Building Blocks of Organizational Capability for Enhancing Sustainable Innovation in Emerging Economies

Review of Integrative Business & Economics Research

Weena Chamlertwat*
Technology Management and Innopreneurship Program,
Graduate School, Chulalongkorn University
Bangkok, Thailand

Danupol Hoonsopon
Department of Marketing, Chulalongkorn University, Bangkok, Thailand

Vitara Pungpapong
Department of Statistic, Chulalongkorn University, Bangkok, Thailand

ABSTRACT

This study assesses the sustainable innovation development potential of organizations in emerging economies, with a focus on the multidimensional framework of organizational capabilities. Employing a structured questionnaire and leveraging responses from 224 organizations within Thailand's Industry 4.0 sectors, the research explores the influence of four key organizational capabilities—Sustainability Orientation, Systemic Thinking, Stakeholder Inclusion, and Resilience—on Sustainable Innovation. The methodology encompasses Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM) to validate the measurement model and to analyze the structural relationships within the proposed framework. The results demonstrate a statistically significant positive impact of each capability on Sustainable Innovation, validating the hypothesized model. The study concludes that these organizational capabilities are crucial drivers of sustainable innovation. For businesses operating in the dynamic context of emerging economies, fostering these capabilities is essential for achieving long-term sustainability and innovation success. The research contributes to both theoretical understanding and practical applications in sustainable development, providing strategic insights for businesses and policymakers in emerging economies.

Keywords: Organizational Capabilities, Sustainable Innovation, Emerging Economies, Sustainable Development.

Received 11 January 2024 | Revised 5 August 2024 | Accepted 10 September 2024.

1. INTRODUCTION

Organizational capabilities need to evolve to effectively support sustainable innovation, a critical response as the global business landscape undergoes rapid transformations influenced by environmental and social pressures (Benn et al., 2014; Sannamwong et al., 2023). This evolution is particularly crucial for organizations in emerging economies, where rapid technological advancements and shifting economic dynamics present both significant challenges and opportunities (Kuo et al., 2022).

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

Although extensive research exists on sustainable innovation and organizational capabilities, particularly in Western contexts, there is a noticeable gap in understanding their synergistic effects within the technologically advanced settings of Industry 4.0 in emerging markets. Previous studies often emphasize the importance of strategic orientations and innovation capabilities but typically overlook how these elements interact within such contexts (Heenkenda et al., 2022; Wetering et al., 2017; Yu et al., 2013). Additionally, the roles of sustainability orientation, systemic thinking, stakeholder inclusion, and resilience in enhancing sustainable innovation remain underexplored, especially in the unique environments of emerging economies.

Thailand exemplifies an emerging economy with distinctive characteristics ideal for this study. The country is currently undergoing significant economic transformation, highlighted by the government's strategic focus on innovation and sustainability through the Thailand 4.0 policy. This initiative aims to transition Thailand from a middle-income to a high-income nation by fostering development through high-tech industries and a digital economy (Puriwat & Tripopsakul, 2020). The unique blend of challenges and opportunities present in Thailand makes it a representative model for examining sustainable innovation dynamics. This paper proposes a framework to identify key organizational capabilities necessary for driving sustainable innovation in such contexts, aiming to enrich academic discourse and offer actionable insights. By reviewing literature and conducting empirical analysis, this research seeks to close the existing knowledge gap, providing guidelines for organizations aiming to leverage sustainable practices for economic growth and development in emerging markets.

2. LITERATURE REVIEW

2.1 Sustainable Innovation in Emerging Economies

Sustainable innovation is increasingly recognized as a key driver of transformation in business and society, offering solutions to global challenges while simultaneously opening new paths for economic development. This shift extends beyond economic and technological progress to include environmental protection and social welfare (Boons et al., 2013). It involves creating products, services, and processes that generate economic value while benefiting society and the environment (Adams et al., 2016). Emerging economies, at the intersection of globalization and technological advancement, find sustainable innovation to be an indispensable tool for harmonizing swift industrial expansion with the mandates of sustainability. This innovation paradigm enables these economies to leapfrog into advanced sustainable practices, leveraging their emerging tech and innovation capabilities to tackle both local and global sustainability challenges (Yap et al., 2022). Nevertheless, the journey towards embedding sustainable innovation is fraught with challenges, including socio-economic disparities, institutional obstacles, and technological challenges (Alam et al., 2019; Luthra & Mangla, 2018; Zapata-Cantu & González, 2021). Therefore, for emerging economies to foster sustainable innovations amid these challenges, there must be a concerted effort to develop and leverage essential organizational capabilities.

2.2 Organizational Capability in Developing Sustainable Innovation

Organizational capability for sustainable innovation combines a diverse set of skills, knowledge, and processes that enable firms to create value sustainably. Beyond mere resource aggregation, it integrates knowledge and human interactions within a dynamic framework that promotes behavioral adaptation (Spanos & Prastacos, 2004). Key to this

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

capability are four principles: Sustainability Orientation, Systemic Thinking, Stakeholder Inclusion, and Resilience, each vital for effectively addressing sustainability challenges.

2.2.1 Sustainability Orientation

Sustainability orientation reflects an organization's commitment to embedding sustainability deeply within its culture and operations, directly influencing strategic and daily decisions towards sustainable outcomes. Linnenluecke and Griffiths (2010) underline the vital connection between an organization's cultural orientation and its commitment to sustainability principles. They argue that embracing a culture oriented towards sustainability is key to effectively adopting these principles, underscoring the role of cultural alignment in fostering sustainable innovation. Furthering this perspective, Cheng (2020) demonstrates how a strong sustainability orientation enables more efficient resource allocation towards the creation of green products, thus enhancing a firm's performance in green innovation. Further, the specific aspects of sustainability orientation:

Value Alignment – Integrating sustainability principles into an organization's core values significantly bolsters its overall sustainability orientation, embedding these principles deeply within its identity and culture. This integration guides organizational behavior and decision-making towards sustainability goals and is crucial for adopting green practices within the supply chain, highlighting the role of leadership's sustainability orientation (Feng et al., 2022). This approach underscores the critical role of value alignment in cultivating a comprehensive sustainability orientation within organizations.

Strategy Alignment – Aligning organizational strategies with sustainability principles enhances the organization's sustainability orientation by ensuring that business practices and innovations are geared towards sustainable outcomes. This strategic alignment embeds sustainability into the core strategy of the organization, impacting both long-term objectives and everyday operations. The integration of sustainability principles into strategic planning is crucial for boosting organizational performance and reinforcing a strong sustainability orientation (Tourani & Khatibi, 2020).

Commitment – An organization's commitment to sustainability, demonstrated through active engagement in sustainable practices, investments in sustainability initiatives, and continuous improvement in sustainability performance, is essential for deepening its sustainability orientation. This strong commitment serves as a catalyst, reinforcing the organization's identity and culture around sustainability principles. Linnenluecke and Griffiths (2010) emphasize that such commitment crucial for fostering a culture inherently supportive of sustainable practices and orientations. This underscores the vital role of organizational commitment to sustainability in promoting a deeper orientation towards sustainability within the organization.

Based on these considerations, the following hypothesis is proposed:

H1: Sustainability orientation positively influences the development of sustainable innovation.

2.2.2 Systemic Thinking

Systemic thinking is a holistic approach that views the world as a network of interconnected systems, emphasizing the interdependence of components within a cohesive whole (Meadows, 2008). This approach is grounded in the principle that the behavior of any part

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

affects the entire system, highlighting the importance of understanding relationships, interactions, and contexts (Williams et al., 2017). In sustainable innovation, systemic thinking gains importance by recognizing the links among ecological, social, and economic systems (Holling, 2001). It offers a comprehensive framework for tackling sustainability's complex challenges, emphasizing the role of interconnectivity, feedback loops, and the management of emergence in fostering sustainable innovation (Williams et al., 2017). Further, the specific aspects of systemic thinking:

Interconnectivity – Acknowledging the complex interplay among system components, interconnectivity serves as a foundational element that enriches systemic thinking. It underscores the significance of understanding how environmental, social, and economic factors are interwoven, essential for navigating complex systems. This fundamental interconnectedness is instrumental in enhancing the systemic perspective, facilitating a holistic approach to problem-solving and decision-making. The principle of interconnectivity, by emphasizing the relationships within systems, directly contributes to a more profound systemic understanding (Johanessen et al., 1999; Kanda et al., 2020) Such a perspective is vital in enabling individuals and organizations to think systemically, addressing the roots of complex issues in a cohesive manner.

Feedback Loops – Providing a mechanism for understanding the dynamic interactions within complex systems. These loops play a crucial role in analyzing how changes within one part of a system can influence other parts, leading to a deeper understanding of systemic behaviors and facilitating the development of more sustainable and innovative solutions. Atwater and Pittman (2006) suggesting that attention to feedback loops can significantly enhance systemic thinking skills across various domains. Similarly, Hokayem et al. (2019) focus on feedback loop reasoning in ecology, demonstrating its critical role in understanding interactions among organisms in ecosystems and highlighting its contribution to enhancing systemic thinking.

Managing Emergence – Navigating through and harnessing the complex, unpredictable outcomes from interactions within systems, managing emergence is essential for refining systemic thinking. It involves pinpointing and leveraging new patterns and behaviors that arise not from individual components but from their collective dynamics. Hovorka and Germonprez (2013) highlight its importance in the context of technology and organizations, where managing emergence helps grasp the impact of technological innovations. Furthermore, Kemenade (2019) discusses how emergent patterns from the network of interactions can significantly influence organizational practices and outcomes, highlighting the general applicability of managing emergence across various contexts. This approach enriches systemic thinking by offering deep insights into complex systems.

Based on these considerations, the following hypothesis is proposed:

H2: Systemic Thinking positively influences the development of sustainable innovation.

2.2.3 Stakeholder Inclusion

Organizations are recognizing that sustainability challenges extend beyond their boundaries, affecting the broader social, environmental, and economic systems they are part of (Bocken et al., 2014). By identifying relevant stakeholders, engaging them, and being responsive to their concerns, organizations can leverage diverse knowledge, perspectives, and resources (Bundy et al., 2013; Jayashree et al., 2022; Reed et al., 2009).

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

This inclusive strategy promotes an innovative and creative environment by tapping into the collective intelligence and capabilities of stakeholders (Jayashree et al., 2022). Further, the specific aspects of stakeholder inclusion:

Stakeholder Identification – Enabling organizations to navigate and recognize the network of parties that can affect or be affected by their activities (Freeman, 2010). This identification process is essential for developing strategies that encompass the perspectives and needs of diverse stakeholders, thereby helping organizations understand the broader impacts of their actions. The identification of stakeholder attributes is crucial for managing stakeholder relationships effectively (Parent & Deephouse, 2007) thereby facilitating stakeholder inclusion in organizational processes.

Stakeholder Engagement – Involving stakeholders actively in the decision-making processes of an organization, especially in sustainability-related strategies and actions, reflects a commitment to inclusivity and collaboration (Freeman, 2010). It extends beyond the initial identification of stakeholders to involve them directly in dialogue and collaboration, aiming to harness diverse perspectives, skills, and knowledge for the development and implementation of organizational initiatives (Manetti, 2011; Reed, 2008). This form of engagement is fundamental in building and maintaining relationships with stakeholders. By proactively engaging stakeholders, organizations can foster increased trust and a deeper mutual understanding, essential for achieving comprehensive stakeholder inclusion (Bhattacharya et al., 2009).

Responsiveness – Demonstrating an organization's ability to attentively listen, understand, and act upon the concerns and needs of its stakeholders (Bundy et al., 2013; Freeman, 2010). It transcends merely acknowledging stakeholders' perspectives to actively adapting practices and strategies in alignment with their expectations. Example of responsiveness include the introduction of new products or services designed to meet stakeholder demands, the adjustment of organizational strategies to societal expectations, and the enactment of changes based on stakeholder feedback (Silva et al., 2019). Through such responsiveness, organizations can strengthen relationships and trust with stakeholders, and ultimately enhance their reputation and legitimacy (Rödl et al., 2022).

Based on these considerations, the following hypothesis is proposed:

H3: Stakeholder Inclusion positively influences the development of sustainable innovation.

2.2.4 Resilience

The concept of resilience focuses on an organization’s capacity to anticipate, cope with, and adapt to disruptions (Bhamra et al., 2011; Duchek, 2020). It is increasingly recognized as a critical attribute that enables organizations to maintain operational continuity and adaptability in the face of internal and external challenges (Hoonsopon & Puriwat, 2021). This capability is essential for fostering an environment conducive to sustainable innovation, where economic viability is harmoniously integrated with environmental and social responsibilities (Linnenluecke, 2017). Therefore, resilient organizations are better positioned to implement innovative solutions that address complex sustainability challenges. They achieve this by leveraging disturbances as opportunities for learning and growth, rather than simply viewing them as obstacles to overcome. Further, the specific aspects of resilience:

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

Anticipation – Envisioning future challenges, this capability involves an organization's ability to detect, interpret, and prepare for potential disruptions (Duchek, 2020). By developing anticipatory capabilities, organizations can stay ahead of changes, strategically preparing and planning to mitigate the impact of potential disturbances (Puriwat & Hoonsopon, 2022). This proactive approach is essential for building systemic resilience, by allowing organizations to maintain functionality and adapt in the face of adversities.

Coping – Managing and mitigating the effects of crises as they occur, this refers to the actions and decisions an organization takes in response to immediate disturbances (Duchek, 2020). Organizations with a high capacity for coping can not only minimize damage and maintain operations during unexpected sustainability challenges but can also uncover potential opportunities within the disruption (Levänen et al., 2023). This transformative approach to coping is critical for resilience, encouraging organizations to innovate and develop novel solutions that not only overcome disturbances but also enhance their operational state.

Adaptation – Enhancing organizational resilience by learning from past events and refining strategies for better preparedness, this capability allows organizations to effectively respond to future disturbances (Duchek, 2020). This process of adaptation also involves mitigating risks associated with sustainability-related challenges, thus enhancing the long-term viability of the organization (Bansal & DesJardine, 2014). By continually adapting, organizations maintain functionality amid challenges, which bolsters overall resilience and ensures they are better equipped to manage and thrive through adversity.

Based on these considerations, the following hypothesis is proposed:

H4: Resilience positively influences the development of sustainable innovation.

2.3 Conceptual Framework

Building on the comprehensive analysis, the proposed conceptual framework integrates the key organizational capabilities—Sustainability Orientation, Systemic Thinking, Stakeholder Inclusion, and Resilience. It explores how these capabilities interact to influence sustainable innovation within organizations, with hypotheses H1 through H4 and their respective components delineating the specific pathways and relationships that drive this dynamic process.

3. METHODOLOGY

3.1 Population and Sample Size

This study targeted businesses operating within Thailand's Industry 4.0 sector as defined by the Thailand 4.0 development plan, which focuses on 10 targeted industries. These industries include Next-Generation Automotive, Smart Electronics, Affluent Medical and Wellness Tourism, Agriculture and Biotechnology, Food for the Future, Robotics, Aviation and Logistics, Biofuels and Biochemicals, Medical Hub, and Digital. The sample included responses from over 200 businesses across these sectors. This specific sample size was selected due to the complexity of the models and the necessity to encompass a broad spectrum of perspectives from diverse industries, thereby enhancing the robustness and reliability of the study's findings (Hair et al., 2010).

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

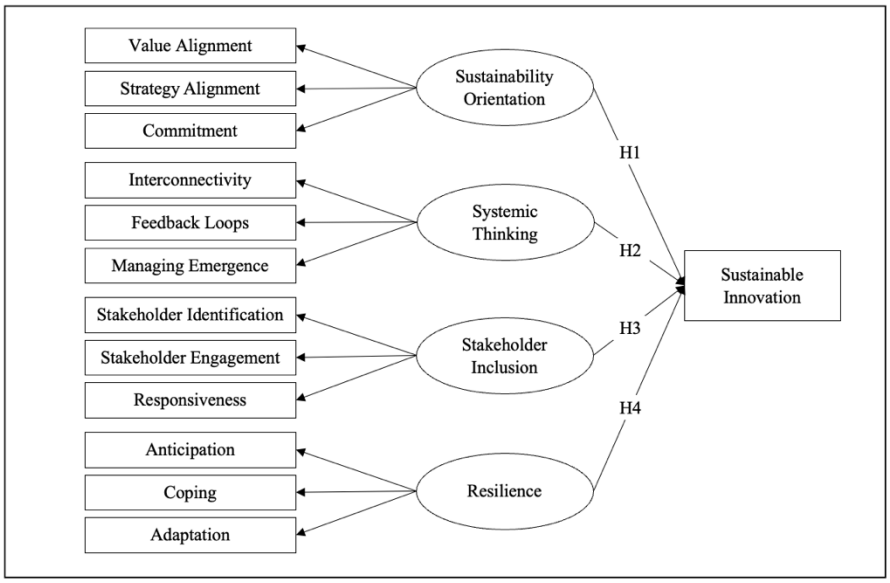

Figure 1: Conceptual Framework

3.2 Instrument Design

The instrument used in this study is a structured questionnaire designed to assess sustainable innovation dimensions within organizations. It was developed from the conceptual framework outlined in the literature review, which identifies four key principles and their respective dimensions. The questionnaire utilizes a 5-point Likert scale, from "strongly disagree" to "strongly agree," allowing for detailed measurement of responses relevant to the study's focus on organizational capabilities and sustainable innovation.

3.3 Data Collection

Data were collected using a combination of purposive and snowball sampling techniques. Purposive sampling was employed initially to identify and select participants who are directly involved in sustainability and innovation roles within the Industry 4.0 context. This approach ensures that the data gathered are relevant to the study's objectives. Following this, snowball sampling was used to expand the sample by asking initial respondents to recommend other potential participants who meet the study criteria. This method helps in reaching a broader network of respondents, potentially uncovering insights from within the industry that are not accessible through simple random sampling.

3.4 Data Analysis

After data collection, the dataset was cleaned to remove missing data and checked for outliers and multicollinearity. Subsequent steps included testing for reliability to confirm the consistency of the responses and for validity to ensure the questionnaire accurately measured the intended constructs. Once the data’s reliability and validity were established, Confirmatory Factor Analysis (CFA) was conducted to validate the measurement model of each construct. This step was crucial to confirm that the observed variables correctly represented their respective latent constructs as per the theoretical framework. Following these tests, Structural Equation Modeling (SEM) was employed to analyze the hypothesized relationships.

4. RESULT & DISCUSSION

4.1 Data Preparation and Descriptive Statistics

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

The study initially collected responses from a total of 232 participants. Upon examining, it was identified that 2 respondents did not give their consent, and 6 were not from the targeted industry. Consequently, these responses were excluded, leaving a valid sample of 224 for further analysis.

To ensure data accuracy, the Z-score method was used to identify outliers by calculating how many standard deviations a data point is from the mean. Data points with Z-scores exceeding ±3 standard deviations are typically considered outliers (Hair et al., 2010). However, no data points in this study exceeded this threshold, confirming the dataset's suitability for subsequent statistical analysis without significant outliers. Furthermore, in assessing multicollinearity, Tolerance and Variance Inflation Factor (VIF) metrics were employed. The tolerance values ranged from 0.242 to 0.365 and VIF values from 2.743 to 4.14. According to Hair et al. (2010), significant multicollinearity is indicated by tolerance below 0.20 and VIF above 5. As the observed values in this dataset do not exceed these thresholds, multicollinearity is not considered significant.

Respondent demographics show varied engagement across industries, with sectors like Food for the Future, Agriculture and Biotechnology, and Digital Technologies having the highest participation due to their growth and innovation potential. In contrast, Aviation and Logistics had minimal engagement, reflecting the smaller size of these sectors.

Table 1: Respondent Demographics

Industry Sector	**Frequency**	**%**
Next-Generation Automotive	18	8.04%
Smart Electronics	27	12.05%
Affluent Medical and Wellness Tourism	31	13.84%
Agriculture and Biotechnology	32	14.29%
Food for the Future	41	18.30%
Robotics	11	4.91%
Aviation and Logistics	2	0.89%
Biofuels and Biochemicals	17	7.59%
Medical Hub	13	5.80%
Digital	32	14.29%
Total	**224**	**100.00%**

4.2 Reliability and Validity Testing

The reliability and validity testing for the constructs in this study are thoroughly detailed in Table 2, showcasing the robustness of the measurement model. This table shows that all factor loadings (λ) for each item exceeded the threshold of 0.7, confirming strong indicator reliability (Hair et al., 2010). Additionally, it presents Cronbach's Alpha (α) and Composite Reliability (CR) scores for all constructs, which were above 0.7, indicating high internal consistency (Hair et al., 2010). Furthermore, the Average Variance Extracted (AVE) for each construct exceeded the threshold of 0.5, ensuring a satisfactory level of convergent validity (Fornell & Larcker, 1981; Hair et al., 2010). These results collectively validate the measurement model, establishing a solid foundation for conducting further structural analyses to explore the hypothesized relationships.

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

Table 2: Reliability and Validity Testing Result

Construct	Item	Statement	λ
Sustainability Orientation: Adapted from Wijethilake and Lama (2019), Baumgartner and Ebner (2010), Kaplan and Norton (2008), and Greiner and Sun (2021)			
Value Alignment (VA) α: 0.902 CR: 0.902 AVE: 0.755	VA1	The core values of our organization align with sustainability principles.	0.870
	VA2	The organization's core values guide us in making decisions that are oriented towards sustainability.	0.870
	VA3	The core values of our organization have shaped our approach to sustainable innovation.	0.866
Strategy Alignment (SA) α: 0.894 CR: 0.894 AVE: 0.738	SA1	Our organizational strategy integrates principles of sustainability.	0.855
	SA2	Our strategic planning process includes explicit considerations of sustainability.	0.860
	SA3	Our organization has a defined strategy to achieve sustainable innovation.	0.862
Commitment (CM) α: 0.887 CR: 0.887 AVE: 0.723	CM1	Our organization demonstrates a strong commitment to sustainability.	0.848
	CM2	Our organization continuously invests in initiatives that promote sustainability.	0.833
	CM3	All levels of our organization, from top management to employees, are committed to sustainability.	0.870
Systemic Thinking: Adapted from Sterman (2001), Williams et al. (2017), Wong and Fong (2011), Schlüter et al. (2023), and Walker and Salt (2006)			
Interconnectivity (IC) α: 0.861 CR: 0.862 AVE: 0.675	IC1	Our organization acknowledges and considers the ripple effects of our actions on the larger system within which we operate.	0.827
	IC2	Our organization considers the interconnections within the broader system in which we operate and engage in external collaborations.	0.794
	IC3	Our organization analyzes the possible impacts of our decisions on other parts of the system and adjust accordingly.	0.843
Feedback Loops (FL) α: 0.887 CR: 0.887 AVE: 0.723	FL1	Our organization considers feedback from past actions to inform our future decisions.	0.833
	FL2	Our organization uses feedback loops to understand the potential implications of our innovations.	0.843
	FL3	Our organization adjusts its strategies based on the understanding of positive and negative feedback loops.	0.875
Managing Emergence (ME) α: 0.876 CR: 0.876 AVE: 0.701	ME1	Our organization is proactive in identifying and responding to emergent trends that could impact our sustainability efforts.	0.846
	ME2	Our organization is adept at adapting to emergent changes and harnessing them for sustainable innovation.	0.818
	ME3	Our organization's structures and processes are designed to facilitate the emergence and development of sustainable innovations.	0.848
Stakeholder Inclusion: Adapted from Freeman (2010), Jayashree et al. (2022), Manetti (2011), Reed (2008), Rödl et al. (2022), and Silva et al. (2019)			
Stakeholder Identification (SI) α: 0.875	SI1	Our organization systematically identifies all potential stakeholders who may affect or be affected by our sustainability initiatives.	0.832
	SI2	Stakeholder identification is a critical part of our strategic decision-making process for sustainability.	0.842

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

CR: 0.876 AVE: 0.701	SI3	Our organization keeps track of changes in our stakeholder landscape and updates our stakeholder list accordingly.	0.838
Stakeholder Engagement (SE) α: 0.870 CR: 0.871 AVE: 0.692	SE1	Our organization actively invites stakeholders to contribute their ideas and perspectives towards our sustainability initiatives.	0.828
	SE2	Stakeholder engagement in our organization has led to the co-creation of innovative solutions for sustainability.	0.833
	SE3	Our organization regularly involves stakeholders in decision-making processes related to sustainability initiatives.	0.835
Responsiveness (RS) α: 0.874 CR: 0.875 AVE: 0.700	RS1	Our organization takes into account the concerns and needs of our stakeholders when making decisions related to sustainability.	0.853
	RS2	Our organization implements changes in response to stakeholder feedback related to sustainability.	0.811
	RS3	The feedback from our stakeholders influences our sustainability-oriented innovation efforts.	0.845
Resilience: Adapted from Duchek (2020), Rohrbeck and Kum (2018), Berman et al. (2012), Levänen et al. (2023), Szemző et al. (2022), and Zanotti et al. (2020)			
Anticipation (AC) α: 0.884 CR: 0.887 AVE: 0.724	AC1	Our organization actively anticipates and prepare for future sustainability trends and changes.	0.823
	AC2	Our organization often identifies potential sustainability challenges before they occur.	0.868
	AC3	Our organization actively anticipates market shifts, emerging technologies, and regulatory changes to steer our sustainability initiatives.	0.859
Coping (CP) α: 0.887 CR: 0.887 AVE: 0.724	CP1	When unexpected events occur, our organization effectively manages the immediate impacts.	0.869
	CP2	Our organization uses unexpected events as opportunities to innovate and improve our operations.	0.831
	CP3	Our organization transforms rather than merely restores the system in response to disturbances.	0.852
Adaptation (AD) α: 0.888 CR: 0.889 AVE: 0.727	AD1	In response to emerging sustainability opportunities or challenges, our organization promptly adapts by modifying strategies, structure, or processes to ensure alignment with these new circumstances.	0.855
	AD2	Our organization has a process in place to learn from past events, thereby improving our preparedness to better manage future uncertainties.	0.846
	AD3	Our organization actively seeks out and implements innovative solutions to enhance our sustainability performance in response to changing circumstances.	0.857
Sustianable Innovation: Adapted from Boons et al. (2013), and (Elkington, 1997).			
Sustainable Innovation (IN) α: 0.945 CR: 0.955 AVE: 0.875	IN1	Our innovations contribute to the organization's long-term sustainability.	0.935
	IN2	Our innovations provide environmental, economic, and social benefits.	0.934
	IN3	Our organization is recognized for its sustainable innovation efforts.	0.938

4.3 Confirmed Factor Loading

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

The Confirmatory Factor Analysis (CFA) outcomes, as outlined in Table 3, provide comprehensive metrics including standardized estimates (β), unstandardized estimates (*b*), standard errors (*S.E.*), and R-squared values. These measure the adequacy of each latent variable's representation by its indicators and the strength of relationships within the model. The CFA tested various structural paths across the constructs, such as the influence of Sustainability Orientation on foundational elements like Value Alignment (VA), Strategy Alignment (SA), and Commitment (CM), as well as the impact of all 4 organizational capabilities on Sustainable Innovation.

Table 3: Confirmed Factor Loading (CFA) Testing Result

	Sustainability Orientation			Systemic Thinking			Stakeholder Inclusion			Resilience			R^2
	β	*b*	*S.E.*	β	*b*	*S.E.*	β	*b*	*S.E.*	β	*b*	*S.E.*	
VA	.972***	1.00											.945
SA	.962***	.941	.060										.925
CM	.967***	.973	.060										.935
IC				.963***	1.00								.927
FL				.930***	.974	.071							.864
ME				.984***	.983	.067							.969
SI							.970***	1.00					.940
SE							.970***	.929	.065				.941
RS							.955***	.990	.069				.911
AC										.955***	1.00		.912
CP										.956***	.940	.063	.914
AD										.948***	.990	.067	.899
IN	.295***	.591	.151	.214**	.484	.167	.228**	.513	.185	.276**	.602	.201	.953

Notes: *** p-value ≤ 0.001; ** p-value ≤ 0.01

The model's fit was evaluated against recognized standards, with the chi-square (χ^2) value of 707.970 and degrees of freedom (df) = 678 resulting in a relative chi-square of 1.044 and a p-value of 0.206. This relative chi-square is well below the threshold of 3, as indicated by Kline (2015) as an acceptable fit and even remains within the more lenient allowance of up to 5 (Schumacker & Lomax, 2004). The Normed Fit Index (NFI) at 0.925 and the Tucker-Lewis Index (TLI) at 0.996, both exceeded the critical value of 0.9, which according to Bentler and Bonett (1980) is indicative of a strong fit. Furthermore, both the Root Mean Square Error of Approximation (RMSEA) at 0.014 and the Root Mean Square Residual (RMR) at 0.024 are below the 0.05 threshold, indicating that they are well within the acceptable limits (MacCallum et al., 1996). These results collectively affirm the model's robustness and its adherence to empirical data, as per the established thresholds.

The favorable outcomes from the CFA validate the theoretical framework posited for the study, demonstrating that the latent constructs are statistically valid. The robust fit indices confirm that the constructs and their interconnections are well-grounded in empirical data, providing a strong foundation for exploring the impacts of organizational capabilities on sustainable innovation. The clear adherence to the proposed relationships and high levels of explained variance across constructs underscore the relevance and applicability of the model in understanding complex interactions.

4.4 Hypotheses Testing

The hypotheses testing, encapsulated in Table 4, offered substantiated insights into the predictive power of various organizational capabilities on Sustainable Innovation.

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

H1: The positive and substantial estimate of 0.295 for the path from Sustainability Orientation to Sustainable Innovation, significant at the p-value ≤ 0.001 level, corroborates the hypothesis. This result underscores the pivotal role of Sustainability Orientation in guiding organizations towards innovation that adheres to sustainable principles, suggesting that organizations with a strong emphasis on sustainability are more likely to achieve sustainable innovative outcomes.

H2: The estimate of 0.214 for Systemic Thinking's impact on Sustainable Innovation, significant at the p-value ≤ 0.01, supports the hypothesis, indicating that the ability to think systemically and comprehend interdependencies within an organization fosters innovative capabilities that align with sustainable development.

H3: With an estimate of 0.228, the relationship between Stakeholder Inclusion and Sustainable Innovation was significant at the p-value ≤ 0.01, affirming the hypothesis. This result emphasizes that incorporating diverse stakeholder perspectives into organizational processes is a catalyst for innovation, enhancing the alignment between organizational strategies and sustainability goals.

H4: Finally, the estimate of 0.276 for the influence of Resilience on Sustainable Innovation, significant at the p-value ≤ 0.01, supports the hypothesis. It reflects the crucial contribution of an organization's resilience—its capacity to withstand and learn from disruptions—in driving sustainable innovation forward.

Table 4: Hypotheses Testing Result

Hypothesis	Relationship	Estimates	Supported
H1	Sustainability Orientation → Sustainable Innovation	0.295^{***}	Yes
H2	Systemic Thinking → Sustainable Innovation	0.214^{**}	Yes
H3	Stakeholder Inclusion → Sustainable Innovation	0.228^{**}	Yes
H4	Resilience → Sustainable Innovation	0.276^{**}	Yes

Notes: *** p-value ≤ 0.001; ** p-value ≤ 0.01 / $R^2 = 0.953$

4.5 Discussion

This study has illuminated the multifaceted nature of sustainable innovation within emerging economies, particularly within the context of Industry 4.0. The results demonstrate that various organizational capabilities are not merely beneficial but essential for fostering sustainable innovation. These capabilities interact in complex ways that significantly influence the ability of organizations to achieve sustainable outcomes.

4.5.1 Theoretical Contributions

This paper contributes to the theoretical understanding of sustainable innovation and organizational capabilities in emerging economies, closing the research gap by examining how these capabilities integrate within the context of Industry 4.0 in emerging markets. Prior studies have highlighted the importance of strategic orientations and innovation capabilities but often overlooked their interaction (Heenkenda et al., 2022; Wetering et al., 2017; Yu et al., 2013). This research enriches understanding by detailing how elements such as sustainability orientation, systemic thinking, stakeholder inclusion, and resilience enhance sustainable innovation in these environments. The study provides empirical evidence on the implementation of these capabilities within Thailand’s Industry 4.0 framework. This contribution is pivotal for understanding the transformative potential of

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

integrating advanced technologies with sustainable practices in the business strategies of emerging economies.

4.5.2 Managerial Implications

This paper highlights crucial implications for organizations in emerging economies navigating Industry 4.0, emphasizing the integration of organizational capabilities with sustainable innovation to boost competitiveness and ensure long-term viability. Organizations are advised to strategically integrate sustainability into their business operations, enhance systemic thinking to manage interdependencies effectively, and engage stakeholders actively to foster inclusive innovation practices. Building resilience is also vital, as it equips organizations to swiftly adapt to market changes and unexpected challenges (Weerapattanawong et al., 2022). By leveraging these insights, organizations can not only address local challenges but also enhance their global competitiveness, positioning themselves strategically for sustainable growth and innovation in the dynamic landscape of emerging markets.

5. CONCLUSION

This research explores the interaction between organizational capabilities and sustainable innovation within Thailand's Industry 4.0 framework, analyzing data from 224 organizations across various sectors. The study confirms that Sustainability Orientation, Systemic Thinking, Stakeholder Inclusion, and Resilience significantly enhance an organization's ability to innovate sustainably. The integration of sustainability into core business strategies is no longer optional but a critical driver of innovation and long-term viability (Hidayah & Kartikadevi, 2021). Thus, embedding a sustainability orientation is the most importance, serving as a foundation for sustainable growth. Following closely in priority is resilience, which equips organizations to adapt and thrive amidst challenges. Stakeholder inclusion is also crucial, as it ensures a diverse range of perspectives and interests are considered. Lastly, systemic thinking, allowing for a holistic understanding of complex systems and their interdependencies, thus completing the suite of indispensable traits for modern organizations. Such a commitment can transform challenges into sustainable opportunities, positioning organizations for future success and ultimately enhancing company value (Chao & Ho, 2019).

5.1 Limitations and Directions for Future Research

This study sheds light on how organizational capabilities integrate with sustainable innovation within Thailand's Industry 4.0, yet its findings may not fully apply to other emerging economies due to varied socio-economic and technological contexts. Future research could expand these insights by conducting comparative studies across various emerging markets and delving into sector-specific dynamics within key industries. Moreover, the study's cross-sectional design limits its ability to track the long-term development and impact of these capabilities. Adopting a longitudinal approach would deepen understanding of how these capabilities evolve and affect firm performance over time. Additionally, while the study touches on the influence of cultural and regulatory factors, a more detailed examination of how cultural diversity and regulatory environments influence sustainable innovation strategies is needed. Addressing these gaps would enhance the understanding of sustainable innovation, offering valuable theoretical and practical insights across various economic and cultural settings.

ACKNOWLEDGEMENTS

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

The authors extend sincere gratitude to all respondents for their invaluable contributions to this study and thank the anonymous reviewer for their insightful comments and suggestions, which have significantly enhanced the quality and depth of our findings.

REFERENCES

[1] Adams, R., Jeanrenaud, S., Bessant, J., Denyer, D., & Overy, P. (2016), "Sustainability-oriented Innovation: A Systematic Review", *International Journal of Management Reviews*, *18*(2), 180-205.
[2] Alam, A., Uddin, M., & Yazdifar, H. (2019), "Institutional determinants of R&D investment: Evidence from emerging markets", *Technological Forecasting and Social Change*, *138*, 34-44.
[3] Atwater, J. B., & Pittman, P. H. (2006), "Facilitating Systemic Thinking in Business Classes", *Decision Sciences Journal of Innovative Education*, *4*(2), 273-292.
[4] Bansal, P., & DesJardine, M. R. (2014), "Business sustainability: It is about time", *Strategic organization*, *12*(1), 70-78.
[5] Baumgartner, R. J., & Ebner, D. (2010), "Corporate sustainability strategies: sustainability profiles and maturity levels", *Sustainable Development*, *18*(2), 76-89.
[6] Benn, S., Dunphy, D., & Griffiths, A. (2014), *Organizational change for corporate sustainability* (Third ed.), Routledge.
[7] Bentler, P. M., & Bonett, D. G. (1980), "Significance tests and goodness of fit in the analysis of covariance structures", *Psychological Bulletin*, *88*(3), 588-606.
[8] Berman, R., Quinn, C., & Paavola, J. (2012), "The role of institutions in the transformation of coping capacity to sustainable adaptive capacity", *Environmental Development*, *2*, 86-100.
[9] Bhamra, R., Dani, S., & Burnard, K. (2011), "Resilience: the concept, a literature review and future directions", *International Journal of Production Research*, *49*(18), 5375-5393.
[10] Bhattacharya, C. B., Korschun, D., & Sen, S. (2009), "Strengthening Stakeholder–Company Relationships Through Mutually Beneficial Corporate Social Responsibility Initiatives", *Journal of Business Ethics*, *85*(S2), 257-272.
[11] Bocken, N. M. P., Short, S. W., Rana, P., & Evans, S. (2014), "A literature and practice review to develop sustainable business model archetypes", *Journal of Cleaner Production*, *65*, 42-56.
[12] Boons, F., Montalvo, C., Quist, J., & Wagner, M. (2013), "Sustainable innovation, business models and economic performance: an overview", *Journal of Cleaner Production*, *45*, 1-8.
[13] Bundy, J., Shropshire, C., & Buchholtz, A. K. (2013), "Strategic Cognition and Issue Salience: Toward an Explanation of Firm Responsiveness to Stakeholder Concerns", *Academy of Management Review*, *38*(3), 352-376.
[14] Chao, C.-M., & Ho, C.-H. (2019), "The relationship between corporate social responsibility and abnormal return: Mergers and acquisitions events", *Review of Integrative Business and Economics Research*, *8*(3), 1.
[15] Cheng, C. C. J. (2020), "Sustainability Orientation, Green Supplier Involvement, and Green Innovation Performance: Evidence from Diversifying Green Entrants", *Journal of Business Ethics*, *161*(2), 393-414.
[16] Duchek, S. (2020), "Organizational resilience: a capability-based conceptualization", *Business Research*, *13*(1), 215-246.

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

[17] Elkington, J. (1997), "Cannibals with forks: The triple bottom line of 21st century business, Capstone", In: Oxford Capestone, London.
[18] Feng, T., Li, Z., Shi, H., & Jiang, W. (2022), "Translating leader sustainability orientation into green supply chain integration: a missing link of green entrepreneurial orientation", *Journal of Business & Industrial Marketing*, *37*(12), 2515-2532.
[19] Fornell, C., & Larcker, D. F. (1981), "Evaluating structural equation models with unobservable variables and measurement error", *Journal of marketing research*, *18*(1).
[20] Freeman, R. E. (2010), "*Strategic Management: A Stakeholder Approach*", Cambridge University Press.
[21] Greiner, M., & Sun, J. (2021), "How corporate social responsibility can incentivize top managers: A commitment to sustainability as an agency intervention", *Corporate Social Responsibility and Environmental Management*, *28*(4), 1360-1375.
[22] Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. (2010), "Multivariate data analysis (7th edition)", *Harlow: Pearson Education Limited*.
[23] Heenkenda, H., Xu, F., Kulathunga, K., & Senevirathne, W. (2022), "The Role of Innovation Capability in Enhancing Sustainability in SMEs: An Emerging Economy Perspective", *Sustainability*, *14*(17), 10832.
[24] Hidayah, E., & Kartikadevi, A. (2021), "The Analysis of Sustainability Report and Its Effects on Company Performance and Company Value", *Review of Integrative Business and Economics Research*, *10*, 40-54.
[25] Hokayem, H., Jin, H., & Yamaguchi, E. (2019), "Feedback Loop Reasoning and Knowledge Sources for Elementary Students in Three Countries", *EURASIA Journal of Mathematics, Science and Technology Education*, *16*(2).
[26] Holling, C. S. (2001), "Understanding the Complexity of Economic, Ecological, and Social Systems", *Ecosystems*, *4*(5), 390-405.
[27] Hoonsopon, D., & Puriwat, W. (2021), "Organizational Agility: Key to the Success of New Product Development", *IEEE transactions on engineering management*, *68*(6), 1722-1733.
[28] Hovorka, D. S., & Germonprez, M. (2013), "Perspectives on Emergence in Information Systems Research", *Communications of the Association for Information Systems*, *33*.
[29] Jayashree, P., El Barachi, M., & Hamza, F. (2022), "Practice of Sustainability Leadership: A Multi-Stakeholder Inclusive Framework", *Sustainability*, *14*(10), 6346.
[30] Johanessen, J. A., Olaisen, J., & Olsen, B. (1999), "Systemic thinking as the philosophical foundation for knowledge management and organizational learning", *Kybernetes*, *28*(1), 24-46.
[31] Kanda, W., Kuisma, M., Kivimaa, P., & Hjelm, O. (2020), "Conceptualising the systemic activities of intermediaries in sustainability transitions", *Environmental Innovation and Societal Transitions*, *36*, 449-465.
[32] Kaplan, R. S., & Norton, D. P. (2008), *The execution premium : linking strategy to operations for competitive advantage*, Harvard Businss Press.
[33] Kemenade, E. V. (2019), "Emergence in TQM, a concept analysis", *The TQM Journal*, *32*(1), 143-161.
[34] Kline, R. B. (2015), "Principles and practice of structural equation modeling", In (Fourth ed.): The Guilford Press.

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

[35] Kuo, Y.-C., Wu, Y.-M., & Liu, Y.-X. (2022), "Identifying Key Factors for Sustainable Manufacturing and Development", *Review of Integrative Business and Economics Research*, 11(1), 30-50.
[36] Levänen, J., Park, S., & Rosca, E. (2023), "Circular solutions in developing countries: Coping with sustainability tensions by means of technical functionality and business model relevance", *Business Strategy & Development*, *6*(1), 75-94.
[37] Linnenluecke, M. K. (2017), "Resilience in Business and Management Research: A Review of Influential Publications and a Research Agenda", *International Journal of Management Reviews*, *19*(1), 4-30.
[38] Linnenluecke, M. K., & Griffiths, A. (2010), "Corporate sustainability and organizational culture", *Journal of World Business*, *45*(4), 357-366.
[39] Luthra, S., & Mangla, S. K. (2018), "Evaluating challenges to Industry 4.0 initiatives for supply chain sustainability in emerging economies", *Process Safety and Environmental Protection*, *117*, 168-179.
[40] MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996), "Power analysis and determination of sample size for covariance structure modeling", *Psychological Methods*, *1*(2), 130-149.
[41] Manetti, G. (2011), "The quality of stakeholder engagement in sustainability reporting: empirical evidence and critical points", *Corporate Social Responsibility and Environmental Management*, *18*(2), 110-122.
[42] Meadows, D. H. (2008), *Thinking in systems: A primer*, chelsea green publishing.
[43] Parent, M. M., & Deephouse, D. L. (2007), "A Case Study of Stakeholder Identification and Prioritization by Managers", *Journal of Business Ethics*, *75*(1), 1-23.
[44] Puriwat, W., & Hoonsopon, D. (2022), "Cultivating product innovation performance through creativity: the impact of organizational agility and flexibility under technological turbulence", *Journal of Manufacturing Technology Management*, *33*(4), 741-762.
[45] Puriwat, W., & Tripopsakul, S. (2020), "Preparing for Industry 4.0--Will Youths Have Enough Essential Skills?: An Evidence from Thailand", *International Journal of Instruction*, *13*(3), 89-104.
[46] Reed, M. S. (2008), "Stakeholder participation for environmental management: A literature review", *Biological Conservation*, *141*(10), 2417-2431.
[47] Reed, M. S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C. H., & Stringer, L. C. (2009), "Who's in and why? A typology of stakeholder analysis methods for natural resource management", *Journal of Environmental Management*, *90*(5), 1933-1949.
[48] Rödl, M. B., Boons, F., & Spekkink, W. (2022), "From responsible to responsive innovation: A systemic and historically sensitive approach to innovation processes", *Technological Forecasting and Social Change*, *174*, 121231.
[49] Rohrbeck, R., & Kum, M. E. (2018), "Corporate foresight and its impact on firm performance: A longitudinal analysis", *Technological Forecasting and Social Change*, *129*, 105-116.
[50] Sannamwong, K., Wongkaew, W.-s., & Hoonsopon, D. (2023), "Strategic Alignment of Eco-Practices: The Mediator of Eco-Controls in Translating Environmental Strategy", *Creative Business and Sustainability Journal*, *45*.
[51] Schlüter, L., Kørnøv, L., Mortensen, L., Løkke, S., Storrs, K., Lyhne, I., & Nors, B. (2023), "Sustainable business model innovation: Design guidelines for integrating systems thinking principles in tools for early-stage sustainability assessment", *Journal of Cleaner Production*, *387*, 135776.

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

[52] Schumacker, R. E., & Lomax, R. G. (2004), "A beginner's guide to structural equation modeling", In (2nd ed.): Lawrence Erlbaum Associates.
[53] Silva, L. M. D., Bitencourt, C. C., Faccin, K., & Iakovleva, T. (2019), "The Role of Stakeholders in the Context of Responsible Innovation: A Meta-Synthesis", *Sustainability*, *11*(6), 1766.
[54] Spanos, Y. E., & Prastacos, G. (2004), "Understanding organizational capabilities: towards a conceptual framework", *Journal of Knowledge Management*, *8*(3), 31-43.
[55] Sterman, J. D. (2001), "System Dynamics Modeling: Tools for Learning in a Complex World", *California management review*, *43*(4), 8-25.
[56] Szemző, H., Mosquera, J., Polyák, L., & Hayes, L. (2022), "Flexibility and Adaptation: Creating a Strategy for Resilience", *Sustainability*, *14*(5), 2688.
[57] Tourani, N., & Khatibi, S. (2020), "Investigating the Impact of Strategic Alignment on Performance Considering the Role of Sustainable Strategy", *Management*, *10*(2), 46-54.
[58] Walker, B., & Salt, D. (2006), "*Resilience Thinking : Sustaining Ecosystems and People in a Changing World*", Island Press.
[59] Weerapattanawong, N., Hoonsopon, D., Chandrachai, A., & Triukose, S. (2022), "The Resilient Marketing Strategy framework in VUCA World", *RES MILITARIS*, *12*(3), 671-683.
[60] Wetering, R. v. d., Mikalef, P., & Helms, R. (2017), "Driving organizational sustainability-oriented innovation capabilities: a complex adaptive systems perspective", *Current Opinion in Environmental Sustainability*, *28*, 71-79.
[61] Wijethilake, C., & Lama, T. (2019), "Sustainability core values and sustainability risk management: Moderating effects of top management commitment and stakeholder pressure", *Business Strategy and the Environment*, *28*(1), 143-154.
[62] Williams, A., Kennedy, S., Philipp, F., & Whiteman, G. (2017), "Systems thinking: A review of sustainability management research", *Journal of Cleaner Production*, *148*, 866-881.
[63] Wong, A. Y. T., & Fong, T. P. W. (2011), "Analysing interconnectivity among economies", *Emerging Markets Review*, *12*(4), 432-442.
[64] Yap, X.-S., Truffer, B., Li, D., & Heimeriks, G. (2022), "Towards transformative leapfrogging", *Environmental Innovation and Societal Transitions*, *44*, 226-244.
[65] Yu, Y., Dong, X.-Y., Shen, K. N., Khalifa, M., & Hao, J.-X. (2013), "Strategies, technologies, and organizational learning for developing organizational innovativeness in emerging economies", *Journal of Business Research*, *66*(12), 2507-2514.
[66] Zanotti, L., Ma, Z., Johnson, J. L., Johnson, D. R., Yu, D. J., Burnham, M., & Carothers, C. (2020), "Sustainability, resilience, adaptation, and transformation: tensions and plural approaches", *Ecology and Society*, *25*(3).
[67] Zapata-Cantu, L., & González, F. (2021), "Challenges for Innovation and Sustainable Development in Latin America: The Significance of Institutions and Human Capital", *Sustainability*, *13*(7), 4077.

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)