating a more balanced configuration of behavioural responses within the HDSI framework.

These findings demonstrate that the overall HDSI score reflects not only differences in the general level of behavioural readiness but also differences in its internal domain structure. In particular, the results suggest that movement from lower to higher HDSI bands is associated with greater balance across the five behavioural domains. This supports the use of domain-level analysis alongside the synthetic HDSI score when interpreting behavioural readiness.

The observed domain configurations should not, however, be interpreted as independently derived behavioural typologies. They represent descriptive profiles of the three distribution-based HDSI bands and provide a basis for further exploratory analysis of behavioural configurations.

Behavioural Readiness Across Educational Pathways

The final stage of the analysis examined whether behavioural readiness differed across educational pathways. Respondents represented five educational groups: general upper-secondary education (n = 807), technical upper-secondary education (n = 792), engineering studies (n = 113), bachelor's studies (n = 264), and master's studies (n = 142). Mean fuzzy scores for the five behavioural readiness domains and the synthetic HDSI across these educational pathways are presented in Table 6.

Table 6: Mean Behavioural Readiness Domain Scores and HDSI Across Educational Pathways

Educational pathway	n	COMM	TEAM	ADAPT	EMOT	CONFLICT	HDSI
General upper-secondary	807	.591	.774	.813	.739	.773	.738
Technical upper-secondary	792	.605	.774	.810	.736	.771	.739
Engineering studies	113	.675	.711	.811	.734	.770	.740
Bachelor's studies	264	.726	.706	.822	.729	.791	.755
Master's studies	142	.712	.687	.820	.696	.795	.742

At the level of the synthetic HDSI, differences between educational pathways were relatively small. Mean HDSI values ranged from 0.738 among respondents in general upper-secondary education to 0.755 among bachelor's students. Respondents in technical upper-secondary education recorded a mean HDSI of 0.739, engineering students 0.740, and master's students 0.742. These results indicate that progression across educational pathways is not associated with a simple or uniform increase in overall behavioural readiness.

More pronounced differences are visible when the five behavioural domains are considered separately. Communication scores were lower among respondents in general upper-secondary (M = 0.591) and technical upper-secondary education (M = 0.605) than among engineering (M = 0.675), bachelor's (M = 0.726), and master's students (M = 0.712). Within the exploratory HDSI framework, communication therefore shows a clearer differentiation across educational pathways than the overall index itself.

An opposite pattern was observed for teamwork. Respondents in both general and technical upper-secondary education recorded a mean teamwork score of 0.774, compared with 0.711 among engineering students, 0.706 among bachelor's students, and 0.687 among master's students. Emotional regulation showed a similar, although less pronounced, pattern, with mean values ranging from 0.739 in general upper-secondary education and 0.736 in technical upper-secondary education to 0.696 among master's students.

Adaptability to change remained comparatively stable across all five educational pathways, with mean fuzzy scores ranging from 0.810 to 0.822. Conflict resolution also showed relatively limited variation, although bachelor's (M = 0.791) and master's students (M = 0.795) recorded somewhat higher mean scores than respondents in the upper-secondary and engineering groups.

Taken together, these findings indicate that educational pathways are associated more clearly with the internal configuration of behavioural readiness domains than with the overall level of the HDSI. Higher educational stages are accompanied by higher communication scores, but not by uniformly higher scores across all behavioural domains. In particular, teamwork and emotional regulation do not show a corresponding increase. This suggests that differences between educational pathways may involve a reconfiguration of behavioural response patterns rather than a simple accumulation of behavioural readiness.

These findings should be interpreted descriptively. The observed differences do not establish that educational progression causes changes in behavioural readiness, as the study is cross-sectional and the educational groups differ in size and composition. Nevertheless, the results demonstrate that similar overall HDSI values may coexist with meaningfully different internal configurations of behavioural responses across educational pathways.

Discussion and Implications

Interpretation of Findings in the Context of Digital Transformation and Sustainability

The findings of this study indicate that behavioural readiness for functioning in digitally transformed work environments is continuous, multidimensional, and internally differentiated rather than binary. Individuals are not simply 'ready' or 'not ready' for digital transformation; instead, they differ both in their overall HDSI level and in the configuration of behavioural responses across the five analysed domains. This perspective is particularly relevant for industrial regions, where digitalisation unfolds under conditions of high operational pressure, strong process interdependence, and increasing sustainability requirements [2].

The mean HDSI value observed in the analysed sample was 0.741. This result should, however, be interpreted comparatively rather than normatively, as the HDSI is a pre-validation indicator and does not provide externally validated thresholds for determining objectively high or low readiness.

At the domain level, the results reveal a differentiated structure of behavioural responses. Adaptability to change showed the highest mean fuzzy score (M = 0.813), followed by conflict resolution (M = 0.776) and teamwork (M = 0.756). Emotional regulation occupied an intermediate position (M = 0.734), while communication showed the lowest mean score (M = 0.626). These differences should not be interpreted as direct evidence of objectively high or low competence levels. Rather, they indicate that respondents selected adaptive behavioural responses with different frequencies across the situational contexts represented in the HDSI framework.

An important finding emerges from the comparison of domain profiles across HDSI readiness bands. Adaptability to change remained relatively high across all three bands, whereas communication showed the greatest differentiation between respondents with relatively lower and higher HDSI scores. Moreover, respondents in the higher-readiness band displayed a more balanced configuration across the five domains. This suggests that higher overall HDSI values are associated not only with higher scores in individual domains but also with a more balanced configuration of behavioural responses across different types of situations.

From the perspective of sustainable digital transformation, these findings reinforce the importance of considering the human component of socio-technical systems alongside technological infrastructure. Digital transformation requires individuals to respond not only to technological change but also to communication demands, collaborative work, interpersonal tensions, and situations involving uncertainty. Behavioural readiness should therefore be understood as a multidimensional human factor that may influence how effectively individuals function within digitally transformed organisational environments.

Implications for Enterprises and Digital Transformation Management

The results carry important implications for enterprises managing digital transformation in industrial regions. First, they indicate that technological investments should be complemented by systematic attention to behavioural readiness among employees and labour market entrants. Understanding how individuals respond to situations involving change, cooperation, communication, emotional pressure, and interpersonal tension may help organisations better align the pace and scope of digital transformation with the human capacities of their workforce [20].

The observed domain profiles across HDSI readiness bands demonstrate that similar overall levels of behavioural readiness may be associated with different internal configurations of behavioural responses. From an enterprise information management perspective, this suggests that digital systems and workflows should be designed with sensitivity to behavioural diversity rather than relying exclusively on standardised assumptions about users and employees. In this context, leadership and middle management may play an important role in supporting employees whose behavioural response patterns differ across particular situational demands.

The findings also have implications for human resource management. Situational and behaviour-based tools, such as SJTs, may complement declarative measures in recruitment, onboarding, and employee development by providing information about preferred responses to realistic organisational situations [6]. Within the present study, such an approach made it possible to identify differences in behavioural response patterns that would not be visible from the synthetic HDSI score alone.

At the same time, because the HDSI remains an exploratory, pre-validation framework, its current application should be primarily analytical and developmental rather than diagnostic or selection-based. Further validation is required before the index can be used to support individual-level personnel decisions. At the present stage, its main practical value lies in highlighting the multidimensional nature of human readiness and in identifying areas that may warrant greater attention during digital transformation processes.

Implications for Practice-Oriented Education and Competence Development

The differentiation of behavioural readiness across educational pathways has important implications for education and competence development. The results indicate that progression across educational pathways is not associated with a simple or uniform increase in overall behavioural readiness. Instead, relatively similar HDSI values coexist with different configurations of behavioural responses across the five domains. This suggests that educational development may be associated more strongly with the configuration of behavioural readiness than with its overall level.

Particularly noteworthy is the contrasting pattern observed for communication and teamwork. Communication scores were higher among university students than among respondents in upper-secondary education, whereas teamwork showed the opposite pattern. Emotional regulation also did not increase with educational progression, while adaptability to change remained comparatively stable across educational pathways. These findings suggest that the development of behavioural readiness is multidimensional and that progress in one domain does not necessarily coincide with progress in others.

From an educational perspective, this reinforces the importance of designing learning environments that develop different dimensions of behavioural functioning in an integrated manner. Higher education institutions, particularly those with a practical orientation, can play an important role within regional digital transformation ecosystems-not merely as providers of technical knowledge, but as environments in which students encounter teamwork, communication, decision-making under uncertainty, and reflection on the social consequences of technological change [21,22].

The findings should not be interpreted as evidence that particular educational pathways cause specific behavioural outcomes. However, they highlight the value of monitoring the internal structure of behavioural readiness throughout the educational process rather than assuming that formal educational progression automatically produces higher readiness across all domains. This perspective may help educational institutions identify areas requiring greater developmental attention and design learning experiences that support a more balanced preparation for digitally transformed work environments.

From a regional policy perspective, the results also support closer cooperation between enterprises and educational institutions in industrial regions. Joint initiatives aimed at developing human readiness may enhance the long-term sustainability of digital transformation by creating stronger links between educational experiences and the behavioural demands of digitally and socially complex work environments.

Limitations and Directions for Future Research

As with any empirical study, the present research is subject to certain limitations that should be considered when interpreting the findings.

First, the study was conducted within a single, context-specific industrial region-the Copper Basin-characterised by a strong concentration of industrial activity and advanced digitalisation processes. While this contextual focus enables a deep, practice-oriented analysis, it also limits the direct generalisability of the results to regions with different economic structures, cultural conditions, or stages of digital transformation.

Second, the research instrument was based on Situational Judgement Tests (SJTs) and designed to capture preferred behavioural responses rather than stable personality traits or competencies in the classical psychometric sense. This represents a deliberate methodological choice aligned with a behavioural conceptualisation of human readiness. Nevertheless, the findings should not be interpreted as diagnostic assessments of individual abilities, but rather as representations of behavioural response patterns within defined situational contexts [6].

Third, the Human Digital Sustainability Index (HDSI) should be regarded as an exploratory, pre-validation framework. Its construction relied on expert-derived fuzzy scoring and fuzzy logic modelling, allowing gradual and non-binary differences in behavioural responses to be represented [7]. At the present stage, however, the HDSI does not provide externally validated normative thresholds and should not be interpreted as a standardised diagnostic measure of behavioural readiness. Further research should therefore examine its psychometric properties, external validity, and stability across independent samples, populations, regions, and organisational contexts.

Fourth, the study employed a cross-sectional design. Consequently, the differences observed across educational pathways cannot be interpreted as evidence that educational progression causes changes in behavioural readiness. The educational groups also differed in size and composition. Longitudinal research following individuals across educational stages would provide a stronger basis for examining whether and how behavioural response patterns change over time.

Several directions for further research emerge from these limitations. One promising avenue involves extending the analysis to employees already operating within digitally transformed organisations. This would enable comparisons between behavioural readiness observed among young people and behavioural responses in actual workplace environments. Longitudinal studies could further examine whether HDSI-related response patterns are associated with subsequent adaptation, performance, or functioning under conditions of technological and organisational change.

Another important direction concerns the integration of behavioural readiness assessment with motivational and contextual factors, such as autonomy, organisational support, leadership style, or organisational culture. Incorporating these dimensions may allow for a more comprehensive understanding of the mechanisms through which individual behavioural responses interact with organisational conditions during digital transformation.

Finally, future research should replicate the HDSI framework in different regional, cultural, and sectoral contexts. Cross-national and cross-industry comparisons would help determine which behavioural response patterns are context-specific and which may represent more general dimensions of human readiness for sustainable digital transformation.

Conclusion

This study examined behavioural readiness for sustainable digital transformation among young people in the Copper Basin using Situational Judgement Tests and fuzzy logic modelling. The Human Digital Sustainability Index (HDSI) was developed as an exploratory, fuzzy-based framework for representing behavioural responses across five domains: communication, teamwork, adaptability to change, emotional regulation, and conflict resolution.

The findings indicate a mean HDSI of 0.741 within the analysed sample, while also revealing substantial differentiation in the internal structure of behavioural readiness. Adaptability to change showed the highest mean fuzzy score, followed by conflict resolution and teamwork, whereas communication recorded the lowest mean score within the adopted framework. Importantly, these domain-level differences should be interpreted as patterns of behavioural responses to specific situational contexts rather than as validated levels of competence.

The analysis of HDSI readiness bands further demonstrates that overall behavioural readiness does not fully capture the internal configuration of behavioural responses. Adaptability to change remained relatively high across all three readiness bands, whereas communication showed the greatest differentiation between respondents with relatively lower and higher HDSI scores. Respondents in the higher-readiness band also displayed a more balanced configuration across the five domains, highlighting the value of examining domain-level patterns alongside a synthetic readiness indicator.

Differences across educational pathways provide an additional insight. Overall HDSI values varied relatively little between educational groups, while more pronounced differences were observed in the configuration of individual domains. Communication scores were higher among university students, whereas teamwork showed the opposite pattern, and adaptability to change remained comparatively stable across educational pathways. These findings suggest that educational progression should not be understood as a simple accumulation of behavioural readiness across all domains. Instead, different educational pathways may be associated with different configurations of behavioural responses.

From a theoretical perspective, the study contributes to research on sustainable digital transformation by conceptualising behavioural readiness as a multidimensional and context-dependent component of human functioning within socio-technical systems. From a methodological perspective, it demonstrates the potential of combining Situational Judgement Tests with fuzzy logic to represent gradual differences in behavioural responses without reducing them to binary categories. The HDSI should, however, be regarded as an exploratory, pre-validation framework, requiring further psychometric evaluation, external validation, and replication before normative or diagnostic applications can be considered.

From a practical perspective, the findings reinforce the need to complement technological investment with systematic attention to the human dimension of digital transformation. Enterprises, educational institutions, and regional stakeholders should consider not only whether individuals are generally prepared for change, but also how their behavioural responses are configured across different situational demands. Developing human readiness therefore requires more than strengthening isolated skills; it requires creating conditions in which individuals can develop a more balanced capacity to communicate, cooperate, adapt, regulate their responses, and manage interpersonal challenges in changing environments.

Sustainable digital transformation ultimately depends on the interaction between technological capability and human readiness. Technology creates new possibilities, but the ability to translate these possibilities into resilient and sustainable organisational development depends on how people respond to change. Systematically examining behavioural readiness as a multidimensional and developable component of human functioning may therefore provide an important foundation for building more adaptive, human-centred, and sustainable industrial regions.

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