

Review

# Technology adoption in the measurement of innovation performance in SMEs: A systematic literature review

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**Abstract:** Continuous innovation is very much needed by small and medium enterprises (SMEs), however many SMEs still use traditional or closed approaches to innovation. Digital technological transformation has become a necessity for long-term survival and development in all SMEs, but currently there is no systematic definition of the innovation performance of SMEs that use digital technology. Seeing this, by using visual analysis of knowledge maps, this paper systematically identifies the role of the use of digital technology in measuring SME innovation performance using data on Scopus to provide references and inspiration for future researchers. The development of researchers who take up the topic of SMEs' innovation performance from 2004 to 2023 is quite increasing, but there are very few who take up technology adoption in measuring SMEs' innovation performance because researchers always focus on the new products produced. Based on research findings, it can be concluded that more and more SMEs are achieving innovation performance by adopting technology because many SMEs already have digital platform capabilities so this can influence SME innovation performance. However, in several other studies, technology adoption cannot be used as a reference in improving innovation performance.

**Keywords:** technology adoption; innovation performance; SMEs; innovation performance in SMEs; systematic literature review; VOSviewer

## 1. Introduction

The developments that occur in the management practices of small and medium enterprises (SMEs) in the current modern era, there are many factors that can drive success, one of which is innovation. Innovation carried out by SMEs on an ongoing basis can encourage the country's growth and can directly strengthen competitiveness both nationally and internationally (Tobiassen and Pettersen, 2017). Continuous innovation is very much needed by SMEs, however many SMEs still use traditional or closed approaches to innovation. Closed innovation is said to be traditional innovation because companies in developing new products and services only use the company's internal resources (Alfarobi and Hartono, 2022). Innovation development that only focuses on the company's internal knowledge is in stark contrast to current competitive conditions, because this closed innovation model does not encourage accelerated progress for the company. Companies will lose a number of opportunities originating from activities outside the company that have the potential to optimize company performance by combining internal and external technology (Chesbrough, 2003).

SMEs have low innovation, caused by many internal obstacles such as the lack of implementation of digital technology as a strategy. Low innovation performance in SMEs will lead to lower profitability and customer loyalty, even though innovation in theory can improve the quality of existing products and be able to introduce new products to customers. According to Ghazilla et al. (2015) suggests that SMEs experience poor innovation performance because they have inadequate or incompetent human resources. Their employees are not prepared or prepared to change according to the current situation. In this case, SMEs experience a shortage of qualified employees, limited internal training, and the inability to retain employees who are competent to innovate. A study by Alegre et al. (2013) found that knowledge in organizations greatly influences the innovation performance of high-tech small and medium enterprises. SMEs that spend more on research and development (R&D) tend to have better innovation performance. Leveraging knowledge through intellectual capital, especially in R&D, helps SMEs realize their innovation potential.

Digital technological transformation has become a necessity for long-term survival and development in all levels of society. Digital transformation refers to the process of reconstructing a business model using a combination of emerging digital technologies such as artificial intelligence, cloud computing, blockchain, and big data. The use of digital transformation to increase production efficiency and company innovation has achieved initial results in several companies such as China, Vietnam, Pakistan, Taiwan, Malaysia, Indonesia, South Korea, Nigeria, American, and South African respectively which have made digital transformation a focal point of development strategy in managing SMEs. However, research results (Sussan et al., 2017) show that there is no direct positive correlation between digital technology and company performance. Hajli et al. (2015) found that only some companies benefited from digitalization, while other companies did not, such as the banking industry in Nigeria and the UK. This shows that producing technology alone is not enough, technology must also be disseminated, then absorbed and applied before its benefits can be fully realized (Chesbrough, 2019), this phenomenon is known as the “IT paradox”

SMEs are embracing digital transformation at an exponential rate in an effort to spur development through the adoption of new business models and digital technologies. The development of digital technology has made things easier for business people, so that they no longer encounter difficulties in obtaining any information that can be easily and quickly spread widely to support business activities globally. Internet users in business change its function to become a tool for exchanging information electronically into business strategy applications, such as; marketing, sales and customer service (Yuliana, 2004).

The significant expansion of the digital industry and the continuous digitalization process of companies are two indicators of the success of digital transformation. The development of the digital economy has become a strategic choice to exploit the new opportunities presented by the new round of technological revolution and industrial transformation, and various studies have confirmed the impact of enterprise digital transformation on innovation (Gaglio et al., 2022; Peng and Tao, 2022; Sudarnice et al., 2023; Y. Chen et al., 2021). The digital industry

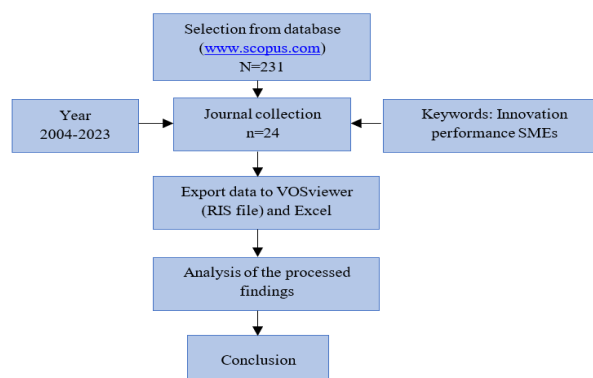
provides digital technology, products, services, infrastructure and solutions for the development of corporate digitalization. This means that the innovation level of regional digital industries is important in the influence of a company's digitalization innovation. So, what is the role of the use of digital technology in measuring SME innovation performance? This is the research question we asked. This research is very important because there has been no previous research that focuses on measuring the innovation performance of SMEs based on digital technology. In addition, based on the identification of articles from all research on SME innovation performance, only a few use digital technology measurements.

Currently, there is no systematic definition of the innovation performance of SMEs that use digital technology. It is generally believed that SME innovation performance is the result or output after innovation activities or innovation behavior (Chen et al., 2018). Research on SME innovation performance will help to have a clearer understanding of the input and output processes of SME innovation activities. Seeing this, by using visual analysis of knowledge maps, this paper systematically identifies the role of the use of digital technology in measuring SME innovation performance. This article presents a systematic literature review (SLR) investigating innovation performance in SMEs using data on Scopus to provide references and inspiration for future researchers.

The marginal contribution of this research has two main points: First, it is different from previous literature, where this research focuses on research that takes the topic of SME innovation performance with digital technology-based measurements. Second, introduce the factors that influence increasing the innovation performance of digital technology-based SMEs.

## 2. Materials and methods

The method used in this research is structured literature review (SLR), where this research looks for evidence in the literature to answer the research question, namely, what is the role of the use of digital technology in measuring SME innovation performance (Janjua et al., 2021). The SLR analysis was conducted in conjunction with the research protocol (see **Figure 1**), which served as the methodological foundation necessary to validate and propose a structured knowledge base for decision makers and research analysts (Tranfield et al., 2003). SLR analysis is carried out in three stages, as proposed by Tranfield et al. (2003).



**Figure 1.** Stages of SLR analysis.

An initial search of the relevant literature can help determine whether the topic is too broad to be covered adequately in a given time period or requires narrowing the topic. Once the focus is determined, SLR can be carried out to find more specific studies related to the topic in this research. This researcher searched for data using the filtering stage in the research procedure (Rejeb et al., 2022). The second step, the literature review process adopted to fulfill the research objectives of the proposed study (Paul et al., 2017; Snyder, 2019). The Scopus online research database is used to search for studies related to SME innovation performance with the following criteria:

TITLE-ABS-KEY (“innovation performance” AND “SMEs”) AND (LIMIT-TO (PUBSTAGE, “final”)) AND (LIMIT-TO (DOCTYPE, “ar”)) AND (LIMIT-TO (EXACTKEYWORD, “Innovation Performance”) OR LIMIT-TO (EXACTKEYWORD, “SMEs”) OR LIMIT-TO (EXACTKEYWORD, “Small and Medium-sized Enterprise”) OR LIMIT-TO (EXACTKEYWORD, “SME”)) AND (LIMIT-TO (LANGUAGE, “English”)) AND (LIMIT-TO (SRCTYPE, “j”))

A total of 231 articles were found in the Scopus database from 2004 to 2023. The author used search criteria on the topic “SME innovation performance” in the Scopus database to find previous research. Based on identification of suitability to the research topic, we found 207 articles that were less suitable, so our total of suitable articles was 24 articles based on identification in the abstract, title, and measurement of innovation performance in SMEs that adopt digital technology. Finally, 24 articles that fit the topic were then analyzed using a literature review with the help of VOSviewer to map the data using systematic and detailed methods.

### **3. Results and discussion**

The analysis results are grouped into two parts: descriptive and conceptual. Descriptive results include several metrics to describe the current research context; These metrics include authors and journals, annual distribution, geographic spread, and research methods. The conceptual results define the antecedent variables, moderator variables, mediation and measurement involved in the innovation performance of SMEs from the conceptual framework.

#### **3.1. State contribution**

Based on a literature review of 93 articles that adopted technology in increasing the innovation performance of SMEs, only 24 articles. The development of researchers who take up the topic of SMEs’ innovation performance from 2004 to 2023 is quite increasing, but there are very few who take up technology adoption in measuring SMEs’ innovation performance because researchers always focus on the new products produced. Apart from that, very few SMEs can be found explaining the production or operational processes of SMEs that use high or digital technology. During the COVID-19 pandemic, many researchers used technology adoption as a benchmark for SMEs’ innovation performance. This illustrates that many SMEs during the pandemic and after the pandemic adopted digital technology, especially in China (**Figure 2**).

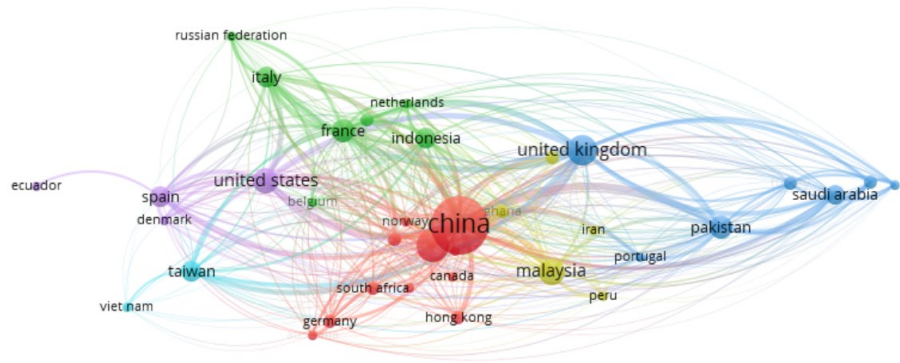


Figure 2. State contribution.

### 3.2. Variable relationship

In general, researchers adopt measuring innovation performance from Janssen et al. (2004), Alegre and Chiva (2008), which focuses on the new products produced. Even though long before that there had been measurements based on the adoption of technology such as Ahn et al. (2015), Bell (2005), Daft (1978), Hagedoorn and Cloudt (2003), Kleinknecht et al. (2003), Kleinknecht and Montfort (2002), Thi and Nguyen (2021), in the form of new products, especially products with original technology and design. Apart from that, patent applications are also used, although patent applications are an imperfect measure of innovation and not all innovations are patented (Brent and Walter, 2007), patent applications have been used as a common measure of innovation performance in the extant literature (Ahuja and Katila, 2001; Salomon and Jin, 2010).

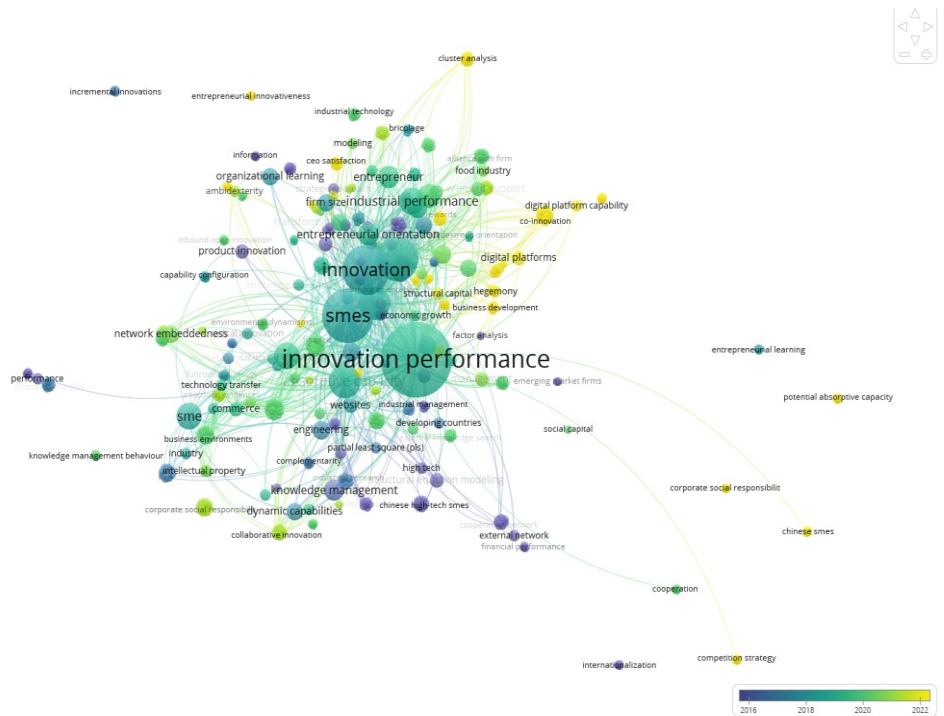


Figure 3. Variable relationship.

Figure 3 shows that the many variables used are very diverse (both as antecedents, mediation and moderation which can be seen clearly in Table 1.

**Table 1.** Variables used in increasing innovation performance of SMEs.

No. Artikel	Author	Antecedent	Mediation	Moderation	Country
(2)	(Jiang et al., 2023)	Digital platform capability	Value co-creation	Ecological institutional norms	China
(3)	(Thi and Nguyen, 2021)	Personality traits	Entrepreneurial innovativeness		Vietnam
(5)	(Farrukh et al., 2021)	Political ties	Absorptive capacity	Technological turbulence	Pakistan
(8)	(Jun et al., 2022)	Digital platform Capability, improvisational Capability	Organizational Readiness		Pakistan
(9)	(Khattak et al., 2022)	digital platforms	Innovation culture	frugal innovation	Pakistan
(15)	(Jaidi et al., 2022)	Social network	Ambidexterity	Proactiveness, commitment to innovation	Indonesia and Taiwan
(17)	(Tong and Rahman, 2022)	Innovation orientation	Capability flexibility, resource flexibility		China
(18)	(Torres de Oliveira et al., 2022)	Barriers to innovation	External knowledge search		China
(22)	(Ngah et al., 2022)	Innovation capital, organizational capital, and technological capital	Innovative intelligence		Malaysia
(25)	(Cui et al., 2022)	Transformational leadership style, and Transactional leadership style	Organizational learning		China
(35)	(Jacob et al., 2022)	Intra-cluster ties, extra-cluster ties and risk taking	Ambidexterity		Indonesia
(39)	(Khattak, 2022)	digital platforms	Innovation culture	E-commerce marketing capabilities	Pakistan
(44)	(Wang et al., 2022)	Industry-university-research (IUR) alliance portfolio breadth, and IUR alliance portfolio depth		Regional marketization degree	China
(75)	(Jeong et al., 2021)	Government support, R&D Investment	Alliance with university, and alliance with other firm		South Korea
(79)	(Lu and Yu, 2020)	External collaboration		Organizational legitimacy, and managers' entrepreneurial orientation	China
(86)	(Ibidunni et al., 2020)	Training, R&D, social networks			Nigeria
(90)	(Wang et al., 2020)	patent cooperation network			China
(134)	(Widodo and Nuhayatie, 2018)	Proactive, risk taking, innovative culture	Exploitability knowledge		Indonesia
(141)	(Zhai et al., 2018)	Entrepreneurial orientation		Absorptive capacity	China
(150)	(Raymond et al., 2018)	Absorptive capacity	Social networking sites (SNSs)		Global
(182)	(Alves et al., 2016)	External network utilization		Entrepreneurial Orientation	American
(187)	(Ren et al., 2015)	Firm R&D capability, firm internationalization		Firm R&D capability, firm Marketing capability	China
(193)	(Urban and Greyling, 2015)	Opensource software adoption			South African
(218)	(Wang and Han, 2011)	Properties of knowledge		Absorptive capacity	China

For the variable antecedent that is often used is digital platform adoption. This proves that more and more SMEs achieve innovation performance by joining digital platforms because digital platform capabilities can directly influence SME innovation performance (Jiang et al., 2023; Jun et al., 2022; Khattak et al., 2022). Apart from that, the variables personality traits, political ties, improvisational capability, social network, innovation orientation, barriers to innovation, innovation capital, organizational capital, technological capital, transformational leadership style, transactional leadership style, intra-cluster ties, extra-cluster ties, risk taking, industry-university-research (IUR) alliance portfolio breadth, IUR alliance portfolio depth, government support, R&D investment, external collaboration, training, R&D, social networks, patent cooperation network, proactive, risk taking, innovative culture, entrepreneurial orientation, absorptive capacity, external network utilization, firm R&D capability, firm internationalization, open source software adoption, and properties of knowledge are antecedent factors in increasing the innovation performance of SMEs.

To mediate the innovation culture variable into aspects that can indirectly influence the innovation performance of SMEs including innovative intelligence and entrepreneurial innovativeness (Jiang et al., 2023; Jun et al., 2022; Khattak, 2022; Ngah et al., 2022; Thi and Nguyen, 2021). Apart from that, the variables value co-creation, absorptive capacity, organizational readiness, ambidexterity, capability flexibility, resource flexibility, external knowledge search, organizational learning, alliance with university and alliance with other firms, exploitability knowledge, and social networking sites (SNSs) are variables that have an indirect influence on the innovation performance of SMEs.

To moderate the variables (ecological institutional norms, technological turbulence, frugal innovation, proactiveness, commitment to innovation, e-commerce marketing capabilities, regional marketization degree, organizational legitimacy, managers' entrepreneurial orientation, absorptive capacity, entrepreneurial orientation, firm R&D capability, and firm marketing capability) can strengthen the relationship between antecedents and mediation on the innovation performance of SMEs

Of the 24 articles, there are 16 articles that show that technology adoption greatly influences innovation performance in Small and Medium Enterprises (SMEs), namely (A2), (A5), (A8), (A9), (A15), (A17), (A18), (A25), (A35), (A39), (A44), (A90), (A141), (A150), (A182), (A187). Meanwhile, in other articles, several hypotheses had an insignificant effect (**Table 2**).

**Table 2.** Research that provides an insignificant influence.

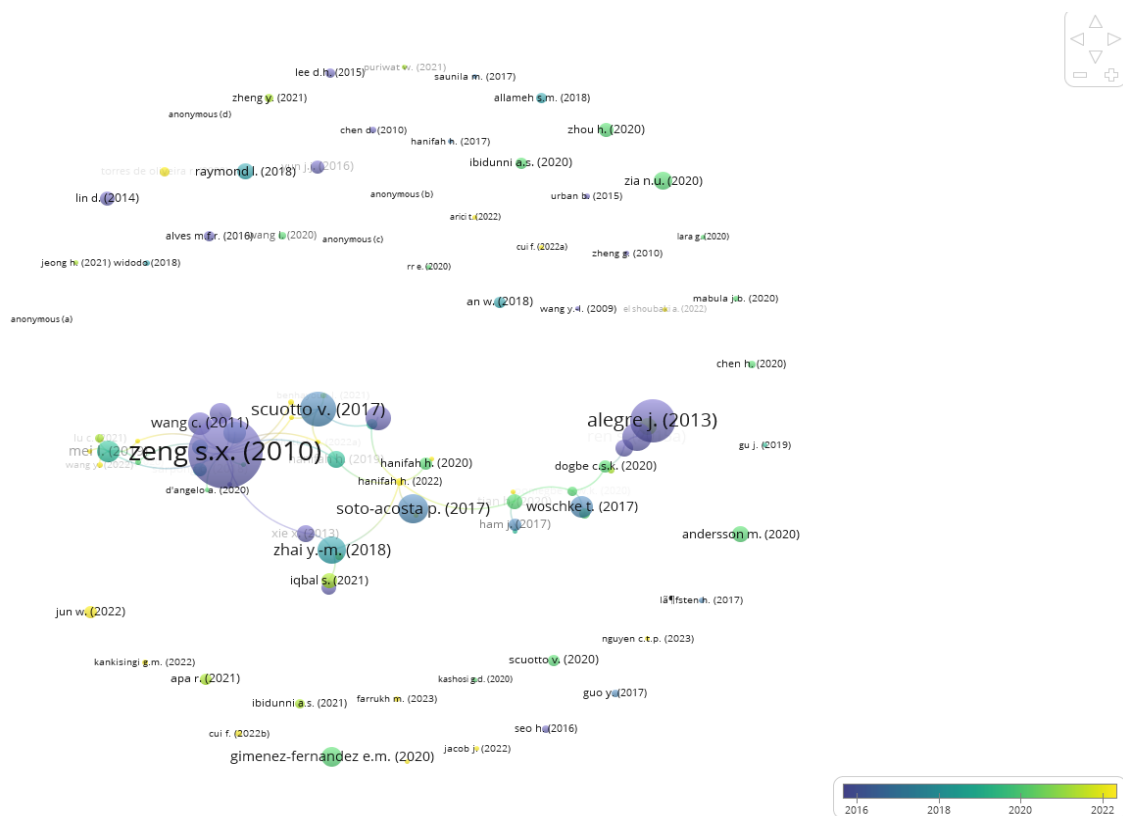
Article	Research result
(3)	Agreeableness is negatively related to entrepreneurial innovation.
(22)	Innovation capital has a negative relationship with innovative intelligence; technological capital has an insignificant relationship with innovative intelligence; innovative intelligence does not mediate the relationship between innovation capital and innovation performance; innovative intelligence mediates the relationship between technological capital and innovation performance.
(75)	Government support does not increase investment in research and business development and government support does not increase business collaboration with other companies.

**Table 2. (Continued).**

Article	Research result
(79)	Managers' entrepreneurial orientation negatively moderates the relationship between formal external collaboration and SME innovation performance.
(86)	Knowledge transfer is not significant to innovation performance
(134)	Proactive culture, daring to take risks and being innovative have no effect on innovative performance
(193)	There is a negative relationship between the level of adoption of open source software (OSS) in terms of the dimensions of the technology, organization and environment (TOE) model and innovation performance according to the number of new process innovations produced by the company.
(218)	The level of knowledge traits (resistance, ambiguity, and complexity) is negatively related to a firm's innovation performance.

### 3.3. Research citation

Based on **Figure 4**, it shows that the research conducted by Zeng et al. (2010) is the article with the most citations, but this research does not adopt digital technology as a measurement of SME innovation performance. Meanwhile, the most citations for research that adopts digital technology as a basis for measuring SME innovation performance are research (Raymond et al., 2018) with as many citations 174.



**Figure 4.** Research citation.

### 4. Conclusion

The development of researchers who raise the topic of SME innovation performance from 2004 to 2023 is quite increasing, but very few raise the topic of technology adoption in measuring SME innovation performance because researchers always focus on the new products produced. During the COVID-19 pandemic and



post-pandemic, many researchers have used technology adoption as a benchmark for SME innovation performance. This illustrates that many SMEs are currently adopting digital technology. Based on research results, it is proven that more and more SMEs are achieving innovation performance by adopting technology because many SMEs already have digital platform capabilities so this can influence SME innovation performance. However, in several other studies, technology adoption cannot be used as a reference in improving innovation performance.

## **5. Contribution**

This research can be used as a reference for SMEs in improving innovation performance that has adopted technology. However, several things also need to be considered, for example related to other research, technology adoption cannot be taken into consideration in improving innovation performance because there are several things that do not have a significant influence, including:

- 1) The relationship between agreeableness and entrepreneurial innovation.
- 2) Relationship between innovation capital and innovative intelligence.
- 3) The relationship between technological capital and innovative intelligence.
- 4) Innovative intelligence mediates between innovation capital and innovation performance.
- 5) Relationship between government support and SME development, SME cooperation.
- 6) Managers' entrepreneurial orientation does not moderate the relationship between formal external collaboration and SME innovation performance.
- 7) The relationship between knowledge transfer and innovation performance.
- 8) The relationship between proactive, risk-taking and innovative culture on innovative performance.
- 9) The relationship between the level of adoption of open sources software (OSS) in terms of the dimensions of the technology, organization and environment (TOE) model on innovation performance.
- 10) Relationship between the level of knowledge properties (resistance, ambiguity and complexity) with innovation performance.

In addition, factors that do not influence the increase in innovation performance of SMEs that adopt this technology require further research as recommendations for further research so that they can help to gain a clearer understanding of the input and output processes of SME innovation activities.

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