

Review Paper

Risk Management Strategy for International Investment Projects of an Innovative Enterprise in the Context of Industry 4.0

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ABSTRACT

The significance of risk management within the framework of Industry 4.0 is on the rise, particularly within the realm of international investment projects. Contemporary technological advancements, such as artificial intelligence and blockchain, are not only ushering in fresh prospects but are also instigating the emergence of novel categories of risks. The primary objective of this investigation is to formulate an all-encompassing strategic risk management framework tailored to innovative enterprises operating within the purview of Industry 4.0. The envisaged research endeavour encompasses a thorough scrutiny of existing methodologies and models, along with an exploration of contentious dimensions within this domain. The study's findings encompass criteria for the evaluation and quantification of risks, in addition to pivotal risk factors that exert notable influence on the efficacy of international investment projects. The pragmatic import of this investigation resides in its potential utility for enhancing managerial decision-making across various tiers of the organizational hierarchy. The presented material seeks to facilitate the alignment of conventional risk management approaches with the intricacies inherent in Industry 4.0. Nonetheless, it is imperative to acknowledge that the efficacy of the formulated model may hinge upon contextual nuances and might necessitate supplementary adaptations.

HIGHLIGHTS

- ① The rise of Industry 4.0 and the introduction of cutting-edge technologies have necessitated the development of a more flexible and timely risk management approach, particularly for international investment projects, as traditional risk management methods like PERT and SWOT have become less effective in this context.
- ① An integrated strategic risk management model designed for innovative enterprises operating within the framework of Industry 4.0 should exhibit characteristics of flexibility, adaptability, and openness, allowing organizations to efficiently respond to rapidly evolving market dynamics while accommodating the complexities of the human element and ethical and social considerations.

Keywords: Risk management, industry 4.0, international investment projects, innovative enterprises, strategic model

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In the contemporary globalized landscape, marked by the escalating significance of information technology and digital assimilation, the indispensability of proficient risk management within international investment undertakings is self-evident. This assertion holds particularly true in light of the advent and swift evolution of Industry 4.0, distinguished by the implementation of automated systems, the deployment of artificial intelligence, and the adoption of various other cutting-edge technologies.

International investment projects invariably contend with a multitude of uncertainties and risk variables, spanning the gamut from regional political volatility to intricacies within the technological sphere. Navigating these turbulent conditions necessitates a thorough examination, coupled with the selection of an optimal strategy aimed at mitigating prospective losses and optimizing returns.

Erroneously selecting an inappropriate risk management strategy can precipitate calamitous repercussions, encompassing the forfeiture of invested capital, exposure to reputational hazards, and in the direst scenarios, insolvency. This predicament assumes heightened significance within the purview of innovative enterprises, frequently situated at the vanguard of scientific and technological advancement, and inherently reliant on the constancy of the financial and regulatory milieu.

It is well-established that Industry 4.0 offers a spectrum of fresh prospects for innovative enterprises, yet simultaneously ushers in a cadre of novel challenges. On one hand, the paradigm of digital transformation furnishes an avenue to optimize production work-flows, amplify productivity, curtail expenses, and enhance product excellence. Conversely, the transition to smart manufacturing necessitates substantial capital outlays, the reconfiguration of operational work-flows, and, most significantly, the management of novel categories of risks, encompassing cybersecurity, safeguarding intellectual property, and contending with reliance on suppliers of cutting-edge technologies, among others. This predicament assumes even greater significance within the realm of international investment projects, where risks can be notably exacerbated due to geographical remoteness, disparities in

culture and legal frameworks, as well as an elevated reliance on global suppliers and markets.

Consequently, Industry 4.0 not only heralds fresh prospects for expansion and ingenuity but also intricately convolutes the landscape of risk management, especially within the global ambit. This demands the inception of a novel, more profound, and methodically structured approach to the formulation of risk management strategies that can proficiently grapple with the intricacies intrinsic to this nascent industrial epoch.

While research about risk management within innovative enterprises amid the backdrop of Industry 4.0 has undeniably made headway, the predominant emphasis has primarily gravitated toward technical facets, notably cybersecurity, and automation. Conversely, the strategic dimension of risk management, particularly within the milieu of international investment initiatives, has received comparatively scant attention. In essence, there exists a conspicuous dearth of research that coalesces technological, economic, and societal variables within a unified strategic framework. Furthermore, a noteworthy deficiency manifests in the form of exhaustive scrutiny of the interplay amongst diverse categories of risks - encompassing commercial, technological, and geopolitical dimensions, among others - within the context of global integration and the tide of digital transformation.

Our research is underpinned by the following hypotheses:

- ◆ *Integrated Risk Management Hypothesis:* A strategic risk management model that assimilates technological, economic, and societal dimensions exhibits superior efficacy in the realm of international investment projects involving innovative enterprises within the context of Industry 4.0 when contrasted with conventional models that singularly concentrate on one of these facets.
- ◆ *Industry 4.0 Risk Specifics Hypothesis:* The pivotal risk factors in international investment endeavours undertaken by innovative enterprises undergo substantial transformation within the milieu of Industry 4.0. Specifically, a proliferation of novel risk categories, such as those entailing cybersecurity, the utilization of

artificial intelligence, and the integration of the Internet of Things, comes to the fore.

- ♦ *Geographical Separation Hypothesis*: Geographical dispersion within the ambit of international investment projects, particularly amid the panorama of Industry 4.0, significantly heightens the intricacy of risk management. However, with the implementation of an appropriate strategic approach, it may concurrently function as a mitigating factor for certain risk types (e.g., risks associated with supply monopolization or political vicissitudes in a single country).

LITERATURE REVIEW

In light of the aforementioned significance of this subject matter, the notable attention it has garnered from researchers on both sides of the Atlantic Ocean is readily explicable. Consequently, we will now delve into an analysis of the principal works in this domain.

In their research, Benjamin *et al.* (2006) undertake an examination of risks within the realm of innovation management. The authors posit that the very notion of risk management can harbour latent risks, particularly when it is not tailor-fitted to the particularities of international investment undertakings. Another noteworthy contribution to this field is the work by Bérard & Teyssier (2017), which casts a wide net over an array of risk management facets, encompassing international investment projects among its purview. This work serves as a pivotal resource for an in-depth exploration of both the theoretical underpinnings and practical dimensions of our research topic.

Bretas *et al.* (2022) delve into the elements that render foreign direct investment an enticing prospect. Their proposal of a bibliometric analysis bears relevance for the study of risks within international investment projects, offering potential insights into the dynamics of risk factors. The work by Buckley *et al.* (2007) explores the determinants of Chinese foreign direct investment, holding significance for the scrutiny of risks in foreign investments, particularly in the context of cross-cultural and cross-economic system interactions. Cicatiello *et al.* (2021) undertake an evaluation of the repercussions of fiscal transparency on the influx of foreign direct investment. This dimension holds pertinence for risk management in the realm of international

investment projects, especially concerning the assessment and mitigation of fiscal-related risks.

Dimitrova *et al.* (2022) investigate the repercussions of terrorism on foreign direct investment within the Middle East and North Africa. Their exploration encompasses an analysis of the political regime as a moderating factor, which holds relevance for comprehending the interplay of political and security risks within this region. Duan *et al.* (2018) formulated a methodology tailored to the evaluation of risks associated with energy investments in countries encompassed by China's strategic initiative. This approach is of particular import for international investment projects linked to energy sectors, shedding light on the complexities of risk assessment in this context. Duka (2017) contemplates the paradigm of integrated risk management, offering insights that may pique the interest of stakeholders involved in international investment projects. This perspective potentially provides a holistic approach to managing multifaceted risks. Fang *et al.* (2021) scrutinize the ramifications of the COVID-19 pandemic on Chinese foreign direct investment. Their study assumes paramount importance in comprehending the intricacies of risks associated with global crises and their implications for international investments.

Florio *et al.* (2022) contributed a collection of papers on risk management, with a particular emphasis on the domain of international investment. This compilation likely encompasses valuable insights into contemporary risk management practices, especially as applied to international investment contexts. In his research, R. Fulbright (2017) examines the methodology underpinning the assurance of innovation, with a focal point on BACUP. The author proffers specific tools for the appraisal and assurance of innovation processes, which may hold significance for the development of risk management strategies in innovative enterprises. Galjanić *et al.* (2022) delve into the scientific evolution of decision support systems within the construction industry. Their analysis encompasses discerning key trends and prospective avenues for further advancement within this sphere, which could potentially inform decision-making processes relevant to international investment projects in the construction domain.

Goerlandt & Li (2021) offer a scientometric review spanning four decades of investment risk analysis. Their study entails an analysis of seminal publications and dominant themes that have shaped the field, providing a comprehensive overview of the evolution of investment risk analysis. Gonchar & Greve (2022) investigate the influence of political risk on foreign direct investment exit decisions. Leveraging empirical evidence, they scrutinize how political instability impacts firms' investment strategies, offering valuable insights into the nexus between political risk and investment decisions within international contexts. Gulen & Ion (2015) delve into an examination of the interplay between political uncertainty and corporate investment. Their research elucidates how the instability of government decisions can either impede or incentivize corporate investment, shedding light on the multifaceted relationship between political dynamics and corporate investment behaviour.

Gushko (2009) conducts a comprehensive review of the definitions of "innovation" and "innovation activity" as delineated in scientific literature. The author undertakes a comparative analysis of diverse approaches and definitions, to consolidate knowledge in this domain, contributing to a clearer conceptualization of innovation and innovation-related activities. Holburn & Zelner (2010) delve into an investigation of the influence of political capability and political risk on international investment strategies, with a specific focus on the electricity industry. Their research delves into the adaptive mechanisms that companies employ to navigate shifting political landscapes, providing insights into the dynamic nature of international investment decisions. Jiang *et al.* (2022) undertake an analysis of the global repercussions of the COVID-19 pandemic on the sustainable development of ocean ecosystems. This study casts a holistic gaze on the pandemic's impacts, spanning economic, environmental, and social dimensions, with particular relevance to the stability of ocean ecosystems within the context of international investment projects and sustainable development goals.

Julio & Yook (2016) centre their research on the ramifications of political uncertainty on cross-border capital flows. Employing mathematical models, the authors embark on an analysis of how

policy uncertainty can shape investment decisions, contributing to an enhanced understanding of the intricate relationship between political factors and international capital movements. Kasser (2020), in his book, delves into a comprehensive exploration of the concepts of risk and risk management within a systemic context. His work underscores the imperative of seamlessly integrating risk management into the overarching strategies of organizations, potentially providing valuable insights for risk management practices within the realm of international investment projects. Kellard *et al.* (2022) embark on an exploration of the nexus between risk, financial stability, and foreign direct investment. Their research entails an analysis of the interplay between risk dynamics and financial stability, and how these elements collectively influence international investment decisions, offering pertinent insights for stakeholders engaged in international investment endeavours.

Koskela & Aspfjäll (2021) concentrate their research on agile risk management. Within their study, they explore the utilization of contemporary methodologies to proficiently administer risks across diverse domains. In his book, Lee (2021) provides a holistic perspective on risk management. He conducts an exhaustive analysis of myriad factors influencing risk management and proffers methodological frameworks for their optimization. Li & Gallagher (2022) undertake an evaluation of the potential impact of climate change on foreign direct investment. Their study encompasses an appraisal of climate-related risks that may exert influence on international investment strategies.

Malek *et al.* (2011) conducted an analysis of risk management within the construction domain. Their research entails an examination of pivotal risks and the proposition of mitigation strategies. Mishchenko *et al.* (2021) delve into an investigation of innovation risk management within financial institutions. The authors contemplate the idiosyncrasies of risk management within the financial services sector. Nguyen & Lee (2021) undertake an evaluation of the influence of financial development and uncertainty on the inflow of foreign direct investment. Their study draws upon global data to substantiate their argument.

Nguyen *et al.* (2022) undertake an examination of the extent to which geopolitical risks influence

technological advancement and the attractiveness of foreign direct investment within emerging economies. Their analysis delves into the capacity of the geopolitical landscape to either constrain or facilitate investment inflows. The Organization for Economic Co-operation and Development (OECD, 2020) centres its attention on foreign direct investment flows amidst the backdrop of the COVID-19 pandemic, as detailed in its report. The authors scrutinize the repercussions of the global crisis stemming from the pandemic on cross-border investment activities, with specific emphasis on the impact on sectors most vulnerable to the pandemic. Pandya (2016) explores the political economy of foreign direct investment within the overarching context of globalization (Petrenko *et al.* 2022; Slobodanyk *et al.* 2022; Melnyk *et al.* 2022; Lelyk *et al.* 2022). His analysis is centred on the interplay between political and economic determinants in shaping global productive endeavours.

Varaniūtė *et al.* (2022) undertake an exploration of the role of management accounting within the sphere of product development, set against the backdrop of digitalization, sustainability, and circularity. Their investigation revolves around an analysis of the influence of contemporary trends on methodologies employed in management accounting. Wall *et al.* (2018) analyzed policy instruments conducive to attracting foreign direct investment in the renewable energy sector. Their research delves into the efficacy of diverse policy measures aimed at catalyzing investments within this sector. Yu *et al.* (2021) examine the impact of geopolitical uncertainty on Chinese outward investment within the energy sector. Their particular focus lies on elucidating how “geopolitical frictions,” exemplified by the South China Sea dispute, reverberate through investment decisions within this sector.

In summarizing the literature review, it is important to highlight that the substantial body of research conducted to date has not comprehensively addressed all facets within the identified domain. Consequently, the ensuing discussions are aimed at bridging these existing gaps in the literature.

The objective of our study is to formulate a strategic risk management model tailored for international investment projects undertaken by innovative enterprises within the framework of Industry 4.0.

To fulfil this aim, the following objectives have been delineated:

- ◆ to execute an exhaustive analytical review of pertinent literature about the research topic.
- ◆ to scrutinize prevailing risk management methodologies and models in the context of industry 4.0.
- ◆ to discern the pivotal risk factors exerting substantial influence on the efficacy of international investment projects.
- ◆ in light of the findings derived from the preceding tasks, formulate criteria for the evaluation and quantification of these risks.
- ◆ to devise a holistic integrated strategic risk management model that duly accommodates the nuances inherent in innovative enterprises and the distinctive attributes characterizing Industry 4.0.

METHODS

The methodology employed in this study adopted a comprehensive approach, commencing with an exhaustive examination of the scientific literature to scrutinize extant risk management methodologies and models. Particular emphasis was placed on contextualizing the study within the framework of Industry 4.0 and the distinctive characteristics of innovative enterprises. Building upon this theoretical foundation, an integrated strategic risk management model was formulated, encompassing salient facets of risk management within this context. Additionally, the methodology encompasses a synthesis of the acquired results, culminating in the formulation of conclusions and recommendations for prospective research endeavours in this domain. The developed model appears to hold significant promise in facilitating the comprehension and resolution of specific risk management challenges encountered by innovative enterprises in the realm of Industry 4.0.

RESULTS AND DISCUSSION

Analysis of risk management methods and models in the context of Industry 4.0

The Program Evaluation and Review Technique (PERT) is a frequently adopted strategy among existing risk management approaches (Bashynska

et al. 2019). Initially intended for the planning and assessment of projects, PERT is adaptable enough to evaluate risks integral to industrial frameworks (Bashynska *et al.* 2020). However, its effectiveness may be compromised within the intricate systems of Industry 4.0, mainly due to numerous variables and constantly changing factors (Dykan *et al.* 2021). SWOT (Strengths, Weaknesses, Opportunities, Threats) is another prevalent methodology utilized in the realm of risk management (Filyppova *et al.* 2019). This method allows for the recognition of system strengths, weaknesses, possible opportunities, and threats. However, similar to PERT, the SWOT approach might show its limitations when assessing risks in the complex, automated networks of Industry 4.0 (Bashynska *et al.* 2020).

Given the integration of modern digital technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), and Blockchain, there is an increasing need for more flexible and timely risk management solutions (Guseva *et al.* 2022). Among the new strategies is the creation of machine learning models designed for instantaneous anomaly detection and forecasting (Halkiv *et al.* 2022). These algorithms have the potential to learn from large data sets and provide accurate risk predictions, enabling quick reaction to emerging risks (Dykan *et al.* 2021). Blockchain methodologies also present opportunities for enhancing data security and transparency, thus reducing risks associated with data tampering or loss (Guseva *et al.* 2022).

As a result, the rise of Industry 4.0 and the introduction of cutting-edge technologies have led to a waning effectiveness of traditional risk management methods. Emerging strategies, such as those based on machine learning and blockchain technologies, are providing more accurate and faster risk management solutions, well-suited for adapting to rapidly changing environments.

Key risk factors that affect the effectiveness of international investment projects

In the domain of global investment initiatives, key risk elements include the host country's political stability, economic conditions, and socio-cultural features (Halkiv *et al.* 2021). The political landscape in a given country critically affects the regulatory framework in which a project operates, having

a subsequent impact on its effectiveness (Khan, Saienko, & Tolchieva, 2021).

Financial indicators such as fluctuations in currency exchange rates, inflation, and interest rates significantly dictate a project's economic resilience (Oklander *et al.* 2023). Furthermore, attention must be given to socio-cultural aspects like language differences and cultural obstacles, which can complicate both communication and operations.

In the era of Industry 4.0, technological uncertainties cannot be overlooked, especially when digital advancements add layers of complexities requiring refined project management skills (Megits *et al.* 2022). Also, when a project is involved in merging with or acquiring a local enterprise, the potential for M&A failures becomes notably relevant (Kwilinski *et al.* 2020). Obstacles could materialize in integrating corporate cultures, administration systems, and various organizational elements, all of which need thorough analysis.

Alongside these primary risk elements, specialized risks such as those linked to managing the supply chain and ecological issues should be taken into account (Oklander *et al.* 2023). Ignoring environmental regulations can lead to legal repercussions and damage to one's reputation, affecting the project's ability to acquire funds and its overall sustainability.

Moreover, project staffing-associated risks should not be disregarded. Having competent professionals who can adeptly manage the project is central to any successful international investment undertaking (Megits *et al.* 2022). A greater focus should be placed on liaising with local communities and other interested parties. Ignoring this component could lead to societal tensions and negative effects on the project's delivery.

In conclusion, managing global investment projects effectively calls for a multi-faceted risk evaluation and mitigation strategy (Oklander *et al.* 2023). This strategy should cover a range of considerations beyond economic factors, including political, socio-cultural, technological, and environmental aspects.

Criteria for risk assessment and quantification

In subsequent sections, we will concentrate on crafting criteria for evaluating and quantifying risks associated with international investment

initiatives. Primarily, we recommend implementing a layered assessment framework that includes both financial and non-financial metrics (Prokopenko & Kasyanenko, 2013). Within the scope of financial metrics, a diversified set of indicators is advisable. These should cover expected returns, measures of liquidity, and the project's vulnerability to currency exchange rate changes. Financial metrics may also integrate elements like the capital cost and a forecast of the investment's return.

Concurrently, we posit that non-financial metrics should be marked by a broad range and inclusiveness. Such criteria could involve factors like ecological performance, commitment to social responsibility, and the initiative's ability for socio-cultural acclimatization (Prokopenko, Domashenko, & Shkola, 2014). For example, performance indicators related to sustainable natural resource usage or community satisfaction levels are essential for evaluating environmental and social risk factors.

Furthermore, employing numerical methods for risk analysis is prudent. These could range from Monte Carlo simulations and sensitivity analyses to decision tree models (Sysoyeva *et al.* 2021). Such techniques support the creation of numeric models appropriate for scenario planning and projecting possible results. Crucially, it is essential to highlight that comprehensive stakeholder involvement—including investors, project supervisors, local governance bodies, and the community—is key to the assessment process. This kind of broad engagement not only refines the accuracy of the evaluation but also elevates trust in the feasibility and successful delivery of the project.

To sum up, the task of evaluating and quantifying risks calls for a composite approach that amalgamates both financial and non-financial metrics while utilizing a variety of quantitative methods. Such a holistic strategy aids in formulating more accurate and well-informed decisions.

An integrated strategic model of risk management of innovative enterprises in the context of industry 4.0 features

In the ensuing discussion, we will explore the feasibility of constructing an integrated strategic risk management model with a specific emphasis on innovative enterprises operating within the purview

of Industry 4.0. The pivotal feature underpinning such a model is adaptability, denoting the capacity to promptly react to fluctuations in both the external and internal environments. This adaptability hinges upon constituent elements, including artificial intelligence, big data analytics, and the Internet of Things (IoT). These components collectively enable real-time analysis and automated decision-making processes.

The initial component of our model entails the establishment of a continuous risk monitoring system, leveraging advanced technologies for data collection and analysis. This system enables the organization not only to detect potential risks but also to forecast their emergence with a high degree of precision. The second component comprises rapid response mechanisms, encompassing automated management systems and expedited implementation measures. Specifically, artificial intelligence algorithms can be harnessed for real-time selection of optimal risk management strategies. The third element of the model encompasses a strategic planning system that seamlessly integrates risk management into the overarching business strategy of the enterprise. This integration mandates that all pivotal decisions incorporate considerations not solely about potential benefits but also encompassing the associated risks.

The concluding facet of the model pertains to stakeholder engagement and transparency. It necessitates that all information concerning risks and risk management strategies remains accessible to investors, partners, and other relevant stakeholders.

In summary, an integrated strategic risk management model situated within the framework of Industry 4.0 ought to exhibit characteristics of flexibility, adaptability, and openness. These attributes empower innovative enterprises to proficiently respond to the swiftly evolving market dynamics.

Some debatable aspects of the risk management strategy for international investment projects of an innovative enterprise in the context of Industry 4.0

Primarily, it is noteworthy that one of these facets concerns the equilibrium between process automation and the human element. While technological advancements facilitate the automation of numerous operational tasks, the human factor

continues to retain its significance, particularly within the ambit of strategic decision-making.

Furthermore, the interaction between traditional risk management methodologies and emerging ones stemming from the evolution of Industry 4.0 remains a challenge. This underscores the necessity for an in-depth examination and, potentially, the adaptation of classical models and approaches. Notably, this pertains to the ethical and social dimensions inherent in risk management. Novel technologies such as artificial intelligence and blockchain introduce unique challenges to established norms concerning privacy and data security.

Despite these complexities, our developed model aspires to furnish a comprehensive approach to risk management that duly accommodates both technological and organizational considerations. It is imperative to recognize, however, that this model does not represent a universal remedy and its efficacy may be contingent upon the specific context, necessitating potential adaptations.

CONCLUSION

In light of the foregoing considerations, there arises an imperative to institute a sophisticated approach to risk management within the ambit of Industry 4.0. This approach underscores the pivotal significance of conducting thorough analyses of key risk factors that impinge upon the efficacy of international investment projects. Our findings are in alignment with our initial anticipations, and we anticipate that they will enrich the comprehension of how technological innovations can be harnessed to optimize risk management endeavours. We hold the view that the integrated strategic risk management model can serve as an efficacious instrument for the assessment and mitigation of risks, particularly within contexts characterized by elevated levels of uncertainty and market dynamism. Notably, the model takes into meticulous consideration the unique attributes of innovative enterprises, which are especially pertinent within the purview of Industry 4.0.

The practical significance of this study resides in the potential utility of the developed integrated strategic risk management model as a valuable tool for guiding management decisions across diverse echelons, ranging from operational to strategic levels. This model can be effectively

employed to tailor corporate strategies, enhance project management protocols, and streamline the allocation of internal resources within an enterprise. The model, as proposed, serves as a framework for systematic risk analysis, affording the capacity to incorporate considerations concerning the interplay among diverse risk categories and their cumulative influence on overall performance.

Nevertheless, our study is not without limitations that warrant further investigation. The examined model necessitates more extensive testing across a broader spectrum of projects, encompassing diverse industry sectors and geographical regions, to ascertain its versatility and adaptability. It is imperative to evaluate how this model can be effectively implemented within varying organizational cultures and structures.

In light of the foregoing, potential avenues for future research may encompass the customization of our proposed model for distinct categories of innovative enterprises and the assessment of its effectiveness within divergent geopolitical contexts.

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