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The Competency, Innovation, And Sustainability Nexus: A Quantitative Study of It Project Managers in Hungary

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ABSTRACT

This study examines the link between project managers' soft competencies and project sustainability, highlighting the mediating role of innovation management in Hungary's software industry. Data were collected from 272 IT project managers using a structured survey, and Partial Least Squares Structural Equation Modeling (PLS-SEM) was applied. Results show that competencies such as adaptability, communication, and emotional intelligence positively affect sustainability, while innovation management amplifies these effects across the project lifecycle. The research contributes new insights by integrating human skills, innovation, and sustainability into a governance-oriented framework, emphasizing the Hungarian Information Technology context. Practical implications suggest that firms, universities, and policymakers should invest in capacity-building and innovation ecosystems aligned with Sustainable Development Goals, particularly SDG 9 and SDG 17.

Keywords: Project Sustainability, Project Management, Soft Competencies, Innovation Management, Hungarian Software Sector

JEL Codes: M12, O32, Q56, L86

INTRODUCTION

Projects play a pivotal role in shaping sustainable development, and project management has become an essential driver of long-term socioeconomic progress. As sustainability emerges as a global imperative, project managers must integrate environmental and social responsibility into their leadership practices. While technical expertise remains important, numerous studies show that project failures often stem from deficiencies in soft competencies such as communication, adaptability, and leadership (Bhatti et al. 2021; Schipper & Silvius 2017). These skills enable project managers to translate sustainability goals into actionable outcomes, yet existing competency frameworks often underestimate their strategic role in driving sustainable performance. In particular, the Hungarian context reveals challenges: weak stakeholder engagement, insufficient top management support, and inadequate planning are frequently cited as reasons for project underperformance, whereas project managers with strong communication and change management skills achieve higher success rates (Joseph & Marnewick 2020). Soft competencies are therefore not ancillary but represent critical assets for sustainable project delivery.

Innovation management provides a vital channel through which these competencies exert influence on sustainability. By fostering adaptability, creativity, and collaboration, innovation processes help projects respond to complexity, optimize resources, and align with long-term value creation (Bamel et al., 2024; Kraśnicka et al., 2016). Creative leadership supported by emotional intelligence and motivation enables teams to generate and implement novel solutions, ensuring that sustainability is integrated throughout the project lifecycle (Niyafard et

al., 2024). Although global literature has increasingly acknowledged the role of innovation in sustainability (Frishammar et al. 2019; Oláh et al. 2019), the mediating effect of innovation management between soft competencies and project sustainability remains underexplored, particularly in national contexts such as Hungary.

Hungary's software industry represents an ideal setting to examine this relationship. With over 38,000 ICT enterprises and 120,000 employees, including more than 80,000 in Budapest, the sector contributes roughly 5% to national GDP and has experienced significant foreign investment from multinational firms such as Nokia, Ericsson, Microsoft, Siemens, and TATA. ICT exports grew annually by 6.4% between 2010 and 2017, making up 8.3% of national exports by 2017, while foreign direct investment in 2019 alone reached €5.5 million. Despite this growth trajectory, sustainability outcomes in IT projects remain inconsistent. A recurring issue is the limited development of soft competencies among project managers, combined with weak innovation practices, which undermines the long-term sustainability of projects (Zuo et al., 2018).

Existing literature has examined competencies, innovation, and sustainability, but these dimensions are often treated in isolation. Integrated models capturing how project managers' soft skills interact with innovation management to affect sustainability are lacking, especially in the Hungarian software sector. This study seeks to address this research gap by testing a model that examines both the direct influence of soft competencies on project sustainability and the mediating effect of innovation management. In doing so, it contributes to theoretical development by linking individual capabilities, organizational innovation processes, and systemic sustainability outcomes. The practical significance extends to firms, universities, and policymakers who aim to strengthen capacity-building initiatives and innovation ecosystems aligned with the United Nations Sustainable Development Goals, particularly SDG 9 (Industry, Innovation, and Infrastructure) and SDG 17 (Partnerships for the Goals).

LITERATURE REVIEW

Project managers require a combination of technical expertise and human-centered soft competencies to deliver projects successfully. Skills such as communication, adaptability, leadership, and behavioral regulation are part of the Project Manager Competency Development (PMCD) framework, which links individual capabilities to organizational outcomes (Bhatti et al., 2021). Schipper and Silvius emphasize that the retention and application of such competencies are critical in the planning and execution stages of projects, directly influencing performance and sustainability. Evidence from a survey of Hungarian IT professionals indicates that poor stakeholder engagement, lack of top management support, and weak planning are common reasons for project failure, while strong communication and change management skills significantly increase success (Joseph & Marnewick, 2020). Luo, Zhang et al. (2020) further argue that competencies are not limited to knowledge and qualifications but extend to personality traits, which are essential for sustainable leadership.

Innovation management supports sustainability by enabling creativity, adaptability, and efficiency in project environments (Khosravi et al., 2019). By systematically integrating new ideas and technologies, organizations align project outcomes with long-term social, environmental, and economic objectives (Zhang et al., 2019). Effective innovation practices are grounded in collaboration, continuous learning, and knowledge sharing (Frishammar et al., 2019), and they enhance stakeholder engagement through initiatives such as green technologies or circular economy models (Bierwolf et al., 2017). The role of project managers is central: their soft skills influence how innovation is embedded into project processes and how sustainability is framed as a core design principle rather than an afterthought (Nambisan et al., 2017; Srivannaboon & Munkongsujarit, 2016). Projects prioritizing innovation are found to be more resilient, resource-efficient, and socially impactful (Albors-Garrigos et al., 2018; Oláh et al., 2019).

Project sustainability requires balancing scope, time, and quality with broader environmental and social considerations (Silvius, 2021). In Hungary, the IT sector increasingly reflects global trends, embedding sustainability into operations and exports (Vrchota et al., 2020). Studies highlight that financial growth is tied to sustainable execution, and project outcomes must be evaluated in terms of long-term value creation, not just short-term efficiency (El Khatib et al., 2020; Nagy et al., 2018). Earlier models often ignored ecological or social dimensions (Mavi & Standing, 2018), whereas contemporary frameworks stress sustainability as a core success factor, requiring systematic attention across all phases of the project life cycle (Martens & Carvalho, 2017). Project managers' ability to mitigate risks, adapt to complexity, and manage stakeholders determines the sustainability of project benefits (Saisa et al., 2019). End-users also play a vital role, reinforcing the long-term continuity of project outcomes (Armenia et al., 2019).

Although competencies, innovation, and sustainability have been discussed in global project management research, their **combined nexus remains underexplored in the Hungarian software industry.** Previous studies either treat competencies and innovation separately or address sustainability in generic terms without considering the contextual dynamics of Hungary's IT sector. Moreover, empirical studies rarely examine innovation management as a mediating factor between individual soft competencies and sustainability outcomes. This study

fills that gap by proposing and testing a governance-oriented model that integrates these three dimensions (Silvius & de Graaf, 2019). The contribution lies not only in contextualizing findings for Hungary but also in advancing theory on how human capabilities and innovation jointly drive sustainability in knowledge-intensive sectors.

METHODS

This study is grounded in two theoretical frameworks that support the linkages between project manager soft competencies, innovation management, and project sustainability. First, the Management Contingency Framework offers a suitable lens to investigate how context-dependent factors shape the relationship between soft competencies and project outcomes. It emphasizes the need to adapt leadership and decision-making approaches to situational demands. This framework integrates critical elements of soft competencies, innovation practices, and sustainability, making it a valuable guide for this research.

Second, the Theory of Sustainability in Projects provides an essential foundation for understanding how sustainability can be embedded in project management practices. This theory highlights the role of project managers in achieving sustainability by applying innovative tools and techniques that address environmental, social, and economic challenges. It enables stakeholders to pursue both competitive advantage and long-term value creation by incorporating financial and non-financial performance indicators into project success criteria. The three main variables with relationship directions are shown in the following figure 1.

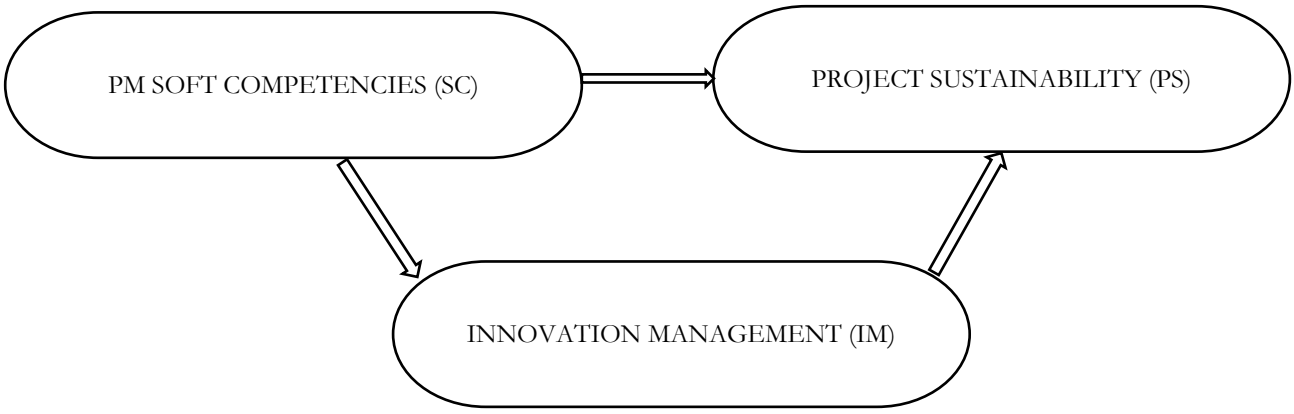

Figure 1: Conceptual Framework

Hypothesis Development

Building on the identified research gap, this study aims to clarify how project managers' soft competencies shape project sustainability and to what extent innovation management strengthens this relationship. The investigation is guided by the premise that soft skills, such as communication, adaptability, and leadership, are not only direct drivers of sustainable outcomes but also act indirectly through fostering innovation practices. Accordingly, the study examines the direct effects of soft competencies on sustainability and innovation management, the contribution of innovation management to sustainability, and its potential mediating role between human-centered leadership and sustainable project performance.

H 1: The Soft competencies of a project manager have a significant impact on the sustainability of the project.

H 2: The soft competencies of a project manager have a positive significant impact on innovation management.

H 3: Innovation management has a significant positive impact on project sustainability.

H 4: Innovation management mediates the relationship between the soft competencies of the project manager and the sustainability of the project.

Research Design and Methodology

This study employed a quantitative, cross-sectional research design to test hypothesized relationships between project managers' soft competencies, innovation management, and project sustainability. Data were collected through a structured online questionnaire that captured respondent perceptions of the three constructs. The survey design followed established measurement models, with items adapted from Gregory and Francis (2010) for soft competencies, Albors-Garrigos, Igartua, and Peiro (2018) for innovation management, and Xue et al. (Soares et al., 2024; Xue et al., 2020) and Soares, Fernandes, and Santos (2024) for sustainability. A total of 32 items were rated on a five-point Likert scale, ensuring clarity and consistency to minimize response bias.

Given the complexity of the proposed model, analysis combined descriptive statistics, reliability testing, and structural equation modeling (SEM). SPSS was used for initial data preparation, while SmartPLS was employed for

SEM due to its suitability for handling latent constructs and mediating effects in small-to-medium samples (Aria et al. 2018; Martinez Avila, Garcia-Machado, & Fierro Moreno 2021).

The target population comprised project managers working in Hungary's IT sector, with emphasis on software houses and IT service companies in Budapest, which hosts nearly 40% of the country's organizations. From 350 approached organizations, 272 valid responses were obtained, representing a mix of experienced and early-career project managers. While convenience sampling was applied to ensure feasibility, efforts were made to mitigate bias by diversifying organizational size and respondent profiles. The unit of analysis was the individual project manager, recognized as the primary decision-maker influencing project outcomes.

Data collection was conducted via a Google Forms questionnaire, distributed electronically with personal follow-up to maximize response rates. This approach ensured efficiency and accessibility while maintaining confidentiality of responses.

RESULTS AND DISCUSSION

Normality Analysis

The normal distribution of the data set was checked through kurtosis skewness tests were conducted and the values were recorded. Table 1 shows the results for Normality.

Table 1: Normality Test Result.

	Skewness	**Kurtosis**
SC01	−1.092	0.780
SC02	−1.244	0.751
SC03	−1.239	0.109
SC04	−1.126	0.023
SC05	−1.243	0.092
SC06	−1.256	0.561
SC07	−1.254	0.512
SC08	−1.222	0.534
SC09	−1.239	0.189
SC10	−1.056	−0.012
IM01	−1.675	1.143
IM02	−1.657	1.311
IM03	−1.650	1.100
IM04	−1.378	1.045
IM05	−1.487	1.112
IM06	−1.123	1.323
IM07	−1.445	1.443
IM08	−1.567	1.076
IM09	−1.467	1.098
IM10	−1.120	1.240
IM11	−1.123	1.347
PS01	−1.456	1.678
PS02	−1.324	1.345
PS03	−1.456	1.208
PS04	−1.672	1.197
PS05	−1.326	1.304
PS06	−1.454	1.110
PS07	−1.478	1.337
PS08	−1.368	1.056
PS09	−1.443	1.346
PS10	−1.421	1.705
PS11	−1.454	1.676

Reliability

Based on the selected sub-variables Cronbach's alpha was used as a reliability test to check the coherence of the variables and items used in the Google form questionnaire. The following table 2 shows the results.

Table 2: Reliability Test Variables.

Variable	Crobach's Alpha	No. of Items
SC	0.956	10
IM	0.965	11
PS	0.953	11

Variance Inflation Factor Analysis (VIF)

The variance inflation factor test was used to find out the multicollinearity between the variables. Table 3 shows the VIF results.

Table 3: Variance Inflation Factor Analysis (VIF)

Model		Collinearity	
		Tolerance	Variance Inflation Factor
1	SC	0.795	1.256
	IM	0.795	1.256

a= PS is dependent

Data Analysis in PLS-SEM

In the CFA result the Alpha and Composite reliability and average variance extracted values were more than 0.5 and 0.7 as shown in Table 4. These values demonstrate that the two variables have greater reliability and homogeneity.

Table 4: Reliability and Validity

Variable	CA	CR	AVE
IM	0.976	0.981	0.823
SC	0.942	0.951	0.655
PS	0.967	0.981	0.817

The determinant validity was checked through the Heterotrait Monotrait Ratio. The following table 5 shows that all the values were less than the standard value of 0.90.

Table 5: Discriminant Validity

	IM	SC	PS
SC	0.731		
PS	0.762	0.826	

The predictive accuracy of the model for this research was calculated through a sample model of R^2. The following table 6 shows the values were more than the standard value of 0.3.

Table 6: In-sample Model Fit

Variable	R^2
IM	0.855
PS	0.771

To have an accurate prediction the out-of-sample power was also measured through RMS and MA errors checking in PLS. The following table 7 I shows the results.

Table 7: Sample model fit

MV Prediction Summary				MV Prediction Summary				Comparison	
	RMSE	MAE	Q2_Predict		RMSE	MAE	Q2_Predict	RMSE	MAE
IM09	0.406	0.265	0.798	IM09	0.537	0.43	0.649	-0.131	-0.175
IM08	0.666	0.353	0.881	IM08	0.644	0.488	0.667	-0.174	-0.123
IM01	0.546	0.347	0.834	IM01	0.867	0.765	0.654	-0.345	-0.367
IM07	0.301	0.264	0.771	IM07	0.398	0.345	0.456	-0.012	-0.075
IM03	0.455	0.316	0.798	IM03	0.456	0.423	0.786	-0.115	-0.145
IM02	0.421	0.312	0.819	IM02	0.567	0.567	0.667	-0.20	-0.678

IM05	0.567	0.345	0.235	IM05	0.234	0.486	0.236	-0.531	-0.459
IM10	0.56	0.562	0.896	IM10	0.238	0.238	0.236	-0.349	-0.456
IM06	0.345	0.56	0.453	IM06	0.456	0.845	0.367	-0.362	-0.569
PS02	0.749	0.236	0.126	PS02	0.568	0.567	0.289	-0.489	-0.564
PS08	0.233	0.436	0.905	PS08	0.023	0.537	0.489	-0.677	-0.678
PS05	0.135	0.783	0.467	PS05	0.450	0.398	0.249	-0.345	-0.879
PS06	0.354	0.581	0.466	PS06	0.178	0.340	0.453	-0.256	-0.456
PS01	0.562	0.465	0.342	PS01	0.368	0.567	0.391	-0.347	-0.563
PS04	0.324	0.287	0.389	PS04	0.436	0.456	0.563	-0.255	-0.568
PS03	0.569	0.298	0.637	PS03	0379.	0.563	0.387	-0.347	-0.420
PS09	0.255	0.673	0.378	PS09	0.675	0.274	0.678	-0.466	-0.356
PS07	0.569	0.267	0.274	PS07	0.732	0.487	0.260	-0.327	-0.479

Factor Loadings

Figure 2, downloaded from SmartPLS4, shows the factor loadings with respect to each variable in model. All the values were under 0.7.

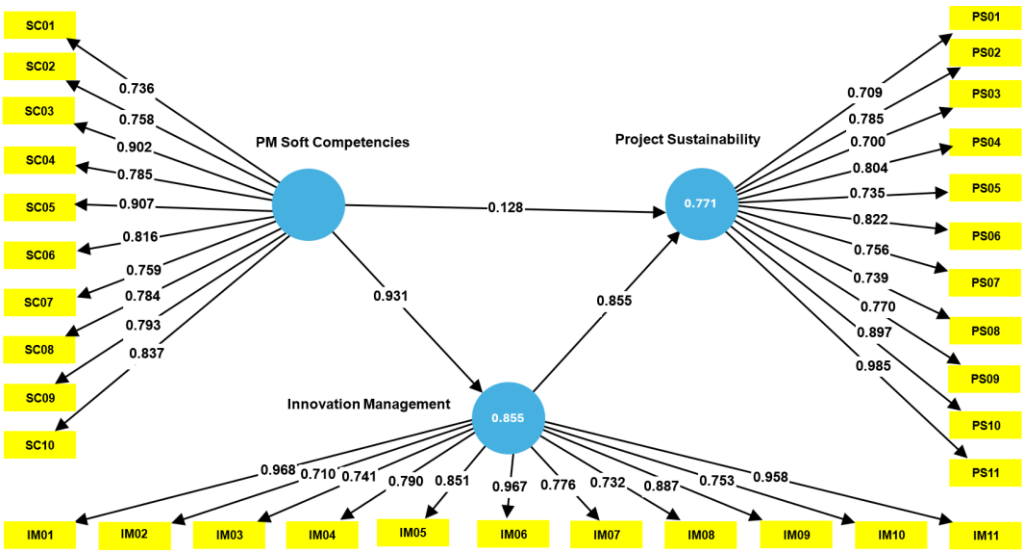

Figure 2: PLS-SEM Model with related indicators and Factor Loadings

Bootstrapping -Path Coefficients

The relationship between the dependent and independent variables, called path coefficient is used here to test the beta values and t-values. This technique is called bootstrapping. Table 8 shows that there is a strong relationship between the variable paths with a higher value of t and a lower value of p less than 0.05.

Table 8: Path co-efficient

	Mean	**Standard Deviation**	**t-value**	**p-value**
IM >>> PS	0.855	0.037	22.844	0.011
SC >>> IM	0.931	0.014	60.064	0.00
SC >>> PS	0.128	0.041	3.345	0.001

Specific Indirect Effect

In Table 9, the t and p values 6.52 and 0.000 respectively show that there is a direct relationship between the independent and dependent variables of this study. The relationship was significant.

Table 9: Specific indirect effect

Path	**Sample Mean**	**SD**	**T Statistics**	**p values**
SC >>> IM >>>PS	0.52	0.077	6.52	0.000

Hypothesis Results

"The Soft Competencies of Project Manager have a positive impact on Sustainability of Project."

According to the data analysis results, there is a strong impact of project manager soft competencies and the sustainability of the project as shown by the beta coefficient value of 0.128 and t value was 3.345 with p less than

0.001. That means that hypothesis H1 is accepted and that means the soft competencies of a project manager have a positive impact on the sustainability of the project.

"The Soft Competencies of Project Manager have a significant impact on the Sustainability of Project."

For hypothesis H2 the values of beta and t along with the p-value are 0.931, 60.064, and 0.00 respectively show proves that hypothesis H2 is true and the soft competencies of the project manager have a direct positive impact on the innovation management factor in the project.

"The Innovation Management significantly impacts Project Sustainability."

The analysis reveals that the beta coefficient for the relationship between innovation and project sustainability is 0.859, supporting the hypothesis that "Innovation Management significantly impacts project sustainability." The findings demonstrate that innovation exerts a positive and substantial effect on project sustainability (β= 0.855, t-value = 22.844, $p < 0.001$). Specifically, a one-unit increase in innovation is predicted to enhance project sustainability by 0.855 units on average. This outcome validates the hypothesis (H3) and rejects the null hypothesis. Furthermore, the results align with the study's research question exploring the influence of project innovation on project sustainability and fulfill the objective of examining this influence comprehensively.

"The Innovation Management has a significant impact on Project Sustainability."

The high value of mean i-e 0.855 proves the positive relationship between variables of hypothesis H3. So Innovation management in project management has a direct positive influence on the sustainability of the project.

"The Innovation Management considerably mediates the relationship of Soft Competencies and Sustainability of Project."

In the table of Specific indirect effects, the sample value of 0.520 proves that the mediating effect of innovation management on the positive influence of competencies of project managers on sustainability is also positive. That means if the project manager increases the sustainability also increases with a ratio of 1:0.52 with innovation management.

DISCUSSION

The results of this study offer significant insights into the complex interrelationships among project manager soft competencies, innovation management, and project sustainability within the IT sector of an emerging economy. The findings reinforce the hypothesis that soft competencies significantly influence both innovation management and sustainability outcomes. Moreover, innovation management emerged as a partial mediator, clarifying the pathway through which competencies are translated into sustainable project outcomes.

These results extend the literature on project-based sustainability by emphasizing that it is not just the structural or technical capabilities of a project team that lead to sustainable performance. Instead, the human-centered competencies, such as communication, adaptability, problem-solving, and emotional intelligence, play a central role when paired with innovation-oriented project strategies. This aligns with the management contingency theory, suggesting that sustainability-driven outcomes require adaptive, context-sensitive managerial behavior.

The mediating role of innovation management is particularly noteworthy. The results suggest that innovation serves as the operational bridge between people-oriented competencies and the broader goal of sustainability. Managers who are more effective in leveraging innovation tools and techniques tend to implement sustainable practices more successfully. This supports the theory of sustainability in projects, which promotes innovation as a core enabler of sustainability, particularly in contexts of environmental uncertainty and economic transition.

These findings reflect the Sustainability Nexus, a dynamic interface between human capital (soft skills), organizational innovation, and sustainable outcomes. In digitalized and knowledge-intensive industries like IT, this nexus is essential for fostering long-term project value, organizational resilience, and competitiveness.

In summary, the study validates that project sustainability is not merely an end goal, but an outcome shaped by interacting layers of competencies and innovation capacity. These insights contribute to a growing body of research that views sustainability as an emergent result of competency-based leadership and innovation-led execution.

CONCLUSION

This study aimed to explore the impact of project managers' soft competencies on project sustainability, while also examining the mediating role of innovation management within the Hungarian IT sector. Drawing upon responses from 272 organizations, the empirical results confirmed a significant and positive relationship between soft competencies and sustainability outcomes. Furthermore, innovation management was found to partially mediate this relationship, suggesting it functions as a critical mechanism for enhancing sustainable project performance.

Theoretical Contributions

This research contributes to the evolving discourse at the intersection of project management, innovation, and sustainability. First, it extends existing competency-based models by empirically demonstrating that soft skills, such as adaptability, communication, and emotional intelligence, are not just peripheral capabilities, but central drivers of sustainability in project environments. Second, the study reinforces the importance of innovation management as an enabling conduit through which these soft competencies translate into sustainable outcomes. By doing so, the findings advance current understanding of the sustainability–competency–innovation nexus, a relatively underexplored dimension in project management literature, particularly in emerging European economies.

Additionally, the research confirms and deepens existing theory by validating relationships previously observed in other contexts; while providing context-specific evidence from Hungary, a transitional economy where digital transformation and sustainability remain evolving priorities. In this way, the study adds regional specificity to global project management debates.

Practical Contributions

From a managerial standpoint, the study highlights the pressing need for strategic investment in soft skills development for project leaders. The findings suggest that Hungarian IT organizations may benefit from revisiting their training and resource allocation strategies, particularly to close competency gaps identified through qualitative responses. Cultivating a culture of innovation across the project lifecycle can amplify the effectiveness of soft competencies, thus promoting more resilient and sustainable project outcomes.

The research reinforces the imperative for organizations to treat sustainability not as a compliance exercise but as a strategic outcome, rooted in leadership competencies and dynamic innovation practices. These insights can guide HR policies, professional development programs, and sustainability-driven project frameworks.

LIMITATIONS

Despite its contributions, the study is subject to certain limitations. The sample is restricted to IT firms within Hungary, limiting the generalizability of findings across industries and regions. Furthermore, cross-sectional design limits the ability to observe long-term sustainability outcomes or dynamic competency development over time. The reliance on self-reported data also introduces the potential for response bias.

Future Research Directions

Future research can build on this study by extending the investigation to other high-impact sectors such as manufacturing, construction, or healthcare, where sustainability challenges are different yet equally pressing. Comparative cross-country studies could enrich our understanding of cultural or institutional influences on the competency, innovation–sustainability triad. Longitudinal designs are also recommended to examine how soft competencies and innovation maturity evolve over project phases.

In addition, future scholars may explore the moderating roles of digital maturity, organizational culture, or stakeholder engagement on the relationships presented here. This would offer a more nuanced understanding of how internal and external factors shape the sustainability impact of project manager competencies.

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