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Critical Challenges and Opportunity Factors in Stakeholder Collaboration for Indonesian Defense Technology Innovation

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Abstract. *Exploring the landscape of defense technology innovation collaboration in Indonesia requires an in-depth study to investigate the important factors that shape the direction of collaboration efforts. Unveiling challenges like the silo effect, funding limitations, and bureaucratic disparities, the research navigated through the intricate landscape of collaboration. Opportunities emerged, encompassing the development of collaboration scopes and enhancing overall effectiveness. The findings underscored the need for adaptive policies, alternative funding models, and cultural transformations to overcome identified hurdles. Recommendations leaned toward fostering a collaborative organizational ethos and implementing structural changes to facilitate seamless integration. Positioned as a roadmap, these insights offer stakeholders and policymakers actionable strategies, paving the way for Indonesia's advancements in the defense technology sector.*

Keywords: *critical factors; stakeholder collaboration; defense technology; innovation.*

I. INTRODUCTION

The contemporary competitive global landscape has given rise to an increasingly intense race for ownership and dominance in defense technology. Therefore, innovation becomes imperative for industries to cultivate new ideas, processes, and products, fostering growth amidst current business conditions. The outcomes of innovation provide industries with advantages necessary for competitiveness, contribution to national economic development, and improved financial performance. According to a previous researcher (Freeman, 2004), innovation involves a company's effort to utilize and develop technology and information for the development, production, and promotion of new products. In essence, innovation represents an update of functions, modifications, and ideas for continuous improvement, responding to the evolving needs of users. An ideal innovation can optimize performance in the management sector, ensuring business continuity aligns with the company's objectives. The ability to innovate, encompassing ideas, methods, and new products, significantly impacts the company's penetration capabilities (Hult, 2004).

The present literature predominantly emphasizes the analysis of trust's significance in fostering collaborative New Product Development (NPD). However, there is a notable gap in elucidating the nuanced understanding, description, or conceptualization of trust in the context of constructing these collaborations (Arvidson & Melander, 2020). Additionally, the existing research primarily concentrates on scrutinizing the influence of trust on stakeholder collaboration within traditional manufacturing organizations. Unfortunately, these studies lack the depth required to comprehend how organizations at the forefront of innovation, particularly those that have embraced Industry 4.0, successfully cultivate trust within their collaborative partnerships (Nellippallil et al., 2019; Savastano, Amendola, & D'Ascenzo, 2018).

Studies suggest that the success or failure of a company is influenced by direct or indirect interactions with other entities (Håkansson & Waluszewski, 2002; Wilkinson & Young, 2002).

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Intensive collaborations are deemed essential, and the term "collaboration" emerged in the 19th century during the era of industrialization when organizations became more complex, leading to the initiation of collaboration concepts across various organizations (Wanna, 2008). Collaboration is defined as a process that unites stakeholders toward common objectives (Harley & Blismas, 2010), requiring integrated efforts from actors with established duties for shared goal attainment.

The triple helix model has been employed to implement collaboration concepts (Etzkowitz & Leydesdorff, 1995), emphasizing the role of collaborations between stakeholders in creating a conducive work environment that fosters synergy, particularly in the technology sector (Ansoff, 1965). Collaborations fostering synergy are believed to multiply teamwork results compared to the total resources allocated by individual stakeholders (Raluca, 2011). This multiplication results from the combined effects of work distribution and the transfer of core competencies (Otola, 2007; Saftiana, 2018).

Resources alone do not guarantee competitive superiority; their combination must lead to value-added efforts. The focus should not solely be on resource ownership but on the value derived from combining resources within a collaborative network (Harrison & Håkansson, 2006). The collaboration network facilitates the exchange and transfer of resources and capabilities between stakeholders, aiming to increase the company's resource value for competitive eminence, as per the resource-based theory (Benito et al., 2016). While previous studies have highlighted the importance of innovation, there is a gap in understanding how collaborative efforts contribute to innovation in defense technology.

Wipulanusat et al., (2019) stated that the opportunities factor in innovation collaboration consists of increased effectiveness and efficiency, reduced operational costs, facing more complex knowledge and challenges, responding to crises, and increasing public demand. Meanwhile, the challenge factor comprises free riders during collaboration, limited resources, leadership system failures, complex regulations, less acceptance of rewards by each stakeholder, differences in bureaucratic culture, hierarchical systems, and silo effects.

Lypchuk and Dmytriv (2020) explained that the opportunities factor in innovation collaboration consists of workload sharing, time and process efficiency, increased performance, and production line efficiency. Meanwhile, the challenge factor comprises differences in organizational factors, managerial issues in technology processes, and nonlinear work duration changes. On the other hand, Kot and Leszczyński (2019) explained that the opportunities factor in innovation collaboration includes collaboration scope development and multiplying stakeholder input. Meanwhile, the challenge factor is the increased interpretation in decision-making.

Ishchuk, Sozanskyy, and Pukała (2020) explained that the opportunities factor in innovation collaboration involves the development of medium and high technology markets as well as resource and cost efficiency. Meanwhile, the challenge factor is the lack of consensus on innovation collaboration mechanisms. Nearly similar, Illiashenko et al. (2020) explained that the opportunities factor in innovation collaboration consists of the growth of innovative company numbers, patent intensification, and the rational structure of innovative companies. Meanwhile, the challenge factor comprises a new knowledge structure that doesn't fulfill the company's needs, a lower number of contributions from innovative companies, and an insignificant volume of patent sales.

Bruneel, D'Este, and Salter (2010) stated that resource optimization and short-term technology superiority are opportunities factors in innovation collaboration. Meanwhile, the challenge factors include differences in duration orientation and dissemination interest in research results, varying long-term research visions among stakeholders, and differing paradigms in the dissemination of research results. Meanwhile, other experts mention that positive externality known as

spillover and adoption of the best management projects are opportunities factors in innovation collaboration. On the other hand, the challenge factors include the lack of integration systems between civil and military innovation, differences in development focus, a lack of alternative government funding, and weaknesses in project management (Moorhouse, 2002; Belin et al., 2019; Olmedo, Quisimalin, and Chavez, 2020).

This research seeks to bridge the gap by examining the collaborative aspects within the defense industry, emphasizing the role of synergy in fostering innovation. The aims and objectives of this study are (a) investigate the role of innovation in defense technology; (b) explore the types of innovation (product, process, market) in the defense industry; (c) examine the impact of collaborative efforts on defense technology innovation; and (d) identify critical factors influencing collaborative success. Understanding the interplay between innovation and collaboration in defense technology is crucial for industry growth, competitiveness, and national development. This research aims to contribute valuable insights for policymakers, industry leaders, and researchers.

II. RESEARCH METHOD

This research adopts a literature study method as a foundational step to identify critical risk factors, forming the basis for the subsequent determination of opportunity and challenge

Table 1. Challenge and Opportunity Factors

Challenge Factor	Code	Opportunity Factor	Code
Free rider during collaboration	T1	Increase effectiveness and efficiency	P1
Limited resources	T2	Reduce operational cost	P2
Leadership system failure	T3	Face the more complex knowledge and challenge	P3
Complex regulation	T4	Respond crisis	P4
Less reward accepted by each stakeholder	T5	Increase public demand	P5
Difference bureaucracy culture	T6	Workload sharing	P6
Hierarchy system	T7	Time and process efficiency	P7
Silo effect	T8	Increase performance	P8
Difference organization factors	T9	Production line efficiency	P9
Managerial on technology process	T10	Collaboration scope development	P10
Nonlinear work duration change	T11	Stakeholder input multiplication	P11
Increase interpretation on decision making	T12	Medium and high technology market development	P12
No innovation collaboration mechanism consensus	T13	Resource and cost efficiency	P13
New knowledge structure doesn't fulfil company's need	T14	Innovative company number growth	P14
Less innovative company contribution number	T15	Patent intensification	P15
Insignificant patent selling volume	T16	Innovative company rational structure	P16
Difference duration orientation and dissemination interest on research result	T17	Resource optimalization	P17
Difference long-term research vision from each stakeholder	T18	Short-term technology superiority	P18
Different research result dissemination paradigm	T19	Positive externality known as spillover	P19
Lack of integration system between civil and military's innovation	T20	Adoption best management projects	P20
Difference development focus	T21		
Lack of government funding alternatives	T22		
Project management weakness	T23		

factors. Data collection is executed through communication on social media platforms with experts possessing significant experience in defense technology innovation collaboration. Thirty experts were purposively selected based on their expertise in defense technology innovation collaboration, following the criteria specified within the range of 30 to 500 people (Roscoe, 1969).

Questionnaires were administered to the selected thirty experts, soliciting their insights on factors influencing the innovation collaboration process. The Likert scale, ranging from (1) Very irrelevant to (5) Very relevant, was employed for participants to express their agreement levels with provided statements. Descriptive statistical methods were employed to analyze the collected questionnaire data. The analysis focused on categorizing the identified forty-three factors into opportunity and challenge factors.

For the validity test of the questionnaire data, a 5% significance level was utilized. The validity number result was deemed valid if the r count exceeded the critical r table value. With a sample size of 30 respondents, the critical r table value was determined as 3.61.

Table 2. Questionnaire Data Reliability Test Result

Variable	Cronbach's Alpha	Conclusion
Critical Challenge Factor	0.917	Very high reliability
Critical Opportunity Factor	0.892	Very high reliability

The reliability of the questionnaire data was assessed through a reliability test for both critical challenge and opportunity factors. The results indicated very high reliability, confirming the consistency and dependability of the collected data.

This methodological approach ensures a systematic investigation of critical factors in defense technology innovation collaboration, integrating literature review, expert insights, and robust statistical analyses.

III. Result and Discussion

Critical Challenge Factors of Indonesian Defense Technology Innovation Collaboration

Defense organizations could consider adopting strategic alliances to facilitate the innovation process and streamline defense operations. Furthermore, corporations, armed forces, and defense systems are forming connections to leverage collective efforts, all orchestrated under the oversight of the Ministry of Defence (Peñalver et al., 2019). Further advantages of technological collaboration encompass cost-sharing, broadening the overall capacity of defense manufacturing, and enhancing efforts to design and produce advanced weapons systems across three nations. This collaborative approach holds the potential to capitalize on economies of scale, enabling more efficient resource utilization and fostering innovation in defense technologies. Additionally, such partnerships can facilitate knowledge exchange and skill transfer, contributing to the overall advancement of defense capabilities on a multinational scale (Taylor, 2023; Taylor, 2022).

The analysis, presented in Table 7, identifies four critical challenge factors that warrant attention in the context of defense technology innovation collaboration. These challenges, encompassing the silo effect, a lack of government funding alternatives, cultural disparities in bureaucracy, and inadequate integration between civil and military innovation, exhibit average values of 4.57, 4.53, 4.50, and 4.50, respectively. In this study, factors receiving ratings between 4.5 and 5 are deemed very relevant challenges encountered by collaborative actors. All these factors are thus categorized as critical challenges, demonstrating their high relevance during collaborative efforts in defense technology innovations.

Conversely, there are additional challenge factors acknowledged by experts but do not attain critical status. These factors fall within the average value range of 3.5 to 4.5, categorizing them as relevant challenges. Such challenges include the presence of free riders during collaboration, limited resources, failures in the

leadership system, complex regulations, insufficient rewards accepted by stakeholders, hierarchical system issues, organizational differences, managerial challenges in the technology process, nonlinear changes in work duration, increased interpretation in decision-making, lack of consensus on innovation collaboration mechanisms, new knowledge structures not aligning with company needs, limited contributions from innovative companies, insignificant volumes in patent sales, differing duration orientations and dissemination interests in research results, disparate long-term research visions among stakeholders, varying paradigms in research result dissemination, differing development focuses, and weaknesses in project management.

Table 3. Critical Challenge Factors of Indonesian Defense Technology Innovation Collaboration

Critical Challenge Factor	Mean	Description
Silo effect	4.57	Very relevant
Lack of government funding alternatives	4.53	Very relevant
Difference bureaucracy culture	4.50	Very relevant
Lack of integration system between civil and military's innovation	4.50	Very relevant

The analysis of critical challenge factors in defense technology innovation collaboration, as delineated in Table 3, reveals four paramount challenges that demand special attention. These challenges, characterized by the silo effect, insufficient government funding alternatives, disparities in bureaucratic cultures, and a lack of integration between civil and military innovation, all exhibit average values ranging from 4.50 to 4.57. The categorization of a rating between 4.5 and 5 as "very relevant" underscores the significance of these challenges in the collaborative landscape. As such, these factors are deemed critical challenges, implying their substantial impact on collaborative efforts within defense technology innovations.

The silo effect underscores the challenges arising from isolated information and knowledge within organizational structures, hindering effective collaboration. The absence of viable government funding alternatives suggests a dependence on a single source, posing a potential bottleneck for innovation initiatives. Cultural differences in bureaucracy and the lack of integration between civil and military innovation highlight the complexities inherent in merging diverse organizational elements, hindering seamless collaboration.

In contrast, the analysis also recognizes additional challenges perceived by experts that do not attain critical status. Factors falling within the average value range of 3.5 to 4.5 are considered relevant challenges. These encompass issues such as free rider dynamics, resource limitations, leadership system failures, regulatory complexities, insufficient rewards for stakeholders, hierarchical challenges, organizational disparities, managerial obstacles in the technology process, nonlinear changes in work duration, increased interpretation in decision-making, lack of consensus on innovation collaboration mechanisms, new knowledge structures misaligned with company needs, limited contributions from innovative companies, insignificant volumes in patent sales, differing duration orientations and dissemination interests in research results, disparate long-term research visions among stakeholders, varying paradigms in research result dissemination, differing development focuses, and weaknesses in project management.

This nuanced analysis provides a comprehensive understanding of both critical and non-critical challenges. It elucidates the multifaceted nature of obstacles encountered during collaborative endeavors in defense technology innovations, offering valuable insights for stakeholders and policymakers aiming to enhance collaborative efficacy in this critical domain.

Critical Opportunity Factors of Indonesian Defense Technology Innovation Collaboration

The analysis, presented in Table 4, delineates five critical opportunity factors crucial for understanding collaboration dynamics in defense technology innovation. These factors, encompassing collaboration scope development, increased effectiveness and efficiency, crisis response capabilities, addressing more complex knowledge and challenges, and fostering an innovative company rational structure, exhibit average values ranging from 4.60 to 4.87. The rating range between 4.5 and 5, denoted as "very relevant" in this study, underscores the utmost significance of these opportunities for collaboration actors. Consequently, all these factors are classified as critical opportunity factors, signifying their substantial relevance during collaborative efforts within defense technology innovations.

Table 4. Critical Opportunity Factors of Indonesian Defense Technology Innovation Collaboration

Top Opportunity Factor	Mean	Description
Collaboration scope development	4.87	Very relevant
Increase effectiveness and efficiency	4.67	Very relevant
Respond crisis	4.63	Very relevant
Face the more complex knowledge and challenge	4.60	Very relevant
Innovative company rational structure	4.60	Very relevant

The first critical opportunity factor, collaboration scope development, indicates the potential for expanding the breadth and depth of collaborative initiatives, paving the way for more comprehensive innovation endeavors. The subsequent factors - increased effectiveness and efficiency, crisis response capabilities, addressing more complex knowledge and challenges, and fostering an innovative company rational structure - all point to opportunities for enhancing the overall efficiency, adaptability, and innovation prowess of collaborative efforts within the defense technology domain.

Conversely, there are additional opportunity factors acknowledged by experts that do not attain critical status but are nonetheless important contributors. These factors fall within the average value range of 3.5 to 4.5, categorizing them as relevant opportunities. Such opportunities include operational cost reduction, increased public demand, workload sharing, time and process efficiency, increased performance, production line efficiency, multiplication of stakeholder input, development of medium and high technology markets, resource and cost efficiency, growth in the number of innovative companies, patent intensification, resource optimization, short-term technology superiority, positive externality known as spillover, and adoption of best management practices.

This nuanced analysis provides a comprehensive understanding of both critical and non-critical opportunities, offering valuable insights into the potential advantages and enhancements that collaborative efforts can bring to defense technology innovation. The identification of critical opportunities helps stakeholders and policymakers focus on key areas for maximizing the benefits of collaboration in this critical domain.

Research Implications

This research holds significant implications for the advancement of defense technology innovation collaboration in Indonesia. The analysis of critical factors sheds light on challenges and opportunities that demand careful consideration by relevant stakeholders. The identification of challenging factors such as the silo effect, limited government funding alternatives, differences in bureaucratic culture, and the lack of integration between civil and military innovation highlights key areas that need improvement in collaborative endeavors.

The research implications extend beyond the identification of challenges to underscore the strategic areas where concerted efforts are needed for successful defense technology innovation collaboration. One key implication is the necessity for policymakers to formulate and implement policies that address the silo effect

and promote cross-disciplinary collaboration. Additionally, finding alternative funding sources and fostering a cohesive organizational culture that transcends bureaucratic differences will be instrumental in overcoming financial and cultural obstacles.

Recognizing the importance of integrating civil and military innovation processes is imperative for a comprehensive and seamless collaborative framework. The implications stress the need for organizational reforms and structural adjustments to facilitate such integration effectively. Stakeholders and decision-makers should view these findings as a roadmap for actionable steps to enhance the overall landscape of defense technology innovation collaboration in Indonesia. This research provides valuable insights that can guide the development of targeted strategies and initiatives, thereby advancing the nation's capabilities in defense technology innovation.

Understanding these factors allows stakeholders to devise more effective strategies to address these challenges systematically. By doing so, collaborative initiatives can be enhanced, fostering a more conducive environment for defense technology innovation. The research implications emphasize the importance of targeted interventions and policy adjustments to promote successful collaboration, ultimately contributing to the growth and advancement of the defense technology sector in Indonesia.

IV. CONCLUSION

Based on the research result, the analysis of critical factors in Indonesian defense technology innovation collaboration reveals distinct challenges and opportunities. The identified critical challenge factors include the silo effect, lack of government funding alternatives, differences in bureaucratic culture, and a lack of integration between civil and military innovation. These challenges highlight significant barriers that need careful consideration for successful collaboration in defense technology innovation. On the other hand, critical opportunity factors offer avenues for enhancing collaborative efforts within the Indonesian defense technology sector. These opportunities encompass collaboration scope development, increased effectiveness and efficiency, crisis response capabilities, addressing more complex knowledge and challenges, and fostering an innovative company rational structure. Recognizing and capitalizing on these opportunities can propel collaborative initiatives towards greater success and impact.

Based on the discussed analysis, further research could delve into specific strategies and frameworks to overcome the identified critical challenge factors. Investigating successful case studies or best practices from other regions could provide valuable insights for mitigating challenges in Indonesian defense technology innovation collaboration. exploring the practical implementation of the identified critical opportunity factors can be a fertile area for future research. Understanding how these opportunities can be leveraged and integrated into collaborative initiatives will contribute to more effective defense technology innovation in Indonesia. Advancing research in these directions can contribute significantly to the improvement of defense technology innovation collaboration in Indonesia, ensuring the nation remains at the forefront of technological advancements in the defense sector.

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