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Research Article

Explaining Industry 5.0 Implementation: Organizational Readiness, Perceived Need, and the Enabling Role of Digital Maturity

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Abstract

Industry 5.0 is increasingly framed as a value-oriented model of industrial transformation emphasizing sustainability, resilience, and human-centricity. Despite the growing scholarly interest in this concept, the organizational mechanisms that explain its actual implementation remain insufficiently understood. This study examines the relationships among perceived organizational readiness for Industry 5.0, perceived need for its implementation, digital maturity, and implementation status at the organizational level. The research was conducted as a quantitative cross-sectional study on a sample of 286 organizations operating in Slovakia. Implementation status was operationalized as a composite index based on 18 items, while the analytical strategy combined hierarchical regression, moderated regression, polynomial regression with response surface analysis, and mediation analysis. The findings show that Industry 5.0 implementation is positively associated with both perceived readiness and perceived need, with readiness emerging as the stronger predictor. In addition, readiness significantly moderates the effect of perceived need, indicating that the impact of strategic urgency on implementation is stronger in organizations with higher readiness. The response surface analysis further demonstrates that implementation is not explained by the simple magnitude of the readiness–need gap, but rather by the absolute levels of both constructs and by an asymmetry favoring surplus readiness over surplus need. Moreover, digital maturity contributes incremental explanatory power and exerts a partially indirect effect on implementation through perceived readiness. The study contributes to the Industry 5.0 literature by moving beyond a simple gap logic and showing that implementation is better understood as a capacity-conditioned process supported by digital maturity and shaped by the interplay of readiness and perceived need.

Keywords: Industry 5.0; organizational readiness; perceived need; digital maturity

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Introduction

In the European context, Industry 5.0 is explicitly anchored as a normative framework that complements the logic of Industry 4.0 and shifts the focus from technological modernization to value-oriented transformation which underlines three pillars: sustainability, resilience, and human-centricity (European Commission, 2021; Breque, 2021). This shift is also significant from a research design perspective: the subject of research is no longer just technological adoption, but a wider process of organizational change in which technologies act as a means to socially and organizationally desirable outcomes (European Commission, 2021). The aim of the scientific article is to analyse the relationships between perceived organizational readiness for Industry 5.0, the perceived need for its implementation, and its implementation status at the organizational level.

Theoretical Background

Professional literature emphasizes that Industry 4.0 (I4.0) and Industry 5.0 (I5.0) are not strictly subsequent "revolutions", but rather coexisting frameworks, with Industry 5.0 conceptually broadening Industry 4.0 to include the dimensions of social value and quality of work. Xu, Lu, Vogel-Heuser and Wang (2021) formulate this distinction as a contrast between technology-driven (I4.0) and value-driven (I5.0) orientation, which has implications for the method of measuring business preparedness: it is not enough to measure technological capabilities, as I5.0 organizational, human and sustainable prerequisites are also equally important (Xu et al., 2021). Nahavandi (2019) points out that I5.0 represents a human-centric industry and complements the technological dominance of I4.0. Özdemir & Hekim (2018) emphasize the synergistic cooperation of man and machine in interpreting Big Data, while Longo et al. (2020) add that I5.0 emphasizes ethical AI and value-oriented technologies.

Readiness–need gap as a concept of organizational transformation

From an analytical perspective, it is useful for the I5.0 empirical research to distinguish between (a) the perceived need for implementation and (b) the perceived readiness to implement it.

In this context, the term “need for implementation” refers to the extent to which an organization considers the adoption of Industry 5.0 principles or technologies to be strategically important or urgent. Perceived need refers to the subjective ability to evaluate factors that take the form of both external and internal stimuli. In the context of I5.0, these initiatives are linked to the assessment of benefits in the areas of sustainability, the humanity of work, and the resilience of production processes (European Commission, 2021; Ivanov, 2023; Romero & Stahre, 2021; Javaid & Haleem, 2022; Shabur et al., 2025). In contrast, readiness refers to an organization’s objective ability to accept and implement change (Tornatzky & Fleischer, 1990; Baker, 2011). The key point, however, is that the perceived need may grow faster than the organization’s ability to actually implement changes, creating a structural imbalance.

In the case of Industry 5.0, this dualism is even more significant, as requirements for sustainability, resilience, and a human-centered approach may be driven primarily by the external environment (regulation, market, and customer chains), while the ability to respond depends on the organization’s resources, competencies, and process maturity (European Commission, 2021; Baker, 2011). Successful implementation of I5.0 occurs when readiness-as the capacity to act-meets need-as the motivation to act (Brückner et al., 2025; Pham & Li, 2025). Bartuś et al. (2025) note that, despite a high level of readiness, implementation in companies is often delayed and fragmented. At the same time, Demir and Cicibas (2023) note that, in the transition from I4.0 to I5.0, the gap between readiness and implementation is often the biggest problem, and research on organizational congruence points to the fact that the differences are inadequate (Edwards, 1994; Edwards & Parry, 1993).

Distinguishing between readiness and need is therefore analytically useful and important in the context of I5.0, as these are two various constructs.

Gap variability: TOE and socio-technical perspective

The gap between readiness and needs is not static but dynamic and variable. The variability among them can theoretically be interpreted through organizational implementation frameworks, in particular the Technology–

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Organization–Environment (TOE) model. The TOE framework is based on the assumption that the implementation of innovations at the organizational level is the result of the interaction between the technological context (availability and compatibility of technologies), the organizational context (resources, structure, competencies, processes), and the environmental context (competition, regulation, pressure from partners) (Tornatzky & Fleischer, 1990; Baker, 2011).

Additionally, this model can also be interpreted from a socio-technical perspective, according to which organizational preparedness cannot be reduced to technical equipment alone, but also has to include human and organizational preconditions for the implementation (Trist & Bamforth, 1951; European Commission, 2021). I5.0 takes this further towards human-centricity, well-being and sustainability (Reyes Dominguez et al., 2025). The variability in the gap between the TOE and the sociotechnical perspective makes it possible to determine whether it is necessary to strengthen technical infrastructure, change the organizational culture, or, for example, develop competencies, since the implementation of I5.0 is influenced by the balance between technical and human factors (Demir & Cicibas, 2023; Zheng et al., 2021; Xu et al., 2021). In this case, we can speak of a multilevel perspective on the gap between readiness and needs (Latino, 2025).

Finally, the distinction between perceptual constructs and the degree of actual implementation can be theoretically supported by the application of implementation status indicators. Research on the maturity of Industry 5.0 highlights the need for measurable indicators that reflect the actual integration of its principles into a company's processes and value creation (Brückner et al., 2025; Himmiche et al., 2025). From this perspective, it is conceptually justified to interpret the implementation status as a result indicator with which the perceived readiness and the perceived need for implementation can be compared.

A review of the literature suggests that the Industry 5.0 discourse is thematically broad and includes dimensions of human-centricity (Nahavandi, 2019; Kadir et al., 2021; Madsen, 2022; Longo et al., 2020), sustainability and resilience (Romero & Stahre, 2021; Ivanov, 2023; Rijwani et al., 2024), as well as technological and organizational readiness (Zheng et al., 2021; Javaid & Haleem, 2022; Xu et al., 2021; Shabur et al., 2025; Pham & Li, 2025; Kadir et al., 2021; Longo et al., 2020; Baker, 2011) and implementation status (Bartuś et al., 2025; Demir & Cicibas, 2023; Shabur et al., 2025). For the purpose of this study, however, three dimensions are analytically crucial: organizational readiness as a set of internal capabilities, the perceived need for implementation as a reflection of strategic and environmental pressures, and the status of implementation as an indicator of the actual degree to which Industry 5.0 principles are being implemented. It is precisely the interconnection of these three constructs that forms the core of this study's empirical analysis.

Methodology

The study was designed as a quantitative cross-sectional study based on questionnaire-based data collection at the organizational level. The design chosen in this way is consistent with the theoretical framework of the study, according to which it is analytically productive to distinguish between the perceptual constructs of readiness and the need for implementation, and indicators of the actual status of implementation. In our empirical analysis, we focused on testing the relationships among four main constructs: perceived organizational readiness, perceived need for Industry 5.0 implementation, the organization's digital maturity, and the status of implementation, with organizational size being included in the models as a control variable. In defining this concept, we sought to align it with the literature, which views the implementation of Industry 5.0 as the result of an interaction between environmental pressures and internal organizational capacities (Tornatzky & Fleischer, 1990; Baker, 2011; European Commission, 2021), as well as with the understanding of Industry 4.0 and Industry 5.0 as coexisting and mutually reinforcing frameworks (Xu et al., 2021; Nahavandi, 2019).

Based on the theoretical framework, six hypotheses were formulated:

H1: Perceived organizational readiness for Industry 5.0 is positively associated with the degree of implementation of its components.

H2: The perceived need to implement Industry 5.0 is positively associated with the degree of implementation of its components.

H3: Perceived readiness moderates the relationship between perceived need and implementation: the impact of the need on implementation is stronger when perceived readiness is higher.

H4: The discrepancy between readiness and need, modeled using polynomial regression with response surface analysis, is associated with the degree of implementation.

H5: An organization's digital maturity influences the implementation of Industry 5.0 indirectly, through perceived readiness (mediation).

H6: An organization's digital maturity provides incremental predictive validity in explaining implementation beyond perceived readiness and need.

Hypotheses H1 and H2 are of a validating nature and build on the fundamental relationships verified in the previous phase of the research; hypotheses H3 through H6 expand the model to include interaction, congruence, and mediation mechanisms. The original gap between need and readiness, measured using a simple gap score (GAP), was replaced by polynomial regression with response surface analysis, based on methodological critiques of gap scores (Edwards, 1994; Edwards & Parry, 1993). The gap score is reported in the analyses only as an additional descriptive variable.

Research sample and measurement instruments

The research sample consisted of 286 organizations operating in the Slovak Republic. The sample can be characterized as sectorally heterogeneous; the largest share was accounted for by organizations in the industrial production sector (13.6%), other activities (12.9%), wholesale and retail trade, including motor vehicle repairs (11.2%), information and communication technologies (8.0%), construction (5.9%), and financial and insurance activities (5.6%). In terms of ownership structure, private enterprises prevailed (71.0%); the remainder of the sample consisted of privately and foreign-owned enterprises (11.2%), foreign-owned enterprises (9.4%), and state-owned organizations (5.9%), with the rest comprising mixed and cooperative forms of ownership. The size structure of the sample was relatively balanced: 60 micro-organizations (0–9 employees; 21.0%), 85 small organizations (10–49 employees; 29.7%), 68 medium-sized organizations (50–249 employees; 23.8%) and 73 large organizations (250 or more employees; 25.5%). Data were collected between September 2025 and February 2026 through an online questionnaire distributed to representatives of the top and middle management of organizations operating across a range of industries; respondents were recruited using convenience sampling. The implications of this choice for the generalizability of the findings are discussed in the section on the study's limitations. Participation in the research was voluntary and anonymous, with one respondent answering for each organization.

The data were collected using a standardized comprehensive questionnaire that included organizational identification items and several thematic sections focused on digital maturity, information strategy, readiness for Industry 5.0, the perceived need for its implementation, the barriers to implementation, and the degree of implementation of Industry 5.0 elements. The variables were identified based on an extensive literature review and measured using Likert scale ranging from 0 (lack of readiness/insignificance) to 6 (implementation process/highly significant).

The **implementation index** was calculated as the average of 18 items focused on the extent of implementation of Industry 5.0 elements within an organization (collaborative robots, artificial intelligence, the Internet of Things, digital twins, predictive maintenance, production personalization, technologies supporting sustainability, process resilience, human-centric solutions, and others). The index served as the main dependent variable in subsequent analyses. We sought to evaluate its psychometric properties in detail in the section titled "Measurement Properties and Construct Validity."

Perceived readiness (Q16) and **perceived need for implementation** (Q17) were measured by single-item global ratings on a scale of 0–6. Single-item measures are psychometrically valid for specific and clearly defined constructs that respondents can assess holistically (Wanous et al., 1997). At the same time, however, we maintain that this approach precludes modeling the aforementioned constructs as latent variables, and this is acknowledged as a limitation of the study.

An organization's **digital maturity** was defined as the average of six questionnaire items focusing on the role of ICTs within the organization, the degree of process digitization, virtualization, the use of augmented reality, the importance attributed to data, and the level of data analytics (on a scale of 0–6). The internal consistency of the index was good (Cronbach's α = .83). The index represents the technological foundation of Industry 4.0, upon which the implementation of Industry 5.0 is conceptually based (Xu et al., 2021).

The organizational size was included in the regression models in logarithmic form as a control variable. A difference indicator (need − readiness) was also constructed as an additional analytical variable; however, given the methodological limitations of difference scores (Edwards, 1994), this indicator did not represent the main explanatory mechanism in the final models.

Analytical procedure

The analytical procedure consisted of six steps. In the first step, we verified the metric properties of the implementation index, specifically its internal consistency (Cronbach's α, McDonald's ω) and factor structure, using exploratory factor analysis (principal component factorization with Oblimin rotation), including a verification of the assumptions (Bartlett's test of sphericity, KMO measure). In the second step, we calculated descriptive statistics and correlation coefficients, since the Shapiro–Wilk test indicated deviations from a normal distribution for the main variables; Pearson's correlations were verified in parallel using Spearman's ρ. In the third step, hypotheses H1, H2, and H6 were tested using hierarchical linear regression, with predictors entered in four blocks: (1) the logarithm of the organization's size, (2) perceived readiness, (3) perceived need, (4) digital maturity. This procedure allowed us to assess the increase in explained variability after including individual variables (ΔR^2, ΔF); effect sizes were evaluated using Cohen's f^2. In step four, the moderation hypothesis H3 was tested using moderated regression with a product term of centered predictors, followed by a simple slopes analysis (Aiken & West, 1991).

In step five, we tested the hypothesis H4 using polynomial regression with response surface analysis (Edwards & Parry, 1993; Shanock et al., 2010). The implementation index was regressed against readiness, need, their squares, and their product, with both predictors centered on a common overall mean. Four parameters of the response surface were calculated from the estimated coefficients: slope (a1) and curvature (a2) along the line of congruence (readiness = need) and slope (a3) and curvature (a4) along the line of incongruence (readiness = −need); their standard errors and tests were derived using the delta method. In step six, the mediation hypothesis H5 was tested: the indirect effect of digital maturity on implementation via perceived readiness was estimated while controlling for organization size and tested using the bootstrap method with 5,000 samples (Preacher & Hayes, 2008; Hayes, 2018), with the significance of the indirect effect assessed using a 95% confidence interval.

All tests were two-tailed with a significance level of α = .05. Multicollinearity was assessed using variance inflation factors (VIF), and autocorrelation of the residuals was assessed using the Durbin–Watson statistic. The risk of common method bias, which arises from collecting all variables from a single respondent per organization, was assessed using Harman's one-factor test (Podsakoff et al., 2003): the first unrotated factor explained 40.7% of the variance in the items, which is less than the critical 50% threshold, suggesting that common method bias is unlikely to be a dominant source of variability; however, it cannot be completely ruled out either.

Results

In this chapter, we present the results of a quantitative analysis conducted on a sample of 286 organizations, organized according to the steps described in the section Analytical Procedure: measurement properties and construct validity, descriptive statistics and bivariate correlations, main effects of readiness, needs, and digital maturity, moderation analysis, polynomial regression with response surface analysis, mediation analysis, and a summary of hypothesis testing.

Measurement properties and construct validity

The internal consistency of the implementation index was excellent (Cronbach's α = .932; McDonald's ω = .935), and the correlations between the items and the rest of the scale ranged from .51 to .74, suggesting that omitting any of the 18 items would not improve reliability. The factorability of the items was confirmed (Bartlett's test of sphericity: $\chi^2(153) = 3095$; $p < .001$; KMO = .925). Exploratory factor analysis yielded four interpretable factors; in line with maturity research, which views readiness for Industry 5.0 as a multidimensional yet coherent construct (Brückner et al., 2025; Himmiche et al., 2025), the index was retained as a composite indicator due to its high and stable reliability.

Since perceived readiness and perceived need were strongly correlated (r = .710), we examined whether they were empirically distinguishable. The two constructs share approximately 50% of their variance, yet remained distinguishable: the variance inflation factors in the full model were well below the conventional threshold of 5.0 (readiness VIF = 2.25; need VIF = 2.09), and the constructs exhibited distinct predictive profiles, as documented in the following sections. The relationship between readiness and need is therefore convergent; not redundant- organizations with more developed capabilities also attribute greater strategic importance to the implementation of Industry 5.0, which is consistent with the assumptions of the TOE framework regarding the interdependence of environmental stimuli and internal capabilities (Tornatzky & Fleischer, 1990; Baker, 2011).

Descriptive statistics and bivariate correlations

Descriptive statistics and correlation matrix are indicated in Table 1. The Shapiro–Wilk test rejected the assumption of normality for all main variables ($p < .001$); Pearson's correlations were therefore cross-validated using Spearman's ρ, and the direction and strength of all relationships were consistent for both coefficients. The paired t-test did not reveal a significant difference between the mean readiness score (M = 3.14; SD = 1.58) and the mean need score (M = 3.22; SD = 1.72): t(285) = −0.98; p = 0.327; Cohen's d = −0.058 [95% CI: –,174; ,058], suggesting that, at the aggregate level, organizations perceive their readiness for and need for Industry 5.0 as comparable. The implementation index correlated positively and significantly with readiness (r = .584), need (r = .529), and digital maturity (r = .543), while its correlation with the simple difference score (need − readiness) was practically zero (r = –.006; p = 0.922) - we discuss this result in the section on polynomial regression and response surface analysis.

Table 1: Descriptive statistics and correlation matrix of main variables

Variable	M	SD	α	1	2	3	4
1 Organization size (log)	4.13	2.24	–				
2. Perceived readiness (Q16)	3.14	1.58	–[a]	.357***			
3. Perceived need (Q17)	3.22	1.72	–[a]	.338***	.710***		
4. Digital maturity	3.76	1.15	.83	.456***	.539***	.487***	
5. Implementation index	1.77	1.17	.93	.315***	.584***	.529***	.543***

Source: Authors' own processing

*Note. N = 286. α = Cronbach's alpha (reported only for multi-item scales). [a]Single-item measure; the internal consistency coefficient cannot be calculated. The coefficients are Pearson's r; Spearman's ρ values were consistent in both direction and magnitude (largest difference: log magnitude × implementation index, ρ = .355). Difference score (need − readiness): M = 0.07; SD = 1.26. ***p < .001 (two-tailed test).*

Main effects: perceived readiness, perceived need, and digital maturity (H1, H2, H6)

To test H1, H2, and H6, we estimated a hierarchical linear regression with the implementation index as the dependent variable (Table 2). Model 1 included the logarithm of organizational size as a control variable and explained 9.9% of the variance ($R^2 = .099$). When we included perceived readiness in Model 2, it resulted in a large and significant increase ($\Delta R^2 = .255$; $\Delta F(1, 283) = 111.58$; $p < .001$; Cohen's $f^2 = .408$). Readiness remained the dominant predictor even after adding need in Model 3 (β = .396; p < .001; 95% CI for B: [.195; .391]), thus confirming H1. Perceived need retained a smaller but significant independent effect (β = .214; p = .002; 95% CI for B: [.056; .234]; $\Delta R^2 = .022$; $f^2 = .036$), thus confirming H2. In Model 3, the effect of need was smaller than that of readiness, which is partly due to the high correlation between the two predictors (r = .710); thus, the effect of need may be partially suppressed in the presence of readiness, but its statistical and practical significance remains intact. The asymmetry between the two predictors is consistent with the understanding of Industry 5.0 as a value-oriented transformation in which merely recognizing the importance of change does not, in itself, create the capacity to implement it (Xu et al., 2021; Nahavandi, 2019; Longo et al., 2020).

Model 4 introduced digital maturity to the organization. It provided significant incremental validity beyond the factors of size, readiness, and need ($\Delta R^2 = .052$; $\Delta F(1, 281) = 25.53$; $p < .001$; $f^2 = .091$) and proved to be a strong predictor ($\beta = .290$; $p < .001$), thereby confirming H6. It is noteworthy that the effect of organizational size became insignificant after controlling for digital maturity ($\beta = .018$; $p = .720$), suggesting that the apparent size advantage operates primarily through digital maturity, which larger organizations typically possess. The full model explained 42.8% of the variance ($R^2 = .428$; $f^2 = .749$), with no signs of problematic multicollinearity (all VIF ≤ 2.25) or autocorrelation of residuals (Durbin–Watson = 1.99).

Table 2: Hierarchical linear regression predicting the implementation index

Predictor	B	SE(B)	β	t	p
Model 1 - $R^2 = .099$, $F(1, 284) = 31.35$, $p < .001$					
Organization size (log)	.164	.029	.315***	5.60	< .001
Model 2 - $R^2 = .354$; $\Delta R^2 = .255$; $\Delta F(1, 283) = 111.58$, $p < .001$					
Organization size (log)	.064	.027	.123*	2.40	.017
Perceived readiness	.400	.038	.540***	10.56	< .001
Model 3 - $R^2 = .376$; $\Delta R^2 = .022$; $\Delta F(1, 282) = 10.13$; $p = .002$					
Organization size (log)	.053	.026	.102*	2.00	.046
Perceived readiness	.293	.050	.396***	5.83	< .001
Perceived need	.145	.046	.214**	3.18	.002
Model 4 - $R^2 = .428$; $\Delta R^2 = .052$; $\Delta F(1, 281) = 25.53$; $p < .001$					
Organization size (log)	.010	.027	.018	0.36	.720
Perceived readiness	.224	.050	.302***	4.47	< .001
Perceived need	.113	.044	.167*	2.57	.011
Digital maturity	.294	.058	.290***	5.05	< .001

Source: Authors' own processing

*Note. N = 286. B = unstandardized coefficient; SE(B) = standard error; β = standardized coefficient. Variables entered without centering. VIF (Model 4): log size = 1.30; readiness = 2.25; need = 2.09; digital maturity = 1.62. Durbin–Watson (Model 4) = 1.99. Shapiro–Wilk test of normality of the residuals in Model 3: W = .983, p = .002; with N = 286, the OLS estimate is robust to this deviation based on the central limit theorem. * p < .05; ** p < .01; *** p < .001.*

Moderation task of readiness (H3)

H3 hypothesized that perceived readiness moderates the relationship between perceived need and implementation. Adding a centred product term of readiness × need to Model 3 yielded a small but significant interaction ($\beta = .102$; $p = .036$; $R^2 = .387$), thereby confirming H3. An analysis of simple slopes (Aiken & West, 1991) showed that the effect of perceived need on implementation increased with rising readiness: the need slope was +0.245 at low readiness (−1 SD) and +0.369 at high readiness (+1 SD); Figure 1 illustrates the pattern of simple slopes. In other words, the perceived need translates into implementation more effectively when the organization already has the capacity to act. Environmental pressure and internal capacity are complementary, not interchangeable, which is consistent with the underlying logic of the Technology–Organization–Environment framework (Baker, 2011; Tornatzky & Fleischer, 1990).

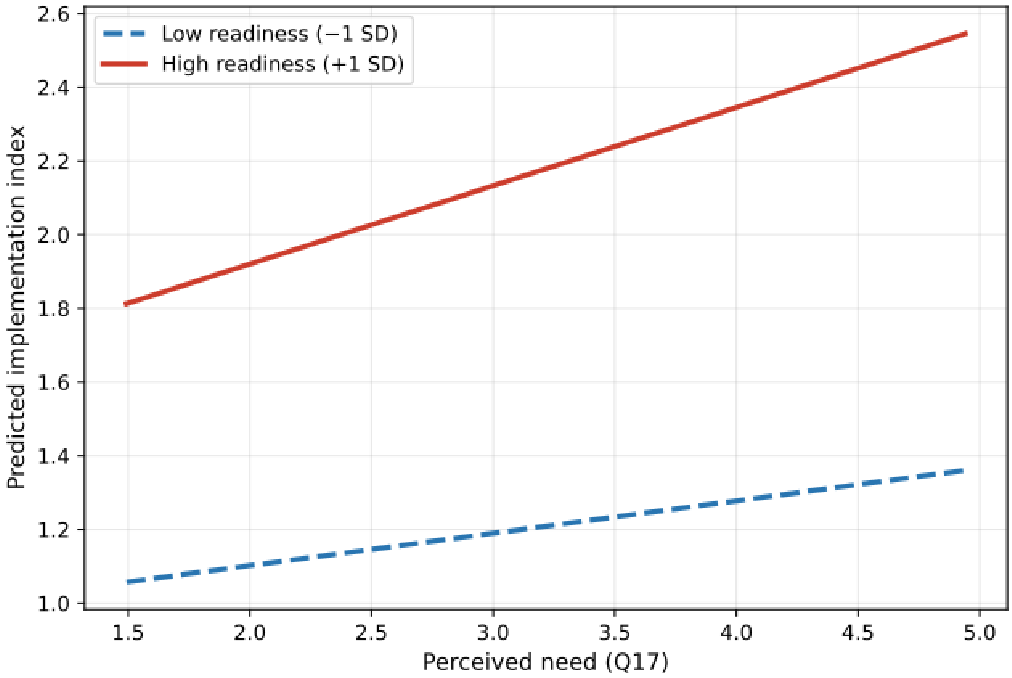

Figure 1. Simple Inclinations: The Effect of Perceived Need at Low and High Levels of Readiness

Source: Authors' own processing

Note. The slopes are estimated from a moderated regression model controlling for organization size (log), with moderator values at ±1 SD from the mean.

Beyond the Difference Score Threshold: Polynomial Regression and Response Surface Analysis (H4)

The bivariate correlation between the simple difference score (need − readiness) and implementation was not significant ($r = -.006$; $p = .922$) and remained so even when using the absolute value of the difference ($r = -.107$; $p = 0.070$), which rules out the possibility that the relationship is masked by the direction of the difference. However, the difference score confounds the level of the components with their difference and imposes untested symmetry constraints, thereby often obscuring the true congruence effects (Edwards & Parry, 1993; Edwards, 1994). We therefore tested H4 using polynomial regression with response surface analysis (Shanock et al., 2010). The implementation index was regressed against readiness, need, their squares, and their product (all predictors centred on a common overall mean 3.18). The quadratic block added significant variance beyond that explained by the linear model ($\Delta R^2 = .020$; $F(3, 280) = 3.09$; $p = .027$; full model $R^2 = .388$). The coefficients and area parameters are specified in Table 3. The product term readiness × need was significant in the moderated regression model reported above ($\beta = .102$; $p = .036$), but did not reach conventional significance once the quadratic terms were entered ($b4 = .079$; $p = .064$). This attenuation is expected, as the squared terms of readiness and need absorb part of the variance previously captured by the product term. The moderation effect should therefore be interpreted as small and model-dependent.

Along the line of congruence (readiness = need), the slope was strongly positive ($a1 = .483$; $p < 0.001$) and the curvature was negligible ($a2 = 0.035$; $p = 0.082$): organizations in which both readiness and need are equally high implement Industry 5.0 to a much greater extent than those in which both are low, and this relationship is essentially linear. Crucially, along the line of incongruence (readiness = −need), the curvature was not significant ($a4 = -.123$; $p = .156$), indicating the absence of a symmetrical penalty for incongruence-which explains why the simple difference score showed no effect. However, the slope of the incongruence line was positive and significant ($a3 = .187$; $p = .034$), revealing directional asymmetry: given the same degree of organizational incongruence, organizations with excess readiness (high readiness, lower need) implement more than organizations with excess need (high need, lower readiness). The response surface is shown in Figure 2.

This formula reframes the zero result of the original difference operationalization. The implementation of Industry 5.0 is not driven by the magnitude of the gap between readiness and need as such, but by the absolute level of both constructs and the asymmetry that consistently favours readiness over need. This finding supports concerns that delayed or fragmented implementation reflects a lack of capacity rather than merely a perceptual mismatch (Bartuś et al., 2025; Demir & Cicibas, 2023), and supports the call for a multidimensional, level-based assessment of readiness rather than simplified gap indicators (Brückner et al., 2025).

Table 3: Polynomial Regression and Response Surface Parameters (Dependent Variable: Implementation Index)

Member/ parameter	Estimate	SE	p
Polynomial coefficients (R^2 = .388; F(5, 280) = 35.49; p < .001)			
Readiness (b1)	.335	.055	< .001
Need (b2)	.148	.046	.001
Readiness^2 (b3)	.005	.032	.867
Readiness × Need (b4)	.079	.043	.064
Need^2 (b5)	- .049	.027	.068
Response surface parameters			
Slope of congruence (a1 = b1 + b2)	.483	.037	< .001
Curvature of congruence (a2 = b3 + b4 + b5)	.035	.020	.082
Slope of incongruence (a3 = b1− b2)	.187	.088	.034
Curvature of incongruence (a4 = b3− b4 + b5)	-.123	.087	.156

Source: Authors' own processing

Note. N = 286. Readiness and need were centered on the overall mean (3.18). Standard errors and area parameter tests were obtained using the delta method. A quadratic block over a linear model: ΔR^2 = .020; F(3, 280) = 3.09; p = .027.

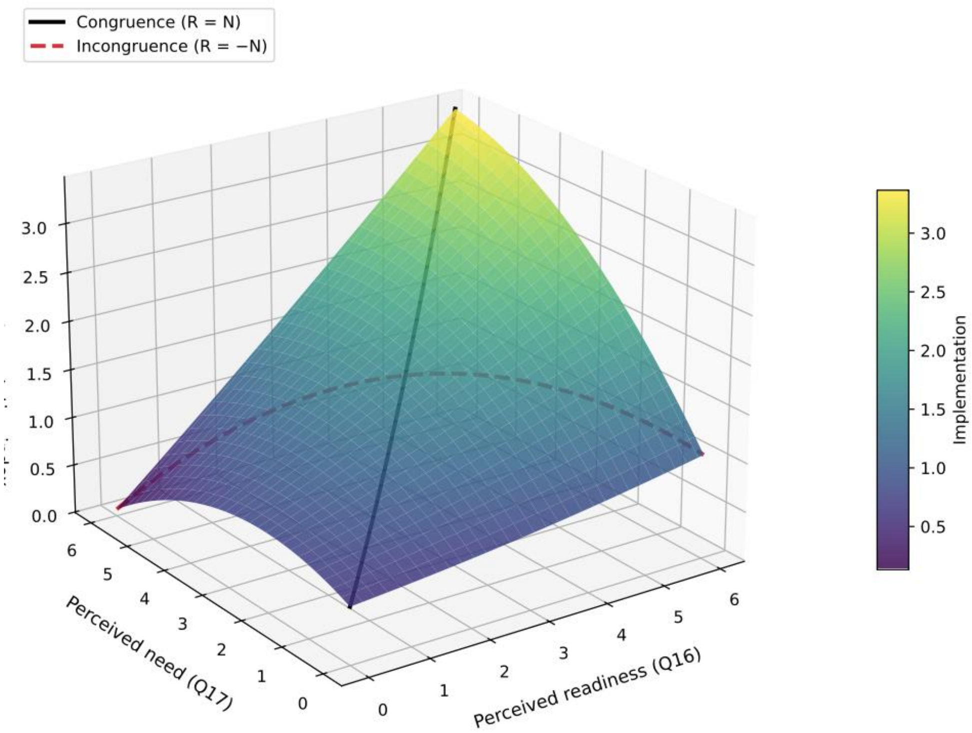

Figure 2. Response Surface of Perceived Readiness × Perceived Need and Implementation of Industry 5.0

Source: Authors' own processing

Note. A solid line indicates a line of congruence (readiness = need); a dashed line indicates a line of incongruence (readiness = −need). The steep, nearly linear increase along the line of congruence reflects a1 = .483 (p < .001); the slope of the line of incongruence toward the corner with excess readiness reflects a3 = .187 (p = .034).

Digital maturity, readiness and implementation: a mediation analysis (H5)

In H5, we hypothesized that an organization's digital maturity (a proxy for the foundation of Industry 4.0, upon which Industry 5.0 is built (Xu et al., 2021)) influences implementation indirectly through perceived readiness. We estimated a mediation model controlling for organization size, and tested the indirect effect using 5,000 bootstrap samples (Preacher & Hayes, 2008; Hayes, 2018). Digital maturity was a strong predictor of readiness (a = .648), and readiness predicted implementation when controlling for digital maturity (b = .300). The indirect effect was significant (ab = .195; 95% bootstrap CI [.133; .263]) and accounted for 38.3% of the total effect of digital maturity for implementation (c = .508). The direct effect remained significant (c′ = .314), indicating partial mediation; the mediation model is illustrated in Figure 3. A more advanced digital foundation thus enhances the implementation of Industry 5.0, in part by increasing an organization's readiness. This finding provides empirical support for the view that Industry 4.0 and Industry 5.0 are coexisting and mutually reinforcing frameworks rather than strictly sequential stages (Xu et al 2021; Nahavandi 2019).

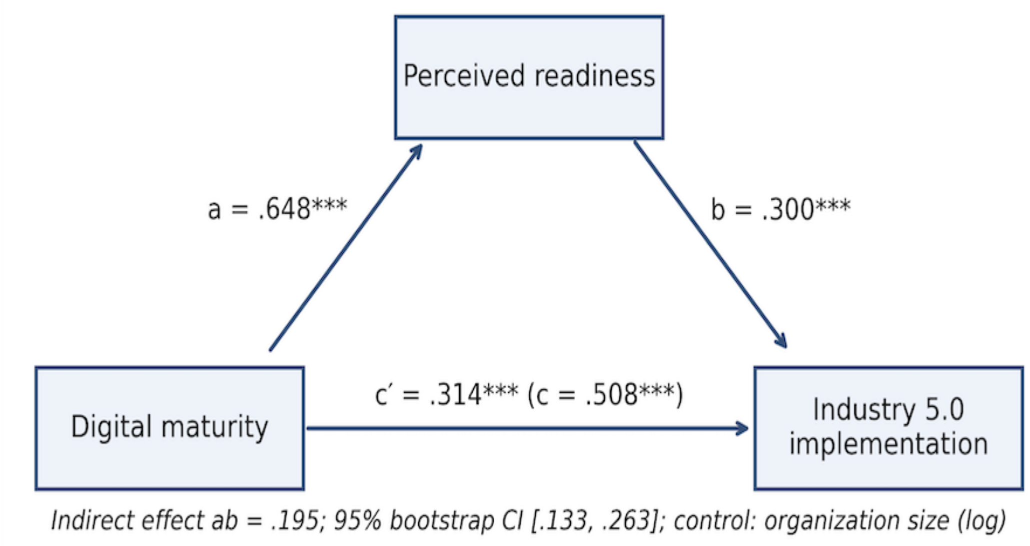

Figure 3. Mediation Model: Digital Maturity → Perceived Readiness → Implementation of Industry 5.0

Source: Authors' own processing

Note. The coefficients are non-standardized; *** p < 0.001. The indirect effect was tested using the bootstrap method (5,000 samples). Control variable: organization size (log).

Summary of Hypothesis Testing

Table 4: Overview of hypothesis testing results

H	Hypothesis	Key result	Conclusion
H1	Perceived readiness positively predicts implementation	r = .584; β = .396; p < .001	Confirmed
H2	Perceived need positively predicts implementation	r = .529; β = .214; p = .002	Confirmed
H3	Readiness moderates the need–implementation relationship	β = .102; p = .036	Confirmed
H4	(In)congruence of readiness and need is related to implementation (RSA)	α1 = .483; p < .001; α3 = .187; p = .034; a4 unimportant	Confirmed
H5	Digital maturity → readiness → implementation (mediation)	a b = .195; 95% CI [.133; .263]	Confirmed (partial)
H6	Digital maturity adds incremental validity beyond readiness and need	ΔR^2 = .052; β = .290; p < .001	Confirmed

Source: Authors' own processing

Note. N = 286. A supplementary analysis of the simple difference score (difference = need − readiness) showed no relationship with implementation (r = –.006; p = .922); the response surface analysis (H4) explains why and provides a substantive interpretation. RSA = response surface analysis.

Discussion

The study's findings suggest that the implementation of Industry 5.0 at the organizational level is shaped primarily by a combination of capacity and motivational factors, with organizational readiness playing a dominant role. Although it was confirmed that both perceived readiness and perceived need for implementation are positively associated with the implementation status, readiness retained a stronger and more robust effect even after the need, the organization size, and the digital maturity were included in the regression model. This model suggests that the transition to Industry 5.0 cannot be viewed merely as a response to growing strategic pressure for sustainability, resilience, and human-centricity, but rather as a process contingent on an organization's actual ability to effectively absorb these requirements and integrate them into its processes. In this sense, our findings support the view of Industry 5.0 as a value-driven transformation, in which simply recognizing the importance of change does not necessarily mean one is capable of implementing it (Xu et al., 2021; Longo et al., 2020; Nahavandi, 2019).

The H1 and H2 confirmation shows that the implementation of Industry 5.0 cannot be explained by a single type of mechanism alone. On the one hand, organizations with a higher perceived readiness also exhibit a higher degree of implementation, which is consistent with the theory of organizational readiness for change, according to which readiness reflects not only a willingness to change but also the organization's perceived ability to implement the change. On the other hand, implementation is also positively associated with the perceived need to adopt Industry 5.0 principles, which can be interpreted as organizations' response to strategic and environmental pressures related to sustainability requirements, resilience, and the quality of work-in line with the TOE framework, in which the environmental context and perceived incentives represent an important driver of the adoption (Baker, 2011; Tornatzky & Fleischer, 1990). However, these two mechanisms are not equivalent but asymmetrical, with preparedness carrying a greater weight. The moderation analysis (H3) further refines this picture: the effect of need on the implementation strengthens as readiness increases, which means that environmental pressure and internal capacity are complementary, not interchangeable. Strategic urgency translates into actual implementation, particularly when an organization has the capabilities to respond to it.

A significant finding remains the strong positive association between readiness and the perceived need for implementation (r = .710). The results suggest that these are not two isolated constructs, but rather interconnected dimensions of the same transformational situation: organizations with more developed capabilities are likely to be more responsive to new regulatory, market, and strategic requirements, and therefore attach greater importance to Industry 5.0; conversely, organizations that are more acutely aware of the need for transformation can systematically build their readiness. At the same time, it is important to emphasize that a strong association does not imply that the constructs are identical: the shared variance of approximately 50% remained below the redundancy threshold, the VIF values were well below the critical threshold, and both constructs exhibited distinct predictive profiles in regression, congruence, and mediation analyses. These are, therefore, empirically distinguishable yet closely interrelated constructs, which is important for their further theoretical and methodological development.

We consider the results of the response surface analysis (H4) - which we used to replace the original GAP scores measuring the discrepancy between the gap and between need and readiness-to be one of the study's most significant contributions. The simple difference score showed no correlation with implementation, which, if interpreted superficially, could lead to the conclusion that the gap between need and readiness is irrelevant. However, polynomial regression revealed a more differentiated picture: implementation increases primarily along the line of congruence (the simultaneous growth of readiness and need); there is no symmetrical penalty for incongruence as such, but the direction of incongruence does matter. An excess of readiness is associated with a higher level of implementation than an excess of need of the same magnitude. This finding corrects the intuitive but methodologically simplified understanding of dissonance as the primary explanation for implementation behaviour and, at the same time, replaces it with a more precise mechanism, namely that the absolute level of both constructs and an asymmetric readiness deficit are decisive. This finding is consistent with the observation that implementation tends to be delayed and fragmented despite the stated urgency (Bartuś et al., 2025) and that the gap between readiness and implementation represents the greatest challenge in the transition from Industry 4.0 to Industry 5.0 (Demir & Cicibas, 2023). At the same time, it supports the argument in favour of a holistic and multidimensional assessment of preparedness rather than simplified indicators (Brückner et al., 2025; Himmiche et al., 2025) and empirically confirms the methodological critique of difference scores (Edwards, 1994; Edwards & Parry, 1993).

The results regarding digital maturity (H5, H6) also shed new perspective on the implementation mechanism. Digital maturity not only provided significant incremental predictive validity beyond perceptual constructs but also influenced implementation partly indirectly, through perceived readiness, which mediated approximately 38% of its total effect. These findings empirically support the conceptualization of Industry 4.0 and Industry 5.0 as coexisting and mutually reinforcing frameworks (Xu et al., 2021; Nahavandi, 2019). A technological foundation built on the principles of Industry 4.0 enhances an organization's perceived ability to manage a value-oriented transformation, thereby also supporting its actual implementation. Another noteworthy finding is that, once digital maturity is taken into account, the effect of organizational size becomes insignificant: the advantage that large organizations have in implementing Industry 5.0 does not, therefore, appear to be a consequence of size alone, but rather of the digital capabilities that large organizations are more likely to possess. From a practical standpoint, this means that even smaller organizations can compensate for the implementation gap by systematically building their digital maturity.

In summary, it can be concluded that this study contributes to the literature on Industry 5.0 by shifting the focus from the predominantly normative and conceptual framing of this agenda to empirically testable implementation mechanisms at the organizational level. While the existing literature strongly emphasizes human-centricity, sustainability, and resilience as the fundamental pillars of Industry 5.0 (European Commission, 2021; Romero & Stahre, 2021; Ivanov, 2023), our results show that the actual implementation of these principles depends primarily on an organization's capacity readiness and its digital foundation, and, to a lesser extent, on the perceived need for transformation. The practical implication is that organizations cannot stop at merely declaring the strategic importance of Industry 5.0, they must systematically build the capabilities needed to actually carry out the transformation, with investments in digital maturity serving as a catalyst for readiness.

Study limitations and directions for future research

However, all results must be interpreted with awareness of the study's limitations. First, the cross-sectional design does not allow for a causal interpretation of the relationships. The direction of effects in the moderation and mediation model is derived theoretically, not empirically, and reciprocal relationships (such as the feedback effect of implementation on perceived readiness) cannot be ruled out. Second, the sample was selected using a convenience sampling method, which limits the generalizability of the findings to the population of organizations in the Slovak Republic and beyond; the sample's heterogeneity in terms of sector and size mitigates this risk but does not eliminate it. Third, all variables were reported by a single respondent per organization through self-report, and, as a result, common-method bias cannot be ruled out (Podsakoff et al., 2003). Harman's one-factor test (first factor accounting for 40.7% of the variance) did not indicate its dominance; however, this is only a preliminary diagnostic test. Fourth, perceived readiness and perceived need were measured using single-item global ratings...although such measures are justifiable for clearly defined constructs (Wanous et al., 1997), they do not allow for the modelling of measurement errors or latent structures. Fifth, the implementation index revealed a multidimensional factor structure, but it was used as a composite indicator in the analyses; disaggregating it to the level of individual implementation dimensions may reveal differentiated patterns. After all, the degree of implementation was measured based on perceptions, not on objective indicators.

We recommend that future research focus on longitudinal designs that will allow for testing the causal relationships among constructs and the dynamics of the transition from awareness of a need to actual implementation, on a multidimensional operationalization of readiness and need using multi-item scales and multiple respondents per organization, as well as on supplementing perceptual measures with objective indicators of implementation. From an analytical perspective, modelling latent variables, conducting a more in-depth analysis of implementation barriers as potential moderators, and replicating congruence analyses in other institutional contexts appear to be promising routes.

Conclusion

The aim of the scientific article is to analyse the relationships between perceived organizational readiness for Industry 5.0, the perceived need for its implementation, and its implementation status at the organizational level. The results showed that the implementation of Industry 5.0 principles is positively related to both perceived readiness and perceived need for its implementation, with readiness emerging as the stronger and more robust predictor. At the same time, a strong positive relationship between readiness and need was confirmed, suggesting that these are closely related yet empirically distinguishable constructs, as well as a moderating effect of readiness: perceived need translates into implementation more effectively in organizations with higher levels of readiness.

The expanded analysis yielded two findings that go beyond the original conference paper. First, the response surface analysis showed that the implementation of Industry 5.0 is not driven by the magnitude of the gap between need and readiness, but rather by the absolute levels of both constructs and a directional asymmetry that favours an excess of readiness over an excess of need; a symmetrical penalty for incongruence was not confirmed. Second, an organization's digital maturity has proven to be a significant predictor of implementation, one that acts partly indirectly-by increasing perceived readiness-and that simultaneously accounts for the apparent effect of organizational size.

Through this study, we are thus contributing to the literature on Industry 5.0 on three levels. First, we shifted the discussion from a predominantly normative and conceptual definition of Industry 5.0 to empirically testable implementation mechanisms at the organizational level. Second, we seek to demonstrate that the actual implementation of Industry 5.0 principles is not determined solely by the perceived importance of the transformation, but above all by the organization's capacity to carry out this transformation, a capacity that rests on a digital foundation built on the principles of Industry 4.0. Third, we methodologically demonstrate that a simple difference score fails to adequately capture the complexity of transformational dynamics and that polynomial regression with response surface analysis represents a more appropriate analytical approach to congruence issues. The practical implication is that organizations cannot stop at simply declaring the need for Industry 5.0. They must actively develop the organizational, process, and competency prerequisites for its implementation, and investments in digital maturity serve as an effective lever for strengthening readiness.

The aforesaid findings should be read with the limitations summarized in Section 5.1. Overcoming these challenges-particularly through longitudinal designs and multidimensional operationalization-can further shed light on the mechanisms by which organizations transition from recognizing the need for Industry 5.0 to its actual implementation.

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