

SYSTEMATIC LITERATURE REVIEW ON TECHNOLOGICAL TURBULENCE IN MSMEs

RAYYAN SUGANGGA

Sekolah Tinggi Ilmu Ekonomi Indonesia Malang

Email: rayyan@stieimlg.ac.id

IRADAH RAHMAN

Sekolah Tinggi Ilmu Ekonomi Indonesia Malang

Email: iradah.rahman@stieimlg.ac.id

ABSTRACT

Abstract. Technological turbulence is an important factor affecting the innovation performance of small companies in today's rapidly changing business environment. Technological turbulence refers to unpredictable technological changes that can have a significant impact on a business, especially in the context of innovation performance. Articles are compiled using Systematic Literature Review from the Scopus database for publishing searches from 1984 to 2024. The results of this study show that importance of adaptability, innovation and strategic orientation in managing the challenges posed by technological turbulence in various organizational contexts. In addition, future research could use longitudinal methods and need to carry out specific sectoral analyzes to understand how various industries are impacted by technological turbulence.

Keywords: *Technological Turbulence, MSME, Systematic Literature Review, SLR*

INTRODUCTION

Technological turbulence is a critical issue that affects small firms' innovation performance in today's rapidly changing business environment. Technological turbulence is the term used to describe unpredictable developments in technology that can significantly impact a company's ability to innovate and stay competitive. In this research, we will conduct a comprehensive literature analysis to examine the relationship among technological turbulence, flow experience, innovation performance, and small business growth.

The idea of technological turbulence and how it affects innovation performance will be covered first in the literature review. Next, we will investigate how technological turbulence and innovation performance relate to flow experience. We will conclude by presenting the results of our comprehensive literature study and talking about the implications for companies trying to minimize the risks and take advantage of the opportunities brought about by technological turbulence.

A thorough search of pertinent academic databases, such as Google Scholar, ResearchGate,

and JSTOR, will serve as the foundation for the systematic literature review. Among the search terms that will be used are "technological turbulence," "innovation performance," "flow experience," and "small firm growth." The quality, methodological rigor, and relevance of the articles chosen for the review will all be taken into consideration.

The relationship between technological turbulence, flow experience, innovation performance, and small business growth will be more clear to readers by the end of this paper. Businesses can use this information to create plans to deal with the difficulties caused by technological upheaval and take advantage of the opportunities it offers.

This article aims to identify, analyze, and synthesize scientific findings related to technological turbulence. Through the SLR approach, the authors aim to uncover research trends, topics or themes related specifically to innovation and growth of MSMEs. In addition, this article also aims to identify research gaps and provide recommendations for future research, so that it can be a comprehensive reference for academics and practitioners in understanding and responding to the dynamics of rapid technological change.

THEORETICAL STUDIES

Technological turbulence refers to the unpredictable changes in technology that can significantly impact businesses, particularly in the context of innovation performance. It is a critical factor that affects the way companies operate and adapt to market conditions. In environments with high levels of technological turbulence, businesses may face challenges in maintaining their competitive position due to the rapid changes in technology. However, technological turbulence can also present opportunities for innovation, as it can drive enterprises to develop new products and services to stay relevant in the market.

Technological turbulence is often studied in the context of new product development practices and its impact on innovation performance. According to the literature, technological turbulence is defined as the rate of technological change within an industry, which can lead to uncertainty for new product development teams. It is caused by technological discontinuities that depart from existing technology and practices, increasing the uncertainty for the team. Technological turbulence has been found to have a positive relationship with innovative outcomes in some contexts, but it can also negatively impact costs from addressing the uncertainty and have no direct effect on quality or cycle time. In the context of small and medium-sized enterprises (MSMEs), perceived technological turbulence refers to entrepreneurs' perception of the rate of technological change in their industry. This perception can influence decision-making, risk-taking, and flow experience, which in turn can impact innovation performance and small firm growth.

Businesses trying to manage the quickly evolving technology world must comprehend the relationship between technological turbulence, flow experience, innovation performance, and small company growth. In order to investigate the relationship between technical turbulence, flow experience, innovation performance, and small business growth in the context of MSMEs, we shall do a comprehensive literature review in this paper. A thorough search of pertinent academic databases will serve as the foundation for the literature evaluation, which will assess the articles' quality, methodological rigor, and relevance. The relationship between technological turbulence, innovation performance, and small business growth in the context of MSMEs will be clearer to readers by the end of this article. This information can assist entrepreneurs, policymakers, and MSMEs in creating plans to take advantage of the

opportunities that technological turbulence presents while reducing the risks that come with it.

RESEARCH METHODS

The goal of this research is to understand the Technological turbulence of MSMEs utilizing the Systematic Literature Review (SLR) method. SLR is a methodical way to discovering, analyzing, and interpreting prior works in a certain topic is the systematic literature review. The SLR uses a highly structured, transparent and replicable approach to avoid bias and provide thorough and reliable conclusions. The basic objective of SLR is to summarize existing empirical data, identify gaps in current research, give a basis for evidence-based decision-making, and lead future research. The strength of SLR resides in its explicit and systematic technique, which allows other researchers to reproduce the process and validate the findings.

Conducting an SLR involves a series of carefully planned and well-documented stages. The process generally begins with the formulation of a clear and specific research question, which will guide the entire review process. The next step is the development of a research protocol detailing the study inclusion and exclusion criteria, a comprehensive literature search strategy (including databases to be searched and keywords to be used), procedures for selecting studies, methods for extracting relevant data from selected studies, and approaches for assessing the methodological quality of the studies. Once eligible studies have been identified and data extracted, the next step is the synthesis of findings, which can be qualitative (such as thematic analysis) or quantitative (such as meta-analysis). Finally, the results of the SLR are presented in a structured report, which transparently explains the entire process and presents the conclusions and implications of the findings.

Identify Research Statement

The SLR technique will investigate the following questions in order to uncover the idea of technological turbulence in MSMEs.

- R1. What does technological turbulence mean?
- R2. How is the development of research related to technological turbulence?
- R3. What research topics or variables are related to technological turbulence?
- R4. What issues were faced during the Technological Turbulence period?
- R5. What is the relationship between technological turbulence, innovation performance, and small firm growth in the context of MSMEs

Study Identification and Selection

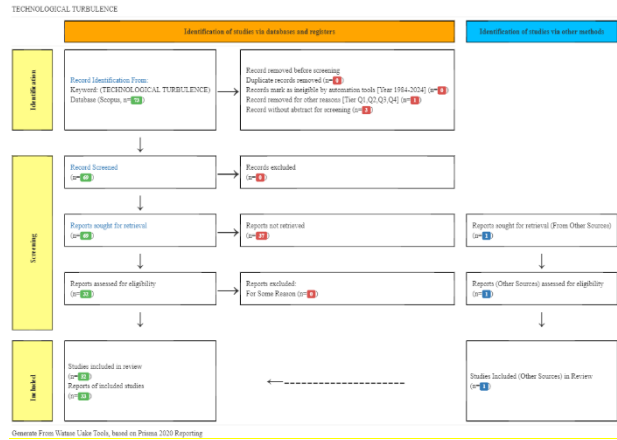
To find relevant studies used various tools such as watase uake, science direct and others, with the following criteria:

Criteria	Limitation
Year from	1984
Year to	2024
Tier (Q1,Q2,Q3,Q4)	Q1,Q2,Q3,Q4

Searching relevant studies using the keyword "Technological Turbulence" with the criteria mentioned above so that 73 articles from the Scopus database, where there are 4 articles that do not meet the requirements.

Study Screening and Extraction

At the screening stage, the author determined 69 articles that were considered relevant. However, there were 37 articles that were not collected, and in the end 33 articles were obtained.



Picture 1 : Generate from Watase Uake Tools, based on Prisma 2020 Reporting

Here are 33 relevant articles :

No	Author and Titles	Year
1	Crick, James M., Friske, Wesley, Morgan, T. A. <i>The relationship between coopetition strategies and company performance under different levels of competitive intensity, market dynamism, and technological turbulence.</i> Elsevier.	2024
2	Puriwat, W., & Hoonsopon, D. <i>Cultivating product innovation performance through creativity: the impact of organizational agility and flexibility under technological turbulence.</i>	2022
3	Folger, N., Brosi, P., & Stumpf-Wollersheim, J. <i>Perceived technological turbulence and individual ambidexterity – The moderating role of formalization.</i>	2022
4	Adomako, Samuel. Amoah, Joseph Amankwah. Danguah, J. K. <i>R&D support, technological turbulence, and SMEs's degree of internationalization: The mediating role of technological capability.</i>	2022
5	Santos, L. L. dos, Borini, F. M., & Pereira, R. M. <i>Bricolage as a path towards organizational innovativeness in times of market and technological turbulence.</i>	2021
6	Cai, W., Wu, J., & Gu, J. (2020). <i>From CEO passion to exploratory and exploitative innovation: the moderating roles of market and technological turbulence.</i>	2020
7	Ogbeibu, S., Emelifeonwu, J., Senadjki, A., Gaskin, J., & Kaivo-oja, J. (2020). <i>Technological turbulence and greening of team creativity, product innovation, and human resource management: Implications for sustainability.</i>	2020
8	Martin, S. L., Javalgi, R. (Raj) G., & Ciravegna, L. (2020). <i>Marketing capabilities and international new venture performance: The mediation role of marketing communication and the moderation effect of technological turbulence.</i>	2020
9	Ullah, A., Iqbal, S., & Shams, S. M. R. (2020). <i>Impact of CRM adoption on organizational performance: Moderating role of technological turbulence.</i> <i>Competitiveness Review</i> , 30(1), 59–77.	2020
10	Srinivasan, M., Srivastava, P., & Iyer, K. N. S. (2020). <i>An empirical model of salesperson competence, buyer-seller trust and collaboration: the moderating role of technological turbulence and product complexity.</i>	2020
11	Carbonell, Pilar. Escudero, A. I. R. (2020). <i>The Effect of Transactive Memory Systems on Job Stress of New Product Development Teams: Moderating Effects of Project Complexity and Technological Turbulence.</i> <i>IEEE Xplore.</i>	2020
12	Sahi, G. K., Gupta, M. C., Cheng, T. C. E., & Lonial, S. C. <i>Relating entrepreneurial orientation with operational responsiveness: Roles of competitive intensity and technological turbulence.</i>	2019
13	Yun, Sunyoung. Lee, Joosung., Lee, S. <i>Technology Development Strategies And Policy Support For The Solar Energy Industry Under Technological Turbulence.</i> Elsevier.	2019
14	Dai, H., Zeng, D., Qualls, W. J., & Li, J. <i>Do social ties matter for the emergence of dominant design? The moderating roles of technological turbulence and IRP enforcement.</i>	2018
15	Chen, Tingting. Li, Fuli. Chen, Xiao-Ping. Ou, Z. <i>Innovate or Die: How Should Knowledge - worker teams respond to technological turbulence.</i> Elsevier.	2018
16	Pratono, A. H. <i>Does Firm Performance Increase With Risk - Taking Behavior Under Information Technological Turbulence ?</i> Emerald.	2018

17	Wu, L., Liu, H., & Zhang, J. <i>Bricolage effects on new-product development speed and creativity: The moderating role of technological turbulence.</i>	2017
18	Tsai, J. M., & Hung, S. W. <i>Supply chain relationship quality and performance in technological turbulence: An artificial neural network approach.</i>	2016
19	Arora, A., Arora, A. S., & Sivakumar, K. <i>Relationships among supply chain strategies, organizational performance, and technological and market turbulences.</i>	2016
20	Pratono, A. H. <i>Strategic orientation and information technological turbulence: Contingency perspective in SMEs.</i>	2016
21	Wilden, R., & Gudergan, S. P. <i>The impact of dynamic capabilities on operational marketing and technological capabilities: investigating the role of environmental turbulence.</i>	2015
22	Carbonell, P., & Escudero, A. I. R. <i>The negative effect of team's prior experience and tecmological turbulence on new service development projects with customer involvement.</i>	2015
23	Bodlaj, Mateja. Coenders, Germa. Zabkar, V. <i>Responsive and Proactive Market Orientation and Inmocation Success Under Market and Technological Turbulence.</i>	2014
24	Nordtvedt, Liliana Perez. Mukherjee, Debmalya. KEdia, B. L. K. <i>Cross-Border Learning, Technological Turbulence and Firm Performance.</i>	2014
25	Lichtenthaler, U. <i>Retraction: "Technological turbulence and the impact of exploration and exploitation within and across organizations on product development performance.</i>	2014
26	Chaves, Roberto. Yu, Wantao. Jacobs, Mark. Fynes, Brian. Wiengarten, Frank. Lecuna, A. <i>Internal lean practices and performance: The role of Technological Turbulence.</i>	2014
27	Chen, Jiyao. Neubaum, Donald O. Reilly, Richard R., Lynn, G. S. <i>The Relationship Between Team Autonomy and New Product Development Performance Under Different Levels of Technological Turbulence.</i>	2014
28	Vaan, M. <i>Interfirm networks in periods of technological turbulence and stability.</i>	2014
29	Fernandez, Pilar. Del Rio, M. Luisa, Varela, Jose. Bander, B. <i>Relationship among functional units and new product performance: The moderating effect of thecnological turbulence.</i>	2010
30	Terawatanavong, Civilai. Whitwell, Gregory J., Widing, Robert E., O. A. <i>Technological Turbulence, Supplier Market Orientation, and Buyer Satisfaction.</i>	2009
31	Wang, Z. <i>Technological Innovation and Market Turbulence: The dot-com experience.</i>	2006
32	Hall, J., & Rosson, P. <i>The impact of technological turbulence on entrepreneurial behavior, social norms and ethics: Three internet-based cases.</i>	2006
33	Cadogan, J. W., Cui, C. C., & Li, E. K. Y. <i>Export market-oriented behavior and export performance: The moderating roles of competitive intensity and technological turbulence.</i>	2003

Each article is then extracted through an analysis of variables, hypotheses, the article production process, the nation of origin, techniques, data collecting, research design, novelty, limitations, future research, and other analyses.

RESULTS AND DISCUSSIONS

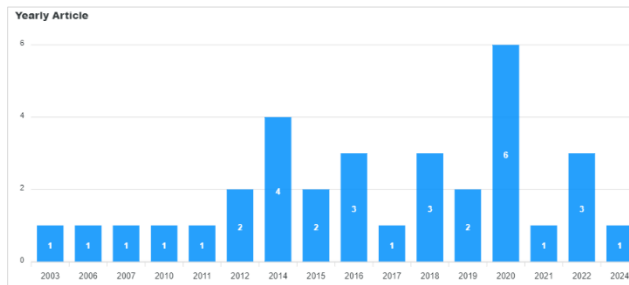
- R1. What does Technological Turbulence mean?

The effect of technological upheaval on organizational effectiveness and innovation is covered in articles. They look at how businesses' ability to innovate and maintain their competitiveness is impacted by the quick changes in technology.

The pace and unpredictability of technical changes within an industry is known as technological turbulence. This idea captures how technology is always changing and how it affects how organizations operate (Folger et al., 2022) (Dai et al., 2018). The frequent and erratic changes

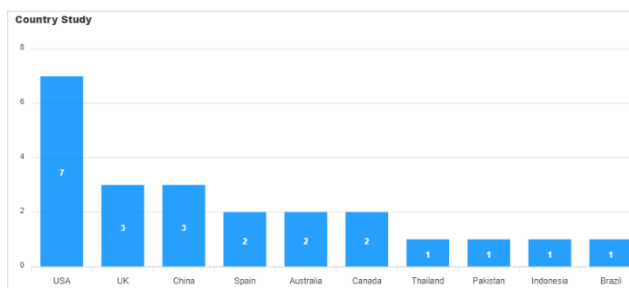
in technologies, which highlight expertise and the level of innovation, are characteristics of technological turbulence. It implies that organizations' current technologies may become obsolete more quickly due to unforeseen changes in technical surroundings (Arora et al., 2016).

- R2. Development of Technological Turbulence Research



Picture 2 : Yearly Article

In this systematic literature review, research using the term Technological Turbulence began to appear in 2003, and will continue to appear until 2024.



Picture 3 : Country Study

Theme of technological turbulence is widely studied by US researchers, followed by the UK and China. Countries in Southeast Asia itself are only from Thailand and Indonesia.

- R3. Topics or Variables Related to Technological Turbulence

The articles discuss several topics and variables related to technological turbulence.

Among them are related organizational capabilities yang membahas need for organizations to develop dynamic capabilities such as sensing and reconfiguring processes to adapt to technological changes is frequently mentioned. These capabilities help firms maintain their competitiveness in turbulent environments The role of green HRM practices in fostering innovation and sustainability in the face of technological turbulence is discussed. This includes training and involving employees in green initiatives to enhance organizational adaptability.

The importance of knowledge management and leveraging social ties (both business and political) in turbulent technological environments is highlighted. These relationships help firms gain resources and information critical for innovation and adaptation.

The impact of technological turbulence on firm performance is analyzed, with a focus on how firms can mitigate negative effects through strategic alliances, effective management practices, and continuous innovation.

Technological turbulence is seen to moderate various relationships within organizations. For instance, it positively moderates the relationship between bricolage (resourcefulness) and new product development speed, enhancing the ability to quickly respond to opportunities. It also influences the relationship between marketing capabilities and competitive strategies, making it crucial for firms to adapt their marketing communications in high-tech environments (Dai et al., 2018) (Martin et al., 2020).

- R4. What issues were faced during the Technological Turbulence period?

Issues that always arise when there is new technology, are disruption issues that disrupt old business patterns or models, as well as ethical issues and norms (Hall & Rosson, 2006). Then the rapid pace of technological change can lead to increased stress and lower morale among employees. Firms

need to provide support and training to help employees cope with the demands of a turbulent technological environment. Rapid technological changes create opportunities for developing new and distinctive services, but they also introduce challenges. Technological turbulence can lead to the rapid obsolescence of existing products, forcing firms to continually innovate and adapt (Pratono, 2016) (Ullah et al., 2020) (Arora et al., 2016).

- R5. What is the relationship between technological turbulence, innovation performance, and small firm growth in the context of MSMEs

Technological turbulence affects the ability of small and medium-sized enterprises (SMEs) to implement opportunity-driven strategies effectively. It indicates that SMEs with greater strategic orientation can increase their performance under certain conditions, but high levels of technological turbulence can hinder this process (Ullah et al., 2020) (Santos et al., 2021).

Technological turbulence impacts innovation processes, requiring firms to engage in both exploratory and exploitative innovation. It also affects the speed of new product development, with higher turbulence necessitating faster adaptation and innovation. The impact of technological turbulence on firm performance is analyzed, with a focus on how firms can mitigate negative effects through strategic alliances, effective management practices, and continuous innovation.

Innovation and research and development (R&D) activities are crucial for firms operating in technologically turbulent environments. These activities help firms develop new products and improve processes to stay competitive (Pratono, 2016) (Carbonell & Escudero, 2015). Technological turbulence creates entrepreneurial opportunities by accelerating the rate of change in scientific and market contexts. It drives firms to be more innovative, leveraging new knowledge,

relationships, and causality systems to maintain competitiveness (Santos et al., 2021).

CONCLUSION

From the discussion above, it is clear the importance of adaptability, innovation and strategic orientation in managing the challenges posed by technological turbulence in various organizational contexts.

FURTHER RESEARCH AND LIMITATIONS

A limitation found in this SLR is that some studies use cross section design, which limits the ability to draw causal conclusions between variables. Longitudinal studies are recommended to establish more assertive causality. Some studies collected data from a single respondent per company, which can introduce bias. Using multiple respondents from different functional areas within the same organization could provide a more comprehensive view and reduce potential biases. Future research should conduct sector-specific analyses to understand how different industries are affected by technological turbulence. This includes investigating the unique challenges and opportunities faced by service industries compared to manufacturing sectors.

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