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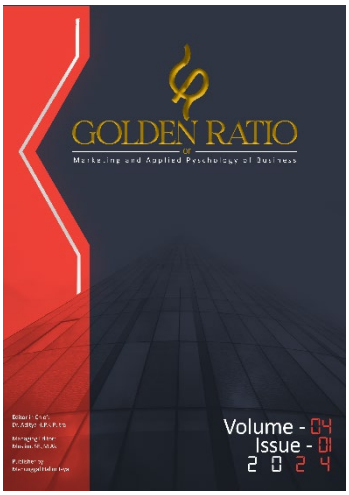

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MARKETING | RESEARCH ARTICLE

Independence and Adaptability: Building Resilience and Competitiveness for Small and Medium-sized Enterprises in the Digital Era

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Abstract: This study aims to investigate the impact of independence and adaptability on business actors in Balikpapan City amidst the industrial revolution 4.0. The study focuses on Micro, Small and Medium Enterprises (MSMEs) in the culinary sector of Balikpapan City, with a sample size of 30 business actors. A quantitative research approach utilizing primary data is employed, and data collection is conducted through the distribution of questionnaires. Statistical analysis using SPSS verifies the significance of the variables of independence (X1) and adaptability (X2) on the industrial revolution 4.0 when tested simultaneously. The findings reveal that both independence and adaptability substantially influence the industrial revolution 4.0. This study contributes to the existing literature by shedding light on the relationship between independence, adaptability, and the impact of the industrial revolution 4.0 on business actors. The findings provide valuable insights for policymakers, MSMEs, and stakeholders in Balikpapan City in navigating and harnessing the opportunities brought by the industrial revolution 4.0.

Keywords: Independence, Adaptability, Industrial Revolution 4.0, Small and Medium Enterprises.

JEL Classification Code: L26, O14, O33, M31

1. INTRODUCTION

In an era where the Fourth Industrial Revolution (IR 4.0) is reshaping the global economic landscape, the adaptability of Small and Medium Enterprises (SMEs) to this technological metamorphosis emerges as a critical area of inquiry (Kalinowska et al., 2021). The fusion of advanced digital technologies, such as the Internet of Things (IoT), artificial intelligence (AI), robotics, and big data analytics, has not only revolutionized the way businesses operate but also presented a unique set of challenges and opportunities for SMEs (Paiola et al., 2022). These entities, which form the backbone of many economies, find themselves at a crossroads where their ability to adapt and thrive amidst rapid technological advancements could determine their survival and growth(Osborn & Simpson, 2017; Sirin et al., 2022). The significance of SMEs in driving innovation, employment, and economic growth cannot be overstated. However, their journey through the tumultuous waters of IR 4.0 is fraught with challenges, including but not limited to, limited access to capital, a lack of digital literacy, and the need for a strategic framework to integrate new technologies effectively. Conversely, the digital era also offers unprecedented opportunities for SMEs to leverage technology for scaling operations, accessing new markets, and enhancing competitiveness (Juniansyah et al., 2022).

The adaptability capability of SME actors to IR 4.0, therefore, becomes a subject of paramount importance, warranting a thorough investigation. This research aims to delve into the multifaceted dimensions of adaptability, exploring how SMEs perceive, react to, and incorporate digital innovations into their business models (Asriati et al., 2022). It seeks to understand the barriers that impede their adaptability and identify the strategies that facilitate a successful transition into the

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digital age (Permatasari & Gunawan, 2023). By examining the intersection of SMEs and IR 4.0, this study endeavors to contribute valuable insights into the enablers and inhibitors of adaptability, offering a roadmap for SMEs to navigate the complexities of the digital revolution. Furthermore, it aims to provide policymakers and stakeholders with evidence-based recommendations to foster an ecosystem that supports SMEs' adaptability, ensuring their pivotal role in the economy is not only preserved but also enhanced in the face of technological progress (Carayannis et al., 2006). In essence, this research stands as an inquiry into the resilience and ingenuity of SMEs, as they embark on a transformative journey through the industrial revolution 4.0, aiming to demystify the capabilities that enable them to adapt, survive, and flourish in an increasingly digital world (Gartner et al., 2022; Rakshit et al., 2022).

Building on the thematic exploration of SME adaptability to the Industrial Revolution 4.0, the context of Small and Medium Enterprises (SMEs) in Balikpapan, a burgeoning economic hub in Indonesia, presents a compelling case study. Balikpapan, known for its strategic port and booming oil industry, is also a fertile ground for SME growth, contributing significantly to local employment and the regional economy. However, as the city propels towards digital transformation, its SME sector faces a unique set of challenges and opportunities in the wake of IR 4.0.

The rapid digitalization and technological advancements globally necessitate a closer examination of how SMEs in Balikpapan are navigating this new industrial landscape. Despite their agility and innovation capabilities, SMEs in Balikpapan grapple with digital adoption due to factors such as limited digital infrastructure, lack of skilled workforce in new technologies, and challenges in accessing finance for digital investments. These barriers echo the broader struggles faced by SMEs in adapting to IR 4.0, yet they are nuanced by the city's unique economic and social fabric. Conversely, the digital era opens up avenues for Balikpapan's SMEs to leapfrog traditional growth stages. Technologies like e-commerce platforms, digital marketing, and cloud computing offer pathways to reach wider markets, optimize operations, and improve customer engagement. The city's strategic position as a key economic center in East Kalimantan further amplifies these opportunities, provided there is adequate support for digital skills development and infrastructure enhancement.

This research aims to bridge the gap between the potential benefits of IR 4.0 and the current adaptability status of SMEs in Balikpapan. By focusing on this locality, the study not only contributes to the global discourse on SMEs and digital transformation but also offers targeted insights that could inform local policy-making, SME support programs, and the development of digital ecosystems tailored to the needs of Balikpapan's SME sector. In essence, this narrative extension seeks to contextualize the adaptability of SMEs to the industrial revolution 4.0 within the specificities of Balikpapan. It endeavors to uncover how these enterprises can harness the power of digital technology to foster economic resilience, drive innovation, and secure a competitive edge in the digital age. Through this localized lens, the study aspires to provide actionable strategies that empower SMEs in Balikpapan and similar contexts to navigate the complexities of digital transformation successfully.

Table 1. Number of SME Actors

District	SME Data			
	2017	2018	2019	2020
South Balikpapan	230	373	407	1.337
Balikpapan City	063	125	162	068
East Balikpapan	036	247	206	385
North Balikpapan	362	169	206	2.194
Central Balikpapan	273	223	271	563
West Balikpapan	071	080	195	141
Total	1.035	1.217	1.447	4.689

Continuing the narrative on the adaptability of SMEs in Balikpapan to the Industrial Revolution 4.0, it is imperative to delve into the specific challenges that these businesses face. The transition towards a digital economy, while brimming with opportunities, also presents a multifaceted set of obstacles for SMEs in this vibrant city. Understanding these challenges is crucial for developing effective strategies that bolster the resilience and competitiveness of Balikpapan's SME sector in the face of rapid technological change. One of the primary challenges is the digital literacy gap among

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SME owners and their workforce. In Balikpapan, as in many parts of the world, the pace of technological advancement often outstrips the rate at which individuals can acquire new digital skills. This discrepancy leads to a situation where SMEs recognize the importance of adopting digital tools but lack the necessary knowledge and expertise to implement them effectively. The result is a digital divide that hinders these businesses from fully exploiting the potential of IR 4.0 technologies to enhance their operations and market reach.

Financial constraints further exacerbate the situation. Investing in new technologies requires significant capital, which many SMEs in Balikpapan struggle to secure. The high costs associated with digital transformation—ranging from purchasing new software and hardware to training employees—can be prohibitive for small businesses operating on tight margins. Access to financing remains a critical hurdle, with many SMEs finding it challenging to obtain loans or investments due to stringent lending criteria and a lack of collateral. Additionally, the regulatory environment can sometimes act as a barrier to digital adoption. SMEs in Balikpapan, like those elsewhere, often navigate a complex web of regulations and compliance requirements that can be both confusing and costly. The rapid evolution of digital technologies means that regulatory frameworks frequently lag, creating uncertainty for businesses about how to proceed with digital initiatives without falling afoul of future regulations. Moreover, the competitive landscape is becoming increasingly fierce. As more businesses in Balikpapan and beyond embark on digital transformation journeys, SMEs face the challenge of distinguishing themselves in a crowded market. The pressure to innovate continuously and offer unique value propositions is heightened by the entry of new, digitally-native competitors that can quickly disrupt traditional business models. To address these challenges, a multi-faceted approach is needed. This includes initiatives to enhance digital literacy among SME owners and employees, financial support mechanisms that ease the burden of investing in new technologies, regulatory reforms that encourage rather than inhibit digital adoption, and programs that foster innovation and collaboration among SMEs.

2. LITERATURE REVIEW

The adaptability capability of small and medium-sized enterprises (SMEs) to Industry 4.0 is a complex issue that is influenced by various factors. This literature review aims to explore the challenges faced by SMEs in adapting to Industry 4.0, the role of technology and digital opportunities, the importance of dynamic capabilities and innovation, the significance of knowledge search strategies and new business models, and practical solutions for SMEs (Brissaud et al., 2022; Dutta et al., 2020; Liu et al., 2023; Tuukkanen et al., 2022). In the evolving landscape of Industry 4.0, characterized by the integration of digital technologies into all aspects of business, small and medium-sized enterprises (SMEs) stand at a crossroads. The adaptability capability of SMEs to this new industrial paradigm is not only critical for their survival but also for leveraging the potential for innovation and growth that Industry 4.0 promises (Chatzistamoulou, 2023; Mondal et al., 2022; Totten, 2018). This literature review delves into the multifaceted challenges and opportunities that SMEs encounter in the journey towards Industry 4.0, drawing insights from a broad spectrum of academic research and practical studies. The challenges faced by SMEs in adapting to Industry 4.0 are manifold (Asdrubali & Desideri, 2019). A significant body of literature highlights the constraints related to financial resources, technological infrastructure, and human capital that SMEs often grapple with (Adomako & Ahsan, 2022; Ṇikitina et al., 2022; Ortiz-Martínez et al., 2023). The high costs associated with the adoption of advanced digital technologies, coupled with a lack of access to capital, emerge as substantial barriers (Singh et al., 2024). Moreover, the digital skills gap prevalent among SMEs' workforce further complicates the transition, underscoring the need for comprehensive skill development initiatives (Chatzistamoulou, 2023).

Despite these challenges, the role of technology and digital opportunities in enabling SMEs to adapt to Industry 4.0 cannot be overstated. The literature suggests that digital technologies, such as cloud computing, big data analytics, and the Internet of Things (IoT), offer SMEs unprecedented opportunities to enhance operational efficiency, innovate product offerings, and enter new markets (Shaikh et al., 2023; Tsiatsis et al., 2019). These technologies not only democratize access to capabilities that were once the preserve of large corporations but also facilitate a more agile and

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responsive business model that is better suited to the dynamic market environment of the digital age (Priyono & Hidayat, 2022; Xie et al., 2022). Central to the discourse on SMEs' adaptability to Industry 4.0 is the concept of dynamic capabilities and innovation. Augier (2013) posits that the ability of firms to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments is paramount. For SMEs, this translates into fostering a culture of innovation and continuously evolving their business processes and models to stay relevant (Teece, 2010). The significance of innovation, both in terms of product and process, is further emphasized as a key driver of competitive advantage in the digital era (Dickel & Moura, 2016; Lestari et al., 2020).

Another critical aspect that emerges from the literature is the importance of knowledge search strategies and the adoption of new business models. The digital transformation necessitated by Industry 4.0 requires SMEs to actively seek out new knowledge and technologies that can enhance their competitiveness (Rakshit et al., 2022). This involves not only scanning and learning from the external environment but also fostering an internal ecosystem that encourages experimentation and learning (Zahra & George, 2002). Moreover, the shift towards digital business models, characterized by a greater focus on customer-centricity and value creation through digital platforms, presents both a challenge and an opportunity for SMEs (Nugraha et al., 2022). Practical solutions for SMEs to navigate the transition to Industry 4.0 are increasingly becoming a focus of academic and policy discussions. These range from government-led initiatives aimed at providing financial and technical support to SMEs, to industry collaborations that facilitate knowledge sharing and technology transfer (European Commission, 2015). Additionally, the role of academic institutions in partnering with SMEs to drive innovation and skill development is highlighted as crucial for building the ecosystem required for a successful transition to Industry 4.0 (Putra, 2022).

Sommer (2017) highlights the challenges faced by SMEs in adapting to Industry 4.0, noting that readiness for this transformation is size-dependent. In other words, larger SMEs may have more resources and capabilities to embrace Industry 4.0 compared to smaller ones. This finding suggests that the adaptability capability of SMEs is influenced by their size, which in turn affects their ability to invest in and implement new technologies and processes. John William et al (2023) emphasizes the role of technology in enhancing the adaptability of SMEs to Industry 4.0. The author argues that technological readiness is crucial for SMEs to effectively embrace the digital transformation. This implies that SMEs need to have the necessary infrastructure, skills, and knowledge to leverage technology and take advantage of the opportunities presented by Industry 4.0. Kristiyanti et al (2024) underscores the importance of dynamic capabilities, particularly in the context of innovation, for SMEs to adapt to Industry 4.0. Dynamic capabilities refer to an organization's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments. In the context of Industry 4.0, SMEs need to possess dynamic capabilities to continuously innovate and adapt their processes, products, and business models to stay competitive. Ricci et al (2021) explores the role of knowledge search strategies in the adaptability of SMEs to Industry 4.0. The author suggests that SMEs need to actively search for new knowledge and information, both internally and externally, to identify digital opportunities and develop the necessary capabilities. This implies that SMEs should engage in knowledge-sharing activities, collaborate with external partners, and invest in continuous learning to enhance their adaptability to Industry 4.0.

Ericson (2020) highlights the need for new business models to enable SMEs to adapt to Industry 4.0. The author argues that traditional business models may not be suitable for the digital era, and SMEs need to explore innovative and disruptive business models that leverage digital technologies. This suggests that SMEs should be open to rethinking their existing business models and embracing new approaches that align with the requirements of Industry 4.0. Arroyabe et al (2024) emphasizes the importance of competent employees in the adaptability of SMEs to Industry 4.0. The author argues that SMEs need to invest in the development of their workforce's digital skills and competencies to effectively leverage technology and drive digital transformation. This implies that SMEs should prioritize employee training and development programs to enhance their adaptability to Industry 4.0.

Amaral & Peças (2021) presents digitalization propositions as practical solutions for SMEs to adapt to Industry 4.0. The author suggests that SMEs should embrace digitalization initiatives, such as implementing digital platforms, using data analytics, and adopting automation technologies, to

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enhance their operational efficiency and competitiveness. This implies that SMEs should actively explore and adopt digital solutions that align with their specific needs and goals. Moeuf et al (2020) provides a comprehensive overview of the challenges and opportunities for SMEs in adapting to Industry 4.0. The author emphasizes the need for SMEs to fully exploit the resources available for Industry 4.0 implementation. This includes leveraging technology, developing dynamic capabilities, adopting new business models, investing in employee competencies, and embracing digitalization initiatives. Moeuf's work serves as a valuable resource for understanding the multifaceted nature of SMEs' adaptability to Industry 4.0.

3. RESEARCH METHOD AND MATERIALS

This research was conducted within the ambit of the Dinas Penanaman Modal Dan Pelayanan Terpadu (DMDPT) in Balikpapan City, focusing on the vibrant culinary sector that forms a significant part of the city's economic landscape. Recognizing the pivotal role of small and medium culinary enterprises in shaping the local economy and culture, this study aims to delve into the factors influencing their growth and sustainability amidst the dynamic business environment of Balikpapan. To this end, a meticulously designed online questionnaire was distributed among 30 culinary business operators, chosen to represent a cross-section of the industry's diverse facets. This approach not only ensures a comprehensive understanding of the sector but also facilitates an in-depth evaluation of the hypotheses posited in the study. The empirical validation of the research hypotheses necessitates a rigorous analytical framework, encompassing a series of statistical tests to ascertain the reliability, validity, and overall integrity of the data collected. The initial phase of this analytical process involves validity and reliability tests, aimed at confirming the accuracy and consistency of the questionnaire responses. Subsequently, the data undergoes a thorough examination through normality tests, aimed at verifying the assumption that the data distribution does not deviate significantly from a normal distribution, which is a prerequisite for the application of multiple regression analysis.

In addition to assessing data normality, the study employs tests for multicollinearity to ensure that the independent variables included in the model do not exhibit a high degree of correlation with each other, which could potentially skew the results. Autocorrelation and heteroskedasticity tests are also conducted to detect any patterns in the residuals that might compromise the model's validity. These tests are critical for confirming the appropriateness of the regression model for the data at hand and for ensuring the robustness of the findings. Upon satisfying these preliminary conditions, the study progresses to the core analytical phase, applying multiple regression analysis to explore the relationships between the identified variables. The coefficient of determination (R^2) test, F-test, and t-test play pivotal roles in this phase, offering insights into the model's explanatory power, the overall significance of the regression model, and the individual contributions of the independent variables, respectively. By adhering to this rigorous methodological framework, the study aspires to provide a nuanced understanding of the challenges and opportunities faced by culinary business operators in Balikpapan. Through the application of multiple regression analysis and a suite of diagnostic tests, the research seeks to offer evidence-based insights that can inform policy-making, support business decision-making, and contribute to the broader discourse on SME development in the context of Balikpapan's dynamic economic environment.

4. RESULTS AND DISCUSSION

4.1. Characteristics of Respondents

The transition into the Results and Discussion section marks a pivotal moment in this research, where the empirical data collected from the field is meticulously analyzed to unveil insights into the adaptability of Small and Medium Enterprises (SMEs) to Industry 4.0. This section commences with a detailed examination of the characteristics of the respondents, offering a foundational understanding of the demographic landscape that underpins the study. A thorough analysis of respondents based on gender, initial capital investment for starting their SME, and educational levels sets the stage for a nuanced discussion on the findings and their implications. The demographic composition of

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respondents is crucial as it reflects the diversity within the SME sector and provides context to the adaptability capabilities being explored. The gender distribution among respondents reveals insights into the participation rates of men and women in the SME sector, which is vital for understanding the dynamics at play in the entrepreneurial ecosystem. The analysis extends to examining the initial capital investment of respondents in establishing their businesses. This aspect is particularly telling of the financial challenges and resource allocation strategies employed by SME owners, offering a glimpse into the economic realities faced by entrepreneurs at the inception of their ventures.

Furthermore, the educational background of respondents is scrutinized, as it plays a significant role in shaping their capacity to adapt to the rapidly evolving digital landscape of Industry 4.0. Education not only equips individuals with the necessary skills and knowledge to navigate the complexities of digital transformation but also influences their attitudes towards innovation and technology adoption. By dissecting the levels of education among SME owners, this research seeks to uncover correlations between educational attainment and adaptability to technological advancements.The ensuing discussion delves into the empirical findings derived from the analysis, situating them within the broader discourse on SME adaptability to Industry 4.0. The exploration of demographic characteristics lays the groundwork for a deeper investigation into how gender, financial capacity at the business's inception, and educational attainment intersect with the ability of SMEs to harness the opportunities presented by the Fourth Industrial Revolution. This section aims to provide a comprehensive understanding of the factors that influence SME adaptability, drawing connections between the demographic profiles of respondents and their experiences navigating the challenges and opportunities of Industry 4.0.

a. Characteristics of Respondents by Gender

Table 2. Gender of Respondents

Gender	Number	Percentage
Female	6	20%
Male	24	80%
Total	30	100%

Table 2 presents a straightforward yet insightful breakdown of the gender distribution among respondents in the study, which examines the adaptability of Small and Medium Enterprises (SMEs) to Industry 4.0. This demographic snapshot is essential for understanding the composition of the entrepreneurial landscape within the context of this research. Out of the 30 respondents surveyed, a significant majority, comprising 24 individuals or 80%, are male. In contrast, female respondents account for a smaller fraction, with 6 individuals or 20% of the total. This stark disparity highlights a gender imbalance within the sample group, suggesting that men predominantly occupy the SME sector, at least among the businesses and individuals participating in this study. The gender composition of respondents is not just a numerical distribution but provides critical insights into the dynamics of SME ownership and operation. The predominance of male respondents could reflect broader societal trends, possibly indicating barriers to entry for women in the business sector or a reflection of the traditional gender roles that influence occupational choices. Conversely, the presence of women, albeit in smaller numbers, signals a growing trend of female entrepreneurship and participation in the SME sector, a crucial aspect of economic diversification and empowerment. Understanding the gender distribution is vital for several reasons. Firstly, it allows for a gender-sensitive analysis of the data, ensuring that the findings and recommendations consider the unique challenges and opportunities that male and female entrepreneurs might face. Secondly, it sheds light on the need for policies and interventions that address gender disparities in the business sector, aiming to foster an inclusive environment that supports and encourages entrepreneurship across all demographics.

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b. Respondents based on Initial Capital

Table 3. Initial Capital of Respondents

Description	Number	Percentage
< 50.000.000	11	36,7%
50.000.000 – 500.000.000	13	43,3%
500.000.000 – 10.000.000.000	6	20%
Total	30	100%

Table 3 provides a comprehensive overview of the initial capital investment of respondents involved in the study, which focuses on the adaptability of Small and Medium Enterprises (SMEs) to Industry 4.0. This data is instrumental in understanding the financial foundation upon which these entrepreneurs have built their businesses, offering insights into the economic strata within the SME sector. The table categorizes the initial capital investment into three distinct ranges, presenting a detailed picture of the financial landscape among the study's respondents. The first category, representing investments less than 50,000,000, includes 11 respondents, accounting for 36.7% of the total. This group highlights a segment of SME owners who have embarked on their entrepreneurial journey with relatively modest financial resources, pointing towards a significant number of SMEs that operate on a small scale or maybe in their nascent stages. The second category encompasses investments ranging from 50,000,000 to 500,000,000, with 13 respondents making up 43.3% of the total. This group represents the largest portion of the respondent base, indicating that a substantial number of SMEs have access to a moderate level of capital for their initial investment. These businesses may have crossed the threshold of micro-enterprises, potentially having a broader operational scope and a stronger market presence.

The third and final category includes investments ranging from 500,000,000 to 10,000,000,000, with 6 respondents or 20% of the total. This segment, though smaller in number, signifies a group of SMEs that commenced their operations with a significant financial base. These enterprises may possess the capacity for larger-scale operations, possibly engaging in more extensive market activities and having a wider reach. This distribution of initial capital investment among the respondents provides crucial context for analyzing the adaptability of SMEs to Industry 4.0. The financial capacity at the onset of business operations can significantly influence an SME's ability to invest in digital technologies, research and development, and human capital—all of which are pivotal for navigating the challenges and seizing the opportunities presented by the Fourth Industrial Revolution. Furthermore, the varied levels of initial capital investment reflect the diversity within the SME sector, underscoring the need for tailored strategies and policies that cater to the distinct needs and capabilities of businesses across different financial spectrums. Understanding this financial diversity is essential for devising effective support mechanisms that can facilitate SMEs' transition towards Industry 4.0, ensuring that businesses, regardless of their initial capital investment, can thrive in the digital era.

c. Characteristics of Respondents Based on Education

Table 4. Education of Respondent

Highest Education	Number	Percentage
Elementary School	1	3.3%
Junior High School	1	3.3%
Senior High School	12	40%
Bachelor's Degree	16	53.3%
Total	30	100%
Total		80

Table 4 presents a detailed breakdown of the educational backgrounds of respondents participating in the study on Small and Medium Enterprises' (SMEs) adaptability to Industry 4.0. This table is crucial for understanding the educational landscape of SME owners, shedding light on

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the levels of formal education attained by the entrepreneurs. The distribution of educational qualifications among respondents provides valuable insights into the potential capabilities and challenges they face in adapting to the technological demands and opportunities of the Fourth Industrial Revolution. The table delineates four categories of educational attainment: elementary school (SD), junior high school (SMP), senior high school (SMA), and bachelor's degree (S1). A singular respondent, accounting for 3.3% of the total, has completed elementary school, indicating a very small fraction of SME owners with basic education. Similarly, another respondent, also representing 3.3% of the total, has completed junior high school, suggesting that a minimal portion of the SME population in this study has education up to the middle school level. The largest proportion of respondents, 40%, have attained a senior high school education. This significant segment indicates that a substantial number of SME owners possess secondary education, which provides a foundational understanding of basic business principles and operations but may lack specialized knowledge in digital technologies and advanced business strategies.

The most notable finding from Table 3 is that the majority of respondents, 53.3%, hold a bachelor's degree. This prevalence of higher education among SME owners is particularly significant in the context of Industry 4.0, as it suggests a higher likelihood of familiarity with digital technologies, critical thinking skills, and a more profound understanding of complex business dynamics. Individuals with higher education levels are generally better positioned to navigate the challenges of digital transformation, leveraging their knowledge to implement innovative solutions and adapt their business models to the rapidly changing economic landscape. The educational composition of SME owners, as outlined in this table, offers a comprehensive overview of the sector's intellectual capital. The high percentage of respondents with a bachelor's degree is encouraging, as it implies a potential readiness among SME owners to engage with and benefit from the advancements of Industry 4.0. However, the presence of entrepreneurs with lower levels of formal education underscores the need for targeted support and training programs. These programs could help bridge knowledge gaps, ensuring that all SME owners, regardless of their educational background, can develop the skills necessary to thrive in an increasingly digitalized economy.

a. Validity Testing

The journey begins with the validity test, a crucial step to ensure that our questionnaire items accurately measure what they are intended to. This process involves scrutinizing the relationship between each item and the overall construct it purports to represent, thus affirming the soundness of our survey instrument. The results from this phase set the stage for further analysis by establishing the foundational integrity of our data collection methods.

Table 5. Validity Testing

Variable Validity	Variable Validity
Independence (X1)	Valid
Adaptability (X2)	Valid
Industry 4.0 Revolution (Y)	Valid

Table 5 provides a concise yet insightful overview of the validity test results for the variables under investigation in this study, which focuses on the impact of Independence (X1) and Adaptability (X2) on navigating the challenges and opportunities presented by the Fourth Industrial Revolution (Y). The table succinctly categorizes each of the three main variables according to the outcome of the validity tests, with all variables marked as "Valid." This designation is crucial, as it signifies that each variable's measurement tools—likely survey items or observational metrics—accurately capture the constructs they are intended to measure, thereby laying a solid foundation for the reliability and integrity of the subsequent analysis. Interpretation of Validity Test Results:

1. Independence (X1): The validation of this variable underscores the relevance and accuracy of the measurement approach used to gauge the degree of independence within SMEs. In the context of Industry 4.0, independence could refer to the autonomy of decision-making processes, the self-sufficiency in managing digital transformations, or the ability to innovate

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without excessive reliance on external entities. The affirmation of validity suggests that the instrument employed effectively captures the essence of independence as it pertains to SMEs' readiness and resilience in adapting to technological advancements.

2. Adaptability (X2): The validity of the Adaptability variable is particularly significant, given the dynamic and ever-evolving nature of Industry 4.0. Adaptability may encompass aspects such as the flexibility of business processes, the agility in responding to technological changes, and the capacity for continuous learning and innovation. The confirmation of this variable's validity indicates that the measures used are adept at reflecting how SMEs adjust their strategies, operations, and mindsets to thrive in the digital era.
3. Fourth Industrial Revolution (Y): The validation of the dependent variable, representing the overarching theme of the Fourth Industrial Revolution, is paramount. This construct likely encapsulates the multifaceted impact of digital transformation on SMEs, including but not limited to, changes in business models, market competitiveness, and operational efficiency. The designation of this variable as valid attests to the robustness of the criteria used to assess the degree to which SMEs are engaging with, benefiting from, or being challenged by the advent of Industry 4.0.

b. Reliability Testing

Subsequently, we delve into the reliability test, employing Cronbach's Alpha to gauge the consistency of responses across the survey items. This test serves as a litmus test for the dependability of our instrument, ensuring that the data collected provide a stable and consistent measure of the constructs under investigation. High reliability coefficients signify that our survey items are well-crafted, capturing the intended variables with minimal measurement error.

Table 6. Reliability Testing

Variable	Cronbach Alpha
Independence (X1)	.901
Adaptability (X2)	.839
Industry 4.0 Revolution (Y)	.904

Table 6 delineates the results of the reliability test conducted for the variables within the study, aimed at assessing the consistency of the measurement instruments used to evaluate Independence (X1), Adaptability (X2), and the impacts of the Fourth Industrial Revolution (Y). The reliability of each variable is quantified using Cronbach's Alpha, a statistical coefficient that measures the internal consistency of a set of survey items or indicators. A higher Cronbach's Alpha value, generally above 0.7, is indicative of a high level of reliability, suggesting that the items consistently represent the underlying construct across different instances. Interpretation of Reliability Test Results:

1. Independence (X1): The Cronbach Alpha coefficient for Independence stands at 0.901, which is exceptionally high. This indicates a very strong internal consistency among the items used to measure the concept of Independence within SMEs. The implication is that the various aspects of Independence, such as decision-making autonomy and self-sufficiency in operational capabilities, are coherently captured by the survey items, ensuring that the variable is reliably assessed across the study's respondents.
2. Adaptability (X2): For Adaptability, the Cronbach Alpha value is 0.839, which also reflects a high level of reliability. This score confirms that the items designed to gauge Adaptability—presumably encompassing flexibility in business processes, agility in technological adoption, and responsiveness to market changes—are consistently aligned and effectively measure the construct. This high degree of reliability strengthens the validity of conclusions drawn about SMEs' adaptability capabilities in the context of Industry 4.0
3. Fourth Industrial Revolution (Y): The dependent variable, representing the broader impact of the Fourth Industrial Revolution on SMEs, shows a Cronbach Alpha of 0.904. This outstanding level of reliability suggests that the survey items or indicators used to assess the multifaceted effects of Industry 4.0—be it on business models, operational efficiency, or

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competitive strategy—are highly consistent and reliably capture the essence of the digital transformation impact.

The results presented in Table 6 are indicative of the rigorous methodological approach employed in this study, ensuring that the constructs of Independence, Adaptability, and the impacts of the Fourth Industrial Revolution are not only valid but also reliably measured. The high Cronbach Alpha values across all variables attest to the strength and integrity of the survey instrument, bolstering the confidence in the data collected and the subsequent analyses performed. In essence, Table 6 underscores the methodological rigor behind the study, providing a solid foundation for interpreting the relationships between Independence, Adaptability, and the effects of the Fourth Industrial Revolution on SMEs. The high levels of reliability for each variable ensure that the findings derived from this research are robust, offering credible insights into the adaptability of SMEs to the challenges and opportunities presented by Industry 4.0.

c. Normality Testing

The normality test follows, assessing whether the distribution of our data adheres to the assumption of normality required for multiple regression analysis. This step is pivotal, as the presence of significant deviations from normality can impact the validity of our inferential statistics, necessitating adjustments to our analytical approach.

Table 7. Normality Testing

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		30
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	1.86206599
Most Extreme Differences	Absolute	.148
	Positive	.104
	Negative	-.148
Test Statistic		.148
Asymp. Sig. (2-tailed)		.090[c]
a. Test distribution is Normal.		
b. Calculated from data.		
c. Lilliefors Significance Correction.		

Table 7 presents the results of a One-Sample Kolmogorov-Smirnov (K-S) Test performed to assess the normality of the unstandardized residuals in the study, which is essential for validating the assumption of normal distribution in multiple regression analysis. This test is particularly useful for determining whether the distribution of a dataset significantly deviates from a normal distribution, which is a critical assumption underlying many parametric statistical tests, including linear regression. The test's outcome provides insights into the appropriateness of the regression model used and the validity of the inferences drawn from the analysis. Analysis of the Kolmogorov-Smirnov Test Results:

1. Sample Size (N): The test was conducted with a sample size of 30, which is adequate for performing the Kolmogorov-Smirnov test, providing a reasonable basis for evaluating the normality of the data distribution.
2. Normal Parameters: The mean of the unstandardized residuals is reported as .0000000, indicating that, on average, the residuals are centered around zero, a desirable property in regression analysis that suggests no systematic bias in the prediction errors. The standard deviation of 1.86206599 reflects the spread of the residuals, contributing to the assessment of data dispersion around the mean.
3. Most Extreme Differences: The absolute, positive, and negative values represent the maximum deviation of the observed cumulative distribution from the expected normal cumulative distribution. An absolute difference of .148 indicates the largest discrepancy, with the positive

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(.104) and negative (-.148) values specifying the direction of these deviations. These figures are crucial for understanding the extent and nature of the deviation from normality.

4. Test Statistic: The test statistic value of .148, derived from the most extreme differences, serves as the basis for evaluating the normality of the data. This value quantifies the observed deviation from a perfectly normal distribution, facilitating the statistical assessment of normality.
5. Asymptotic Significance (Asymp. Sig. (2-tailed)): The significance level of .090, with the Lilliefors Significance Correction applied, indicates the probability of observing the test statistic under the null hypothesis that the data are normally distributed. A significance value greater than the typical alpha level of .05 suggests that the null hypothesis cannot be rejected at the conventional significance level, implying that the distribution of the unstandardized residuals does not significantly deviate from normality.

The results from Table 6 imply that the distribution of the unstandardized residuals in the study is not significantly different from a normal distribution, supporting the assumption of normality required for the validity of multiple regression analysis. The normality of residuals is a key assumption in regression analysis, as it underpins the reliability of parameter estimates and the accuracy of confidence intervals and hypothesis tests. Therefore, the findings from the Kolmogorov-Smirnov test reinforce the appropriateness of the statistical methods used in this study, affirming the robustness of the conclusions drawn from the analysis regarding the adaptability of SMEs to Industry 4.0.

d. Multicollinearity Testing

We then proceed to examine the specter of multicollinearity, evaluating the degree to which our independent variables are interrelated. The detection of high multicollinearity could undermine the distinct impact of each variable, complicating the interpretation of our regression coefficients. This test ensures that each independent variable uniquely contributes to our model, allowing for clear delineation of effects.

Table 8: Multicollinearity Testing

Coefficients			
Model		Collinearity Statistics	
		Tolerance	VIF
1	Independence	.384	2.601
	Adaptability	.384	2.601
a. Dependent Variable: industrial revolution 4.0			

Table 8 illustrates the outcomes of the multicollinearity test, a crucial step in regression analysis that assesses the degree to which independent variables in the model are correlated with each other. Multicollinearity can severely impact the reliability of a regression analysis by inflating the variance of the coefficient estimates, making it difficult to discern the individual effect of each predictor variable on the dependent variable. In this context, the table evaluates multicollinearity within a model that investigates the influence of Independence (Kemandirian) and Adaptability (Kemampuan Adaptasi) on the Industrial Revolution 4.0. Analysis of Multicollinearity Test Results:

1. Collinearity Statistics: The table provides two key statistics for assessing multicollinearity: Tolerance and the Variance Inflation Factor (VIF). Both metrics offer insights into the extent of multicollinearity present among the independent variables.
2. Tolerance: Tolerance is the inverse of R-squared for a given independent variable regressed against all other independent variables. It measures the proportion of variance of the independent variable that is not explained by the other independent variables. For both Independence and Adaptability, the tolerance value is .384. Tolerance values closer to 0 indicate higher multicollinearity, whereas values closer to 1 suggest minimal multicollinearity. In this case, the tolerance values indicate a moderate level of multicollinearity, suggesting that a portion of the variance in each predictor is explained by the other.

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3. Variance Inflation Factor (VIF): The VIF measures how much the variance of an estimated regression coefficient increases if your predictors are correlated. If VIF is 1, there is no multicollinearity among predictors; however, values above 10 are often regarded as indicating serious multicollinearity. The VIF values for both Independence and Adaptability are 2.601, which are above the ideal but well below the threshold of concern. These values suggest that while there is some degree of multicollinearity, it is not at a level that should unduly affect the regression analysis.

The presence of moderate multicollinearity, as indicated by the tolerance and VIF statistics, implies that while the variables Independence and Adaptability are somewhat correlated, this correlation is not so high as to invalidate the results of the regression analysis. However, it does warrant careful interpretation of the regression coefficients, considering the potential for multicollinearity to affect the precision of the estimates.

e. Heteroskedasticity and Autocorrelation Testing

Further, our analysis encompasses tests for heteroskedasticity and autocorrelation, investigating the presence of irregular variance and correlation patterns in the residuals of our regression model. These phenomena, if present, could indicate model specification errors or violations of the assumptions underlying linear regression, necessitating remedial measures to ensure the robustness of our findings.

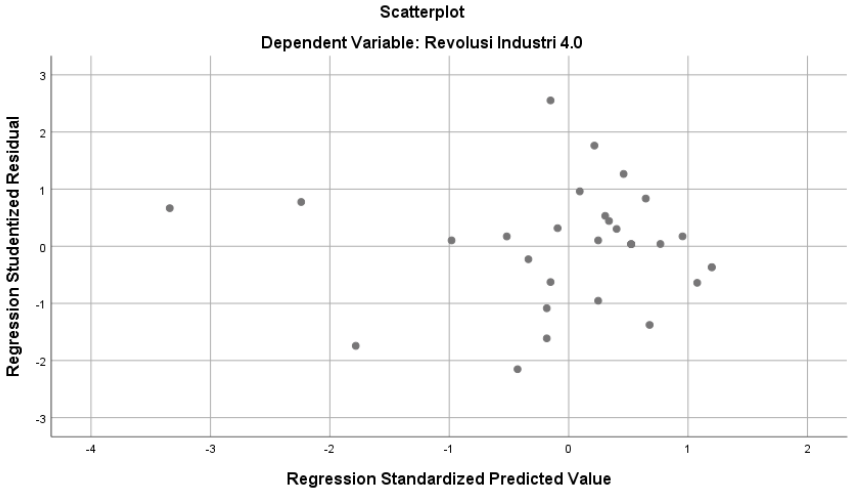

Figure 1. Heteroskedasticity Testing

Based on the scatter plot graph above, it shows that there is a clear pattern and the points spread far from the X and Y axes. so it can be concluded that there is no heteroscedasticity in the regression model.

Table 9. Autocorrelation Testing

Model Summary[b]					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.909[a]	.827	.814	1.930	1.689
a. Predictors: (Constant), Adaptability, Independence					
b. Dependent Variable: industrial revolution 4.0					

Table 9 provides a summary of the model's performance in predicting the impact of Independence and Adaptability on the Fourth Industrial Revolution, with a particular focus on detecting the presence of autocorrelation. Autocorrelation, also known as serial correlation, refers to the correlation of a variable with itself across observations. It's a phenomenon that can significantly compromise the assumptions of ordinary least squares regression, leading to biased and inefficient estimates. The

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Durbin-Watson statistic, featured in this table, is a test specifically designed to detect the presence of autocorrelation in the residuals of a regression analysis. Analysis of Autocorrelation Test Results:

1. R and R Square: The model's R value of .909 indicates a very strong positive relationship between the predictors and the dependent variable, suggesting that the model explains a large portion of the variance observed in the adaptation to Industry 4.0. The R Square value of .827 further quantifies this relationship, indicating that approximately 82.7% of the variance in the Fourth Industrial Revolution adaptation can be explained by Independence and Adaptability. This high level of explanatory power is promising for understanding the dynamics at play.
2. Adjusted R Square: The Adjusted R Square of .814 adjusts the R Square based on the number of predictors in the model, providing a more accurate measure of the model's explanatory power. This slight reduction from the R Square value reflects the penalty for the addition of variables, maintaining a strong indication that the model is robust and significant.
3. Standard Error of the Estimate: The standard error of 1.930 reflects the average distance that the observed values fall from the regression line. This measure gives an indication of the model's precision in predicting the adaptation to the Fourth Industrial Revolution, with lower values indicating higher precision.
4. Durbin-Watson Statistic: The Durbin-Watson statistic of 1.689 is crucial for evaluating autocorrelation. Generally, values of the Durbin-Watson statistic range from 0 to 4, where a value around 2 suggests no autocorrelation, values approaching 0 indicate positive autocorrelation, and values toward 4 suggest negative autocorrelation. The statistic of 1.689 in this context indicates a slight positive autocorrelation among residuals, though it is not severe enough to invalidate the model. This slight positive autocorrelation suggests that the residuals are not entirely independent, a condition worth noting but not necessarily alarming for the validity of the regression analysis.

In summarizing the model's performance and specifically addressing the issue of autocorrelation, Table 8 provides a comprehensive overview of the statistical health of the regression model used in this study. The high R and R Square values demonstrate the model's effectiveness in capturing the relationship between Independence, Adaptability, and the adaptation to the Fourth Industrial Revolution. Meanwhile, the Durbin-Watson statistic, though indicating a slight positive autocorrelation, remains within an acceptable range, suggesting that the model's predictions are reliable, albeit with a note of caution regarding the independence of residuals. This nuanced understanding of the model's performance is crucial for interpreting the results with an informed perspective on the potential limitations and strengths of the analysis.

f. Multiple Linear Regression Analysis

At the heart of our inquiry lies the multiple linear regression analysis, a powerful tool that unravels the complex relationships between our independent variables and the dependent variable. This analytical centerpiece allows us to quantify the impact of each predictor, offering a nuanced understanding of the dynamics at play within our research model.

Table 10. Multiple Linear Regression Analysis Output

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.204	2.093		1.531	.137
	Independence	.498	.131	.491	3.801	.001
	Adaptability	.627	.172	.472	3.653	.001
a. Dependent Variable: Industrial Revolution 4.0						

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g. T-test, F-test, and Coefficient of Determination

The exploration culminates in the application of the T-test and F-test, aimed at assessing the statistical significance of individual predictors and the overall regression model, respectively. These tests illuminate the relative importance of each variable and the collective explanatory power of our model. The coefficient of determination, or R^2, further quantifies the proportion of variance in the dependent variable accounted for by our independent variables, encapsulating the model's effectiveness in capturing the phenomena under study. In synthesizing the results from these comprehensive statistical tests, this section endeavors to translate the empirical evidence into a coherent narrative. Through the lens of SPSS analysis, we seek to interpret the multifaceted dimensions of our research, unraveling the intricate tapestry of relationships that define the adaptability of SMEs to Industry 4.0. This discussion aims not only to validate our hypotheses but also to contribute meaningful insights to the broader discourse on digital transformation within the SME sector.

Table 11. Results of The Partial Analysis

Variable	t_{hitung} : t_{table}		Prob.Sig		Explanation
Independence (X1)	3.801	2,05183	0,001	0,05	Significantly Influential
Adaptability (X2)	3.653	2,05183	0,001	0,05	Significantly Influential

Table 11 presents the results of the partial analysis, specifically the outcomes of t-tests conducted to assess the individual effects of Independence and Adaptability on the dependent variable, within the context of the Fourth Industrial Revolution. This partial analysis aims to isolate the impact of each independent variable, providing insights into how each one contributes to the model and the extent to which they are statistically significant predictors of the outcome variable. The table outlines the calculated t-values, the critical t-values for comparison, the probability significance (Prob.Sig), and the significance level set for the study (α = 5% for two-tailed tests), alongside a narrative conclusion on the influence of each variable.Interpretation of Partial Analysis Results:

1. Independence (X1): The t-value for Independence is 3.801, which surpasses the critical t-value of 2.05183. This result, coupled with a probability significance of 0.001, indicates that Independence has a statistically significant effect on the adaptation to the Fourth Industrial Revolution at the 5% significance level. The probability significance being well below the α threshold of 0.05 suggests that the likelihood of observing such an effect by chance is minimal. Thus, the data supports the hypothesis that Independence significantly influences the dependent variable, affirming its role as a critical factor in navigating the complexities and opportunities presented by Industry 4.0.
2. Adaptability (X2): Similarly, Adaptability yields a t-value of 3.653, also exceeding the critical t-value of 2.05183. With a probability significance of 0.001, this variable too is identified as having a statistically significant impact on the dependent variable at the 5% significance level. This finding underscores the importance of Adaptability in the context of the Fourth Industrial Revolution, highlighting its significant contribution to the model. The result validates the premise that the capacity of SMEs to adapt their operations, processes, and strategies is crucial for leveraging the benefits of digital transformation.

The results from Table 11 underscore the significant impacts of both Independence and Adaptability on the adaptation to the Fourth Industrial Revolution. By demonstrating that both variables significantly influence the dependent variable, the analysis provides empirical evidence supporting the theoretical framework posited at the outset of the study. These findings not only reinforce the importance of fostering an environment that encourages Independence and Adaptability among SMEs but also contribute to the broader discourse on SME resilience and innovation in the face of rapid technological change. In essence, this partial analysis elucidates the critical roles that Independence and Adaptability play as determinants of success in the era of Industry 4.0. The statistical significance of these factors highlights the necessity for SMEs to cultivate these attributes to

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navigate the challenges and seize the opportunities presented by the current industrial revolution. The insights derived from this analysis offer valuable guidance for policymakers, educators, and business leaders in formulating strategies to support SMEs in their journey towards digital transformation and sustained competitiveness.

Table 12. ANOVA (Analysis of Variance) Test

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	480.249	2	240.124	64.478	.000[b]
	Residual	100.551	27	3.724		
	Total	580.800	29			
a. Dependent Variable: Industrial Revolution 4.0						
b. Predictors: (Constant), Adaptability, Independence						

Table 12 presents the results of the F-test from an ANOVA (Analysis of Variance) analysis, which is crucial for evaluating the overall significance of the regression model that investigates the impact of Independence and Adaptability on the adaptation to the Fourth Industrial Revolution. This test assesses whether the collective effect of the independent variables on the dependent variable is statistically significant. Interpretation of the F-test Results:

1. Sum of Squares: This column divides the total variability observed in the dependent variable into two components: the variability explained by the regression model (Regression) and the unexplained variability or error (Residual). The Regression sum of squares is 480.249, indicating the portion of the total variation in the adaptation to Industry 4.0 that can be explained by the model. The Residual sum of squares is 100.551, representing the variation that the model does not account for.
2. Degrees of Freedom (df): The degrees of freedom for the regression are 2, corresponding to the two predictors (Independence and Adaptability) included in the model. The degrees of freedom for the residual are 27, calculated by subtracting the number of predictors plus one (for the constant term) from the total number of observations, which is 30 in this case.
3. Mean Square: This is the Sum of Squares divided by the corresponding degrees of freedom, providing an average measure of variability. The Mean Square for Regression is 240.124, indicating the average amount of variation explained per predictor variable in the model. The Mean Square for Residual is 3.724, reflecting the average unexplained variation per observation.
4. F Statistic: The F statistic, calculated as the Mean Square for Regression divided by the Mean Square for Residual, is 64.478. This value measures the ratio of explained variation to unexplained variation, serving as the basis for testing the null hypothesis that the model with predictors does not explain the variation in the dependent variable any better than a model with no predictors.
5. Significance (Sig.): The significance level of .000 indicates the probability of observing the calculated F statistic or a more extreme value under the null hypothesis. A significance level below the conventional threshold of .05 (or even .01) suggests that the null hypothesis can be rejected with high confidence. In this context, the p-value of .000 demonstrates that the regression model significantly explains the variability in the adaptation to Industry 4.0, and the effects of Independence and Adaptability are statistically significant.

Table 13, thus, underscores the statistical significance of the regression model, affirming that the collective influence of Independence and Adaptability on the adaptation to the Fourth Industrial Revolution is both significant and impactful. This outcome validates the theoretical framework posited in the study and highlights the critical roles these variables play in enabling SMEs to navigate the complexities and seize the opportunities of Industry 4.0. The results provide empirical support for the importance of fostering these attributes within the SME sector to enhance adaptability and resilience in the face of rapid technological advancements.

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Table 13. Coefficient of Determination

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.909[a]	.827	.814	1.930
a. Predictors: (Constant), Adaptability, Independence				
b. Dependent Variable: Industrial Revolution 4.0				

Table 13 provides a summary of the model's performance in terms of explaining the variance in the adaptation to the Fourth Industrial Revolution (Revolusi Industri 4.0) through the independent variables of Independence (Kemandirian) and Adaptability (Kemampuan Adaptasi). The table focuses on the coefficient of determination, denoted as R^2, alongside other related statistics that collectively offer insights into the effectiveness and precision of the regression model utilized in this study. Interpretation of the Coefficient of Determination (R^2) Results:

1. R (Multiple Correlation Coefficient): The value of R is .909, which indicates a very high degree of correlation between the independent variables and the dependent variable. This high R value suggests that the model has a strong linear relationship with the observed outcomes, implying that the predictors collectively explain a significant portion of the variance in SMEs' adaptation to Industry 4.0.
2. R Square (R^2): R^2, or the coefficient of determination, quantifies the proportion of variance in the dependent variable that is predictable from the independent variables. With an R^2 value of .827, the model explains approximately 82.7% of the variance in the adaptation to the Fourth Industrial Revolution. This indicates a high level of explanatory power, demonstrating that a substantial part of the variation in how SMEs adapt to Industry 4.0 can be accounted for by differences in Independence and Adaptability.
3. Adjusted R Square: The Adjusted R Square value, standing at .814, adjusts the R^2 value for the number of predictors in the model to provide a more accurate estimate of the model's explanatory power in the population. This slight adjustment from the R^2 value accounts for the model complexity, ensuring that the model's performance is not overstated. An Adjusted R Square of .814 still signifies that after adjusting for the number of predictors, the model remains highly effective in explaining the adaptation to Industry 4.0, validating the inclusion of Independence and Adaptability as key factors.
4. Standard Error of the Estimate: This statistic, 1.930, represents the standard deviation of the prediction errors or residuals. It measures the average distance that the observed values fall from the regression line. A Standard Error of 1.930 suggests that, on average, the actual observations of SMEs' adaptation to Industry 4.0 deviate from the predicted values by this amount. While the model exhibits a strong explanatory power, this value highlights the presence of variability in SME adaptation that the model does not capture.

The results encapsulated in Table 13 affirm the significant predictive capability of the regression model, with Independence and Adaptability serving as robust predictors of SMEs' adaptation to the rapidly evolving technological landscape of Industry 4.0. The high R^2 and Adjusted R^2 values underscore the relevance and impact of these factors in understanding the dynamics of SME adaptation. This analysis not only reinforces the theoretical underpinnings of the study but also emphasizes the practical implications for SMEs, suggesting that enhancing independence and adaptability among SMEs could markedly improve their resilience and success in the face of the Fourth Industrial Revolution.

4.2. Discussion

The Fourth Industrial Revolution, characterized by the fusion of digital, biological, and physical worlds, as well as the advent of cyber-physical systems, presents a transformative landscape for businesses worldwide. For Small and Medium Enterprises (SMEs), this era of Industry 4.0 is not just

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a horizon of technological advancements but a crucible in which their adaptability and independence are tested. The importance of these aspects—kemandirian (independence) and kemampuan adaptasi (adaptability)—becomes paramount as SMEs navigate through the challenges and opportunities presented by Industry 4.0.

a. The Imperative of Independence

Independence, in the context of SMEs, entails the capability of a business to make autonomous decisions, control its resources effectively, and chart its strategic direction without undue reliance on external entities. This autonomy is crucial in the fast-evolving landscape of Industry 4.0, where technological trends and market dynamics shift with unprecedented speed. Independence allows SMEs to respond swiftly to new opportunities, tailor innovations to their unique business models, and cultivate a distinctive competitive edge. Moreover, financial independence ensures that SMEs can invest in new technologies and skill development, essential for leveraging the benefits of digital transformation. In an era marked by rapid changes, the agility afforded by independence becomes a critical survival and growth strategy. The concept of independence holds significant importance in the context of small and medium-sized enterprises (SMEs). It refers to the ability of a business to make decisions autonomously, effectively control its resources, and determine its strategic direction without excessive reliance on external entities. This autonomy becomes even more crucial in the rapidly evolving landscape of Industry 4.0, where technological trends and market dynamics shift with unprecedented speed. In this section, we will delve into the various aspects of independence for SMEs and its implications in the current business environment. Firstly, independence allows SMEs to respond swiftly to new opportunities. In the era of Industry 4.0, where new technologies and business models emerge frequently, having the freedom to make autonomous decisions enables SMEs to seize these opportunities promptly. Unlike larger corporations, SMEs are often more agile and adaptable, and their ability to act independently empowers them to capitalize on emerging trends and gain a competitive advantage. By being free from excessive reliance on external entities, SMEs can make quick decisions, implement changes, and adapt their strategies to align with the evolving market conditions.

Furthermore, independence enables SMEs to tailor innovations to their unique business models. Unlike larger corporations that may have standardized processes and structures, SMEs often possess distinct characteristics and niche markets. By being independent, SMEs have the flexibility to develop and implement innovations that are specifically tailored to their needs and requirements. This customization allows SMEs to differentiate themselves from competitors and cater to the specific demands of their target customers. Consequently, independence becomes a valuable asset for SMEs in creating a distinctive competitive edge. Financial independence is another critical aspect of independence for SMEs. It ensures that SMEs have the necessary resources to invest in new technologies and skill development, which are essential for leveraging the benefits of digital transformation. In the era of Industry 4.0, where digitalization and automation play a pivotal role, SMEs need to stay updated with the latest technologies to remain competitive. Financial independence allows SMEs to allocate funds towards research and development, technology adoption, and employee training. By investing in these areas, SMEs can enhance their capabilities, improve productivity, and unlock new growth opportunities.

Moreover, in a rapidly changing business environment, the agility afforded by independence becomes a critical survival and growth strategy for SMEs. The ability to make autonomous decisions and adapt quickly to market dynamics allows SMEs to navigate uncertainties and challenges more effectively. Unlike larger corporations, which may have complex decision-making processes and bureaucratic structures, SMEs can make agile decisions and implement changes swiftly. This agility enables SMEs to respond to disruptions, exploit emerging trends, and seize opportunities before their competitors. Therefore, independence becomes a key factor in ensuring the survival and growth of SMEs in the fast-paced Industry 4.0 landscape. However, it is important to note that independence does not imply complete isolation. SMEs still need to establish and maintain strategic partnerships and collaborations with external entities, such as suppliers, customers, and industry associations.

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Website: https://goldenratio.id/index.php/grmapb
ISSN [Online]: 2776-6349

These relationships can provide valuable resources, expertise, and market insights that complement the autonomy of SMEs. Therefore, while independence is crucial, SMEs should strike a balance between autonomy and collaboration to maximize their growth potential.

b. The Vital Role of Adaptability

Adaptability, on the other hand, signifies the ability of SMEs to pivot in response to the evolving demands of Industry 4.0. It encompasses the readiness to embrace new technologies, the flexibility to overhaul traditional business processes, and the foresight to anticipate market shifts. Adaptability is not merely reactive but proactive, enabling SMEs to future-proof their operations and business models. The digital age demands a culture of continuous learning, innovation, and the willingness to experiment and take calculated risks. For SMEs, adaptability is the linchpin of resilience, allowing them to thrive amid the complexities of digital ecosystems, global competition, and changing consumer behaviors. The concept of adaptability is crucial for small and medium-sized enterprises (SMEs) to navigate the challenges and opportunities presented by Industry 4.0. In this section, we will discuss the significance of adaptability for SMEs, its various dimensions, and its role in ensuring their resilience and success in the digital age. Adaptability, in the context of Industry 4.0, refers to the ability of SMEs to pivot and respond to the evolving demands of the digital era. It goes beyond mere survival and encompasses the readiness to embrace new technologies, the flexibility to overhaul traditional business processes, and the foresight to anticipate market shifts. In other words, it involves both reactive and proactive elements, enabling SMEs to future-proof their operations and business models. One key aspect of adaptability is the willingness to embrace new technologies. The digital age is characterized by rapid technological advancements, such as artificial intelligence, Internet of Things, and big data analytics. SMEs that are adaptable can quickly adopt and integrate these technologies into their operations, gaining a competitive edge in terms of efficiency, productivity, and customer experience. By staying up-to-date with technological trends, SMEs can better meet the changing expectations of their customers and adapt to the demands of the digital ecosystem.

Another dimension of adaptability is the flexibility to overhaul traditional business processes. Industry 4.0 brings with it new ways of doing business, such as automation, remote working, and online marketplaces. SMEs need to be adaptable enough to re-evaluate their existing processes and make necessary changes to align with the digital landscape. This may involve streamlining operations, retraining employees, or even redefining the entire value chain. By doing so, SMEs can optimize their operations, reduce costs, and improve overall efficiency. Furthermore, adaptability requires the foresight to anticipate market shifts. In the digital age, markets are constantly evolving, driven by factors such as changing consumer behaviors, emerging technologies, and global competition. SMEs that are adaptable can stay ahead of these shifts by continuously monitoring market trends, conducting market research, and engaging with their customers. By being proactive, SMEs can identify new opportunities, develop innovative products or services, and adjust their strategies accordingly. Adaptability is not without its challenges. It requires a culture of continuous learning, innovation, and the willingness to experiment and take calculated risks. SMEs need to foster an environment that encourages employees to learn new skills, adapt to new technologies, and embrace change. This may involve investing in employee training and development programs, creating cross-functional teams, or establishing partnerships with external experts. By nurturing a culture of adaptability, SMEs can create a workforce that is agile, innovative, and capable of responding to the demands of Industry 4.0.

c. Synergy of Independence and Adaptability

The synergy between independence and adaptability is what truly empowers SMEs in the face of Industry 4.0. While independence provides the strategic freedom to navigate the digital landscape, adaptability ensures that SMEs remain responsive and resilient amidst technological and market evolutions. Together, these aspects foster a dynamic capability within SMEs, enabling them to exploit digital technologies for operational efficiency, customer engagement, and innovation. This dynamic capability is critical for SMEs to transform challenges into opportunities, whether it's leveraging big

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data analytics for informed decision-making, adopting IoT for enhanced operational connectivity, or utilizing AI to offer personalized customer experiences. The findings of this study highlight the importance of the synergy between independence and adaptability in empowering small and medium-sized enterprises (SMEs) in the context of Industry 4.0. Independence provides SMEs with strategic freedom, allowing them to navigate the complex digital landscape and make decisions that align with their unique goals and objectives. On the other hand, adaptability ensures that SMEs remain responsive and resilient amidst technological and market evolutions, enabling them to effectively respond to changing customer demands and competitive pressures. The dynamic capability fostered by the synergy between independence and adaptability is crucial for SMEs to exploit digital technologies for operational efficiency, customer engagement, and innovation. In today's highly competitive and rapidly changing business environment, SMEs need to continuously adapt and evolve their strategies and operations to remain relevant and competitive. The ability to leverage digital technologies effectively is a key factor in achieving this. One of the ways in which SMEs can utilize their dynamic capability is by leveraging big data analytics for informed decision-making. The abundance of data available in the digital era presents both challenges and opportunities for SMEs. By analyzing and interpreting this data, SMEs can gain valuable insights into customer preferences, market trends, and operational inefficiencies. This knowledge can then be used to make informed decisions that optimize operational processes, improve customer experiences, and drive innovation.

Furthermore, the adoption of Internet of Things (IoT) technologies can enhance operational connectivity for SMEs. IoT allows for the seamless integration of physical devices, sensors, and software systems, enabling real-time monitoring and control of various aspects of business operations. Through IoT, SMEs can achieve greater operational efficiency, reduce costs, and improve overall productivity. The dynamic capability of SMEs allows them to adapt and adopt IoT technologies as per their specific needs and requirements, ensuring that they remain agile and responsive to changes in the digital landscape. Artificial Intelligence (AI) is another digital technology that can be effectively utilized by SMEs to offer personalized customer experiences. AI algorithms can analyze vast amounts of customer data, enabling SMEs to understand individual preferences, anticipate needs, and tailor their products and services accordingly. This level of personalization can significantly enhance customer engagement and satisfaction, leading to increased loyalty and repeat business.

d. Historical Context and Contemporary Insights

Historically, the success of SMEs has hinged on their ability to adapt and innovate. However, the advent of Industry 4.0 has amplified the importance of these attributes. Past research underscores the resilience of SMEs that exhibit high levels of independence and adaptability, demonstrating their capacity to outperform peers and sustain growth over time. Contemporary findings from this study align with historical insights, empirically validating the critical roles of independence and adaptability in the context of Industry 4.0. The analysis revealed that SMEs with higher independence and adaptability are better positioned to capitalize on the opportunities presented by digital transformation, driving business success and innovation. The discussion section of this paper aims to provide a comprehensive analysis and interpretation of the findings in relation to the historical and contemporary understanding of the importance of independence and adaptability for the success of small and medium-sized enterprises (SMEs). The discussion will also explore the implications of these findings within the context of Industry 4.0 and digital transformation.

Historically, independence and adaptability have been recognized as key factors contributing to the success of SMEs. Previous research has consistently highlighted the significance of these attributes in enabling SMEs to overcome challenges, respond to market changes, and sustain growth over time. The present study's findings align with this historical understanding, providing empirical evidence that supports the critical roles of independence and adaptability in the context of Industry 4.0. The analysis conducted in this study revealed that SMEs with higher levels of independence and adaptability are better positioned to capitalize on the opportunities presented by digital transformation. This finding suggests that SMEs that are able to operate autonomously and make decisions independently are more likely to identify and seize the potential benefits of Industry 4.0 technologies. Furthermore, the ability to adapt quickly and effectively to changing market dynamics

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and technological advancements allows these SMEs to stay ahead of the competition and drive business success. One possible explanation for the positive relationship between independence and adaptability and SME success in the context of Industry 4.0 is that independent SMEs are more flexible in their decision-making processes. They are not bound by bureaucratic constraints or hierarchical structures that may hinder the adoption of new technologies or the implementation of innovative strategies. This flexibility allows them to respond swiftly to market demands, experiment with new approaches, and take calculated risks, which are crucial in the rapidly evolving digital landscape.

Moreover, SMEs with higher levels of adaptability possess the ability to adjust their business models, processes, and strategies to align with the changing requirements of Industry 4.0. These SMEs demonstrate a willingness to embrace new technologies, modify their operations, and invest in the necessary resources and capabilities to leverage the potential benefits of digital transformation. By doing so, they are able to enhance their competitiveness, improve operational efficiency, and drive innovation within their respective industries. The findings of this study have important implications for SMEs, policymakers, and researchers. SMEs that recognize the significance of independence and adaptability in the context of Industry 4.0 can strategically position themselves to take advantage of the opportunities presented by digital transformation. They can invest in developing a culture of independence, encouraging employees to take ownership of their work and fostering an environment that supports autonomous decision-making. Additionally, SMEs should prioritize building adaptive capabilities, such as fostering a learning culture, investing in employee training and development, and establishing partnerships with technology providers to stay up-to-date with the latest advancements. From a policy perspective, governments and other relevant stakeholders should provide support and resources to help SMEs enhance their independence and adaptability. This can be achieved through targeted funding programs, training initiatives, and the creation of networks and platforms that facilitate knowledge sharing and collaboration. By doing so, policymakers can foster an ecosystem that enables SMEs to thrive in the era of Industry 4.0 and contribute to economic growth and innovation. In terms of future research, this study opens up several avenues for further investigation. Firstly, it would be valuable to explore the specific mechanisms through which independence and adaptability contribute to SME success in the context of Industry 4.0. Understanding the underlying processes and factors that drive the positive relationship between these attributes and business outcomes can provide deeper insights and inform the development of effective strategies and interventions.

Secondly, future research could examine the potential challenges and barriers that SMEs face in developing and maintaining high levels of independence and adaptability. Identifying these obstacles can help policymakers and practitioners design targeted interventions to address them and support SMEs in their digital transformation journey. Lastly, it would be beneficial to investigate the long-term effects of independence and adaptability on SME performance and sustainability. Understanding whether the positive relationship between these attributes and business success is sustained over time can provide valuable insights into the long-term implications of Industry 4.0 and digital transformation for SMEs.

5. CONCLUSION

In conclusion, the advent of Industry 4.0 has brought about significant changes and challenges for small and medium-sized enterprises (SMEs). As these organizations navigate the uncharted waters of the digital era, the imperatives of independence and adaptability emerge as crucial factors for their success. Independence empowers SMEs to steer their course with confidence, while adaptability ensures they can weather the storms and harness the winds of change. Together, these attributes form the cornerstone of SME resilience and competitiveness in the digital era. The importance of independence for SMEs cannot be overstated. In an increasingly interconnected and complex business environment, SMEs must have the ability to make their own decisions and chart their own path. This independence allows them to respond quickly to market changes, identify new opportunities, and differentiate themselves from larger competitors. By embracing independence, SMEs can leverage their agility and flexibility to their advantage, enabling them to adapt and thrive in the rapidly evolving

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digital landscape. However, independence alone is not enough. SMEs must also possess adaptability to effectively navigate the challenges and opportunities of Industry 4.0. The digital era is characterized by rapid technological advancements, changing consumer demands, and evolving business models. SMEs that can adapt to these changes are better positioned to stay competitive and seize new opportunities. Adaptability enables SMEs to embrace emerging technologies, optimize their operations, and continuously innovate. By embracing change, SMEs can transform challenges into opportunities and ensure their long-term sustainability.

The discussion presented in this paper emphasizes the importance of fostering independence and adaptability among SMEs. Policymakers, industry associations, and other stakeholders must recognize the significance of these attributes and work towards creating an enabling environment for SMEs to develop and thrive amidst the challenges and opportunities of Industry 4.0. To foster independence, SMEs need access to resources and support systems that allow them to make informed decisions and take calculated risks. This includes access to relevant market information, financial resources, and business development services. Policymakers should focus on promoting transparency, reducing bureaucratic barriers, and providing targeted support programs to empower SMEs and enhance their decision-making capabilities. Additionally, industry associations and networks can play a crucial role in facilitating knowledge sharing, collaboration, and mentorship opportunities among SMEs, further enhancing their independence. Adaptability, on the other hand, requires a supportive ecosystem that encourages experimentation, learning, and innovation. Policymakers should create an environment conducive to experimentation and risk-taking, where SMEs can test and adopt new technologies and business models. This may involve providing financial incentives, promoting research and development activities, and fostering collaboration between SMEs, research institutions, and larger corporations. Furthermore, policymakers should invest in digital infrastructure and skills development initiatives to ensure SMEs have the necessary tools and capabilities to adapt to the digital era. In addition to government support, industry associations and networks have a crucial role to play in promoting independence and adaptability among SMEs. These organizations can provide training and capacity-building programs to enhance SMEs' decision-making and adaptability skills. They can also facilitate networking events, conferences, and forums where SMEs can learn from each other, share best practices, and explore potential collaborations. By fostering a sense of community and providing a platform for knowledge exchange, industry associations and networks can create a supportive ecosystem that enables SMEs to thrive in the digital era.

Overall, the conclusions drawn from this paper highlight the importance of independence and adaptability for SMEs in the context of Industry 4.0. These attributes are essential for SME resilience and competitiveness in the digital era. Policymakers, industry associations, and other stakeholders must recognize the significance of fostering independence and adaptability among SMEs and work towards creating supportive ecosystems that enable SMEs to develop and thrive amidst the challenges and opportunities of Industry 4.0. By doing so, we can ensure that SMEs remain at the forefront of innovation and contribute to economic growth and prosperity in the digital age.

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