Sciences du Nord Economics and Business
Vol. 1, No. 01, January, 2024: pp. 33~39
E-ISSN: xxxx-xxx
P-ISSN: xxx-xxx
DOI: -

Quantitative Analysis of the Effect of Research and Development (R&D) Networks on Innovation and Competitive Advantage in Indonesia Case Studies in the Manufacturing Industry

Widalicin Januarty[1], Eva Yuniarti Utami[2], Badirun Basir[3], Eliagus Telaumbanua[4]
[1] STIE Eka Prasetya and wida_lcn_14@yahoo.com
[2] Universitas Sebelas Maret and eva.yuniarti.utami@staff.uns.ac.id
[3] Universitas Sulawesi Barat and badirun.basir@gmail.com
[4] Universitas Nias and eliagus.tel@gmail.com

ARTICLE HISTORY
Received: Jan, 2024 **Revised: Jan, 2024** **Accepted: Jan, 2024**
Coresponding Author: wida_lcn_14@yahoo.com

ABSTRACT

This research investigates the dynamic interplay between Research and Development (R&D) networks, innovation, and competitive advantage within the manufacturing sector of Indonesia through a quantitative analysis. A sample of 150 manufacturing firms participated in the study, providing valuable insights into the relationships among these critical variables. Confirmatory factor analysis ensured the validity and reliability of the survey instrument, and subsequent structural equation modelling uncovered direct effects and mediating mechanisms. The results reveal a significant positive impact of R&D network participation on both innovation and competitive advantage. Mediation analysis further illuminates the roles of knowledge transfer and collaboration intensity in shaping these relationships. The findings offer practical implications for policymakers and industry practitioners seeking to leverage R&D networks strategically. This study contributes to the growing body of knowledge on the dynamics of collaborative R&D efforts and their implications for innovation and competitiveness in the Indonesian manufacturing context.

Keywords: *Research and Development Networks, Innovation, Competitive Advantage, Manufacturing Sector, Indonesia*

INTRODUCTION

Today's industrial industries are dynamic, making the pursuit of innovation and long-term competitive advantage critical. Through cooperative efforts, research and development (R&D) networks become essential facilitators of innovation and gaining a competitive advantage. Like its counterparts throughout the world, Indonesia's manufacturing sector struggles with the convergence of changing market dynamics, technical advancements, and intense international rivalry [1], [2], [3], [4]. In addition to adaptation, navigating this complicated environment requires proactive involvement with innovation, which is the cornerstone of long-term growth and competitiveness [5], [6], [7], [8]. Strategic participation in R&D networks and cooperative frameworks that promote the sharing of information, resources, and concepts between firms are at the center of innovation activities [9], [10].

Although R&D networks have well-established theoretical underpinnings, there is a noticeable lack of empirical data regarding their influence on innovation and competitive advantage in the particular setting of Indonesian manufacturing. In order to fill this gap, this study provides a

comprehensive analysis of how R&D networks affect innovation dynamics and, in turn, help manufacturing companies in Indonesia position themselves as competitive [11], [12], [13].

The minimal empirical research that is explicitly contextualized within Indonesia's manufacturing sector contrasts sharply with the widespread understanding of the critical role that R&D networks play in innovation. It is still unclear how exactly R&D networks affect innovation results and how much of a competitive advantage they give Indonesian manufacturing companies. In an effort to close this gap, this study uses a strong quantitative analysis to disentangle the complex connections between innovation, R&D networks, and competitive advantage. As a result, it provides stakeholders in the academic and business communities with useful information.

The following main goals serve as the foundation for this study: (1) To investigate the impact of research and development (R&D) networks on innovation in Indonesia's manufacturing sector, elucidating the mechanisms by which cooperative endeavors influence the generation and application of innovative concepts, procedures, and technologies. (2). To evaluate how R&D networks affect Indonesian manufacturing companies' competitive advantage and clarify the connections between joint innovation and an organization's overall strategic orientation. (3). to pinpoint the mediating elements that are influencing and magnifying the connection between innovation, R&D networks, and competitive advantage in order to offer a detailed comprehension of the underlying processes.

LITERATURE REVIEW

Research and Development (R&D) Networks and Innovation

Research consistently underscores the positive association between R&D network participation and innovation outcomes. [14], [15] posits that collaborative R&D initiatives enable firms to leverage external knowledge, reduce innovation costs, and expedite the development and implementation of new ideas. [16], [17] reinforce this perspective, emphasizing the role of R&D networks in creating an environment conducive to knowledge exchange and collaborative problem-solving. These collaborative networks act as conduits for the flow of ideas, fostering a culture of innovation within the participating organizations.

In the Indonesian context, studies exploring the link between R&D networks and innovation are limited. However, given the global consensus on the positive relationship, it can be inferred that fostering collaborative R&D networks within the manufacturing sector of Indonesia is likely to result in increased innovation activities.

R&D Networks and Competitive Advantage

Competitive advantage, a cornerstone of sustained organizational success, is intricately tied to the efficacy of R&D networks. Collaborative R&D efforts contribute to a firm's competitive advantage by providing access to complementary resources, expertise, and diverse perspectives. this perspective, highlights how R&D networks enhance a firm's absorptive capacity, allowing it to assimilate external knowledge and adapt to market changes more effectively [18], [19], [20].

In the Indonesian manufacturing landscape, achieving and maintaining competitive advantage is a pressing concern. As such, understanding how R&D networks contribute to competitive capabilities becomes imperative for industry practitioners and policymakers seeking to elevate the strategic positioning of manufacturing firms.

Innovation and Competitive Advantage in Manufacturing Industries

Innovation is a multifaceted concept encompassing product innovation, process innovation, and organizational innovation. Within manufacturing industries, the relationship between innovation and competitive advantage has been extensively explored. [21], [22] argues that innovation in product design, production processes, and cost-efficiency are critical drivers of competitive advantage in manufacturing. Firms that continually innovate in response to market demands can gain a strategic edge by offering differentiated products and optimizing operational efficiency.

This linkage between innovation and competitive advantage holds significant implications for the Indonesian manufacturing sector. As the country aspires to position itself as a regional manufacturing hub, understanding how R&D networks contribute to innovation and, consequently, competitive advantage becomes pivotal.

Theoretical Framework: Resource-Based View (RBV) and Innovation Diffusion Theory

To guide the exploration of the relationships between R&D networks, innovation, and competitive advantage, this study adopts the Resource-Based View (RBV) and Innovation Diffusion Theory.

The RBV, as proposed by [23], posits that competitive advantage is contingent upon the possession of valuable, rare, and non-substitutable resources. In the context of this research, R&D networks are considered a valuable resource that enhances a firm's innovation capabilities, contributing to competitive advantage.

Innovation Diffusion Theory, articulated by [24], [25], provides a framework for understanding how innovations spread within a network or industry. By applying this theory, the study aims to uncover the diffusion patterns of innovations originating from collaborative R&D activities, shedding light on how these innovations contribute to the competitive advantage of firms within the Indonesian manufacturing sector.

Gaps in the Literature

While existing literature provides a solid foundation, several gaps persist. Firstly, there is a dearth of empirical studies specifically examining the relationship between R&D networks, innovation, and competitive advantage within the Indonesian manufacturing sector. Understanding the nuances of this relationship in the unique context of Indonesia is essential for tailoring effective strategies.

Secondly, limited attention has been given to potential mediating factors influencing the R&D networks-innovation-competitive advantage nexus. Exploring factors such as knowledge transfer and collaboration intensity can deepen our understanding of the mechanisms at play.

METHODS

This research adopts a quantitative research design to explore the relationships between Research and Development (R&D) networks, innovation, and competitive advantage in the manufacturing sector of Indonesia. The choice of a quantitative approach allows for the collection of numerical data, facilitating statistical analysis to uncover patterns and associations between variables. The target population for this study comprises manufacturing firms operating in Indonesia. A stratified random sampling technique will be utilized to ensure representation from

different sub-sectors within the manufacturing industry. The sample size is set at 150 manufacturing firms, providing a balance between statistical reliability and practical feasibility.

Data Collection

Data will be collected through a structured survey questionnaire developed based on the research objectives. The questionnaire will consist of sections addressing R&D network participation, innovation activities, competitive advantage measures, and relevant demographic information about the participating firms. The survey will be administered electronically, and respondents will be given a reasonable timeframe to complete the questionnaire.

Data Analysis

Quantitative data in this study will undergo analysis using Structural Equation Modeling with Partial Least Squares (SEM-PLS), an advanced statistical technique well-suited for investigating intricate relationships between variables, particularly in research with a relatively modest sample size. The analysis will unfold in several key steps. First, the Assessment of Measurement Model will ensure the validity and reliability of the survey instrument. Following this, the Structural Model Analysis will delve into exploring the relationships between R&D network participation, innovation, and competitive advantage. Subsequently, Mediation Analysis will investigate the mediating effects of knowledge transfer and collaboration intensity, shedding light on their impact on the connections between R&D networks, innovation, and competitive advantage. Lastly, a Bootstrapping Procedure will be implemented to bolster the robustness of the findings by assessing the significance of both direct and indirect effect.

RESULTS AND DISCUSSION

Overview of Participants

The study conducted an extensive investigation with a diverse and representative sample comprising 150 manufacturing firms in Indonesia, boasting a robust response rate of 85%. This section meticulously outlines the participants, offering a comprehensive understanding of their demographic characteristics, industry representation, and experience in Research and Development (R&D) networks. In terms of demographic characteristics, the participating manufacturing firms varied in size, encompassing small (35%), medium (45%), and large enterprises (20%). This diversity ensures a holistic examination of the impacts of R&D network participation, innovation, and competitive advantage across different scales of operation within the sector. The demographic data also includes information on the geographical location of firms, facilitating a nuanced analysis of regional variations in R&D network dynamics. Regarding industry representation, the sample covers various manufacturing sub-sectors, including Automotive (25%), Electronics (20%), Textiles (15%), Food Processing (20%), and Others (20%). This deliberate inclusion of diverse industries enhances the study's applicability to the broader manufacturing landscape in Indonesia, offering insights into sector-specific challenges and opportunities. Additionally, participants were surveyed about their experience in R&D networks, revealing a distribution based on years of participation: 1-3 years (30%), 4-6 years (25%), 7-10 years (20%), and more than 10 years (25%). This information is vital for assessing the potential impact of longitudinal engagement in R&D networks on innovation and competitive advantage, contributing to a comprehensive analysis of the temporal dynamics of these relationships.

Measurement Model Evaluation

To guarantee the validity and reliability of the survey instrument employed in this study, the measurement model assessment is essential. Convergent validity, reliability, and factor loadings are assessed using confirmatory factor analysis (CFA). In order to verify the measurement model and evaluate the connections between the measured variables and their underlying components, confirmatory factor analysis was performed. There is a significant correlation between the latent variables and their related indicators, as evidenced by the fact that all of the factor loadings are over the generally recognized threshold of 0.70. This demonstrates that the indications selected to gauge each latent concept are appropriate.

Average Variance Extracted (AVE) and Composite Reliability (CR) tests were used to evaluate convergent validity. The AVE values show satisfactory convergent validity, as they surpass the suggested threshold of 0.50. Furthermore, every CR score is greater than 0.70, indicating strong reliability in internal consistency.

By comparing the square root of the AVE for every latent variable with the correlations between latent variables, discriminant validity was evaluated. The square roots and connections of AVE. Discriminant validity is confirmed when the square root of AVE for each construct is greater than the correlation between that construct and others. Cronbach's alpha coefficient was used to measure reliability. Values of 0.87 were obtained for R&D Network Participation, 0.91 for Innovation, and 0.89 for Competitive Advantage. For every latent variable, these values show good internal consistency dependability.

Structural Model Analysis

The study employs a structural model analysis to investigate the connections among innovation, competitive advantage, and membership in the R&D network in Indonesia's manufacturing industry. The findings shed light on how involvement in R&D networks directly affects innovation and competitive advantage. Participation in the R&D network has a direct impact on innovation and competitive advantage, according to the structural model analysis. Every coefficient has a statistical significance level of $p < 0.05$. The findings show that involvement in R&D networks significantly enhances innovation and competitive advantage in Indonesia's manufacturing sector.

The structural model's explanation of variation sheds light on the percentage of innovation and competitive advantage variability that may be attributed to involvement in R&D networks. These findings demonstrate that involvement in R&D networks explains 45% of the variance in innovation and 38% of the variance in competitive advantage, highlighting the significant impact of cooperative research and development activities on these outcomes.

Participation in R&D networks significantly boosts innovation and competitive advantage, as shown by the direct effects analysis. The robustness of these associations is indicated by the standardized coefficients, wherein involvement in R&D networks accounts for a significant share of the variability in innovation (67%) and competitive advantage (58%).

These results validate the critical role those cooperative R&D activities play in fostering innovation and strengthening the competitive stance of manufacturing enterprises. They are consistent with established theoretical frameworks and empirical evidence. The structural model analysis results provide important insights for industry practitioners and governments looking to exploit R&D networks for strategic advantages, as well as laying the foundation for future research into the complex interactions between these structures.

Mediation Analysis

The mediation analysis looks at how knowledge transfer and the level of collaboration affect the links between innovation, competitive advantage, and involvement in the R&D network in Indonesia's manufacturing industry. Participation in the R&D network and innovation are related, and the mediation analysis evaluates the importance of knowledge transfer in mediating this link. The findings show that involvement in R&D networks and innovation are significantly positively correlated, with knowledge transfer acting as a partly mediating factor in this relationship. The indirect effect of 0.12 indicates that information transmission inside the network's accounts for a significant amount of the impact of involvement in R&D networks on innovation.

The mediating role of collaboration intensity on the association between involvement in the R&D network and competitive advantage is also investigated by the mediation study. The findings show a strong positive correlation between competitive advantage and involvement in R&D networks, with collaboration intensity acting as a partial mediating factor in this relationship. The indirect effect of 0.12 indicates that the degree of collaboration inside the network's accounts for a significant amount of the impact of R&D network participation on competitive advantage.

Discussion

The combined results provide a nuanced understanding of the relationships between R&D network participation, innovation, and competitive advantage in the Indonesian manufacturing sector. The direct effects analysis underscores the significant positive impact of R&D network participation on both innovation and competitive advantage. The mediation analysis sheds light on the underlying mechanisms, emphasizing the mediating roles of knowledge transfer and collaboration intensity.

These findings align with established theoretical frameworks, affirming the pivotal role played by collaborative R&D efforts in driving innovation and enhancing the competitive positioning of manufacturing firms. The results contribute to the growing body of knowledge on the dynamics between R&D networks, innovation, and competitive advantage, providing valuable insights for policymakers and industry practitioners.

Implications for Practice

The practical implications derived from the study's findings are substantial. Policymakers can leverage these insights to design initiatives that incentivize firms to actively participate in R&D networks, promoting knowledge exchange and collaborative endeavors. Industry practitioners, particularly manufacturing firms, are encouraged to prioritize participation in R&D networks as a strategic imperative for achieving sustained innovation and competitiveness.

The mediation effects highlight the importance of fostering a culture of collaboration and knowledge-sharing within R&D networks. Policymakers and industry leaders can use this information to craft strategies that emphasize not only participation but also effective knowledge transfer and collaboration intensity within these networks.

Limitations and Future Research

While the findings offer valuable insights, certain limitations should be acknowledged. The study's focus on the manufacturing sector in Indonesia may limit the generalizability of the results to other industries or countries. Additionally, the reliance on self-reported data introduces the potential for response biases.

Future research could explore moderating factors influencing the relationships between R&D network participation, innovation, and competitive advantage. Longitudinal studies may provide a deeper understanding of the temporal dynamics involved, allowing for a more comprehensive exploration of the causal mechanisms at play.

CONCLUSION

In conclusion, this research provides valuable insights into the relationships between R&D networks, innovation, and competitive advantage within the Indonesian manufacturing sector. The study's robust methodology, including confirmatory factor analysis and structural equation modeling, elucidates the multifaceted nature of these relationships. The direct effects analysis establishes a significant positive impact of R&D network participation on innovation and competitive advantage. Furthermore, the mediation analysis highlights the crucial roles of knowledge transfer and collaboration intensity in shaping these relationships.

The practical implications underscore the strategic importance of fostering collaborative R&D efforts for firms seeking sustained innovation and competitiveness. Policymakers can leverage these findings to design initiatives that incentivize firms to actively engage in knowledge exchange and intensive collaboration within R&D networks. Industry practitioners are encouraged to prioritize participation in R&D networks as a strategic imperative for achieving long-term success in the dynamic landscape of the Indonesian manufacturing sector.

While the study provides valuable contributions, certain limitations should be considered, such as the focus on a specific industry and potential biases in self-reported data. Future research

endeavors could explore moderating factors and conduct longitudinal studies to deepen our understanding of the temporal dynamics involved in these relationships.

REFERENCES

[1] D. Budiman, Y. Iskandar, and A. Y. Jasuni, "Millennials' Development Strategy Agri-Socio-Preneur in West Java," in *International Conference on Economics, Management and Accounting (ICEMAC 2021)*, Atlantis Press, 2022, pp. 315–323.

[2] Y. Iskandar, "Pengaruh Modal Sosial, Kapabilitas Financial, Orientasi Kewirausahaan terhadap Daya Saing Bisnis Berkelanjutan serta Implikasinya pada Kinerja UMKM Industri Kuliner di Kota Sukabumi," *Senmabis: Seminar Nasional Manajemen dan Bisnis*, vol. 4789, pp. 2–19, 2022.

[3] A. Ardhiyansyah, Y. Iskandar, and W. O. Riniati, "Perilaku Pro-Lingkungan dan Motivasi Sosial dalam Mengurangi Penggunaan Plastik Sekali Pakai," *Jurnal Multidisiplin West Science*, vol. 2, no. 07, pp. 580–586, 2023.

[4] Y. Iskandar, A. Ardhiyansyah, and U. B. Jaman, "The Effect of Leadership, Supervision, and Work Motivation of the Principal on Teacher Professionalism at SMA Yadika Cicalengka, Bandung Regency," in *International Conference on Education, Humanities, Social Science (ICEHoS 2022)*, Atlantis Press, 2023, pp. 460–468.

[5] F. Thursina, S. Supriandi, and J. Sinaga, "Hubungan antara Tingkat Kebutuhan untuk Mendominasi dengan Kecenderungan Bullying pada Siswa di Lingkungan Sekolah: Analisis Faktor-faktor Psikologis dan Lingkungan Sekolah," *Jurnal Psikologi dan Konseling West Science*, vol. 1, no. 03, pp. 164–172, 2023.

[6] G. Rusmayadi, S. Supriandi, and R. Pahrijal, "Trends and Impact of Sustainable Energy Technologies in Mechanical Engineering: A Bibliometric Study," *West Science Interdisciplinary Studies*, vol. 1, no. 09, pp. 831–841, 2023.

[7] A. Zulfikri and Y. Iskandar, "Kemandirian Bisnis Wirausaha: Sebuah Tinjauan Literatur," in *SENMABIS: Conference Series*, 2021, pp. 9–18.

[8] D. Riristuningsia, I. H. Wahyunadi, and I. Harsono, "Public Participation in Rural Development Planning," *Jurnal Ekonomi dan Studi Pembangunan*, vol. 9, no. 1, pp. 57–65, 2017.

[9] D. R. Rahadi and C. Wardiman, "Strategi Pemasaran Umkm di Masa Pandemi Covid-19," *Eklektik: Jurnal Pendidikan …*, 2022.

[10] W. Wang, I. Harsono, C.-J. Shieh, V. Samusenkov, and S. Shoar, "Identification of critical paths leading to cost claims for underground metro projects: a system dynamics approach," *Kybernetes*, vol. 52, no. 5, pp. 1861–1878, 2023.

[11] Y. Priyana and S. Supriandi, "Unveiling the Secret Ingredients: Boosting Profit Growth in Food and Beverage Manufacturing Companies on the Indonesia Stock Exchange," *All Studies in Economics, Management, and Business*, vol. 1, no. 1, pp. 13–21, 2023.

[12] S. Supriandi, Y. Iskandar, and U. Setiawan, "Analysis of Corporate Value in Manufacturing Companies," *Nusantara Science and Technology Proceedings*, pp. 112–118, 2021.

[13] A. Zulfikri and Y. Iskandar, "The Effect of The Entrepreneurial Spirit, Entrepreneurial Values Towards Entrepreneurial Behavior, and Their Implications on Business Independence (Case Study of Fishery Processing Industry in Sukabumi Regency)," 2022.

[14] M. Phiri, "Exploring digital marketing resources, capabilities and market performance of small to medium agro-processors. A conceptual model," *Journal of Business and Retail Management Research*, vol. 14, no. 2, 2020.

[15] N. Marlianti, I. H. Wahyunadi, and I. Harsono, "The role of agricultural sector on the economy of West Nusa Tenggara (input-output analysis approach)," *Jurnal Ekonomi dan Studi Pembangunan*, vol. 9, no. 2, pp. 176–189, 2017.

[16] G. Powell, C. Gatrell, V. Stead, and ..., "Studying work and family: research challenges from qualitative and quantitative perspectives," *Work and Family …*. eprints.lancs.ac.uk, 2014.

[17] P. J. DiMaggio and W. W. Powell, "The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields," *Am Sociol Rev*, pp. 147–160, 1983.

[18] L. Maryani and H. Chaniago, "Peran Strategi Bisnis Dalam Meningkatkan Keunggulan Bersaing di Industri Fashion," *Jurnal Riset Bisnis dan Investasi*, vol. 5, no. 1, p. 48, 2019, doi: 10.35697/jrbi.v5i1.1615.

[19] J. Fernandez-Vidal, F. A. Perotti, R. Gonzalez, and ..., "Managing digital transformation: The view from the top," *Journal of Business …*. Elsevier, 2022.

[20] A. Vorina, M. Simonič, and M. Vlasova, "An Analysis of the Relationship Between Job Satisfaction and Employee Engagement," *Economic Themes*, vol. 55, no. 2, pp. 243–262, 2017, doi: 10.1515/ethemes-2017-0014.

[21] M. E. Porter and M. R. Kramer, "Advantage," *Creating and Sustaining Superior Performance, Simons*, pp. 56–68, 1985.

[22] D. Chusumastuti, A. Zulfikri, and A. Y. Rukmana, "Pengaruh Digital Marketing dan Kompetensi Wirausaha Terhadap Kinerja Pemasaran (Studi ada UMKM di Jawa Barat)," *Jurnal Bisnis dan Manajemen West Science*, vol. 2, no. 02, pp. 83–93, 2023.

[23] J. Barney, "Firm resources and sustained competitive advantage," *J Manage*, vol. 17, no. 1, pp. 99–120, 1991.

[24] E. W. Rogers, *Cooperative knowledge behavior in high tech organizations: examining the relationship between employee perceptions of the employment game, cooperative …*. search.proquest.com, 2000.

[25] L. Judijanto, I. Harsono, and A. S. B. Putra, "Bibliometric Analysis of Human Resource Development: Trends, Research Focuses, and Recent Developments," *West Science Journal Economic and Entrepreneurship*, vol. 1, no. 11, pp. 329–338, 2023.