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Blockchain-Capabilities, Supply Chain Resilience, and Company Performance: An Empirical Study in Indonesia and Switzerland

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Abstract **-** Alignment and agility are essential supply chain capabilities required to maintain and enhance performance, particularly in the current era of disruption. The research aimed to examine the impact of blockchain capabilities on supply chain resilience and company performance using quantitative and cross-sectional survey methods. Logistics service providers (LSP) were selected as the units of analysis, and individuals such as logisticians in Indonesia and Switzerland served as units of observation. Data were collected through an electronic questionnaire (Google Forms) using a quota sampling technique and analyzed using Smart-PLS software. The sample size included 60 respondents, comprising 45 and 15 from Indonesia and Switzerland based on the 10-times rule. The results show that supply chain resilience partially and fully mediated the impact of blockchain capabilities (supply chain alignment and agility) on LSP-Performance. LSP could also enhance performance and resilience by implementing blockchain technology to enhance supply chain alignment and agility. In theoretical terms, the results have implications contributing to dynamic capability theory. In practical applications, the research serves as valuable insights for government authorities and IT consultants when formulating effective plans and strategies to analyze the adoption of blockchain technology among LSP. Additionally, directors and owners of these companies are persuaded that blockchain has the potential to create and enhance supply chain capabilities, as well as increasing competitive advantage.

Keywords: blockchain capability, supplay chain resilience, company performance

I. INTRODUCTION

Indonesia's logistics performance index for 2023 issued by the World Bank was reported to show a significant decline, from ranking 46th in 2018 down to 63rd in 2023 (World Bank, 2023). The decline was caused by timelines, tracking and tracing, international shipments, as well as logistics competence and quality. This index is a reference for a country's logistics performance released continuously by the World Bank to provide an overview of trade logistics conditions. Furthermore, it is often used as a reference for investors to invest capital in a country. The two important aspects causing the decline in performance are COVID-19 pandemic and inadequate technology, disrupting supply chain and logistics activities. The activities related to this condition include alignment, agility, and adaptability. Therefore, the implementation of technology to enhance various aspects is important and time-sensitive for supply chain and logistics operations. This holds for businesses, governmental entities, and other stakeholders, and logistics services is an industry significantly impacted by the ongoing pandemic. During the pandemic, there has been an unprecedented 80% reduction in volume, particularly in business-to-business (B2B) logistics dealing with the transportation of manufactured goods ("Kegiatan bisnis logistik", 2020). The pandemic has disrupted the global supply chain, leading to a shortage of containers for export activities. This shortage is pronounced in shipments to the USA and China, resulting in a substantial increase in export costs. In some cases, the costs have increased to ten times the original expenses. Given these circumstances, Logistics service providers

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(LSP), as key players in the global supply chain, in terms of integration and collaboration, are focused on enhancing alignment, agility, and adaptability. The incorporation of blockchain technology into logistics service companies becomes crucial and urgent, serving as a strategic move to increase alignment and agility capabilities.

Technology is a company's resource that can develop capabilities including supply chain alignment and agility (Aslam et al., 2020, 2018; Chu et al., 2019; Patrucco & Kähkönen, 2021; Polater, 2020; Ruan et al., 2022; Salisu & Abu Bakar, 2019). Blockchain as one of the technologies can create and develop capabilities in supply chain. In the context of management, the technology can improve alignment, agility, adaptability, real-time information, cybersecurity, transparency, reliability, traceability, and visibility (Aslam et al., 2018; Sheel & Nath, 2019)

Supply chain agility is one of the services or features of blockchain technology implemented by LSP to increase resilience and performance (Sheel & Nath, 2019). This variable has an important role or significant impact in improving resilience (Gligor et al., 2019; Li, Cheong, & Lee, 2021). In addition, it has a significant impact on company performance (Ahmad et al., 2023; Baah et al., 2022; Zhou et al., 2023)

Supply chain alignment refers to integrating the operations of all members to improve the performance of LSP. The idea is very important for operations strategy and supply chain planning (Simatupang & Sridharan, 2018). According to operations strategists, a company's resources and capabilities must be consistent with market demand and operational performance objectives such as cost or flexibility (Qi et al., 2017). The strategic considerations extend upstream, showing the necessity for a business to harmonize the performance objectives with suppliers. This alignment should synchronize with the requirements of a customer-centric business model to hold a substantial influence on resilience of the entire supply chain ecosystem (Dubey et al., 2018; Feizabadi, Maloni, & Gligor, 2019; Guan et al., 2023; Salam & Bajaba, 2023). The influence of a supply chain alignment on resilience is dependent on the specific situation and context. The collective prioritization of efficiency, focusing on cost considerations, responsiveness, and flexibility, varies based on the product type and the distinctive characteristics of supply and demand.

Business resilience shows a company's capacity to effectively uphold different functions, processes, or responses following the occurrence of a disturbance or disruption, thereby ensuring survival and prosperity (Dormady, Roa-Henriquez, & Rose, 2017; Pettit et al., 2019). Meanwhile, supply chain resilience characterizes the adaptive capabilities of a company to proactively prepare for events, respond to disruptions, and recover by sustaining operational continuity at the desired level of interconnectedness and control over structure and function (Ivanov, 2022; Ivanov, Dolgui, & Sokolov, 2019). Key facets of business resilience include competitiveness, value, social capital, team empowerment, psychological capital, flexibility, objective interdependence, anticipation, coping, resilience, redundancy, resourcefulness, and speed (Duchek, 2020; Liu & Lee, 2018; Shani, 2020). Robustness refers to the ability of elements, systems, and other units of analysis to endure stress and demands without incurring damage, degradation, or loss of function.

Redundancy quantifies the extent to which elements, systems, or other units of analysis exist to meet functional requirements during disruption, degradation, or loss of the system's primary function. Resourcefulness signifies the capacity to identify problems, set priorities, and mobilize resources to prevent damage or disruption, as well as the ability to allocate human and material resources. Speed represents the capacity to fulfill priorities and achieve different objectives. In this context, the impact of supply chain resilience on performance is substantial (Hamidu et al., 2023; Hendijani & Norouzi, 2023; Mukherjee et al., 2023). Company performance refers to the actions conducted by a company to communicate with stakeholders, including financial, operational, environmental, economic, market capitalization, customer-related, and learning or growth aspects (Ahmed, Najmi, & Khan, 2019; Anand, 2016; Raval et al., 2020; Sousa-Zomer et al., 2020). This is the measure of efficiency and effectiveness in executing actions.

Efficiency relates to the resources used to obtain results or outputs, while effectiveness relates to the extent to which the results of an action meet the specifications, requirements, and expectations. From a financial or economic perspective, several indicators consist of return on assets (ROA), return on investments (ROI), return on equity ratio (ROE), net profit, etc. (Shakil et al., 2019). In operational terms, some indicators include delivery time, rate errors, and new markets identified. In the context of customers, some of the measurements include customer satisfaction, brand expectations, and relationship management. Learning and growth measurements consist of employee or total costs, and the percentage of compensation related to performance (Anand, 2016).

Blockchain technology plays a role in increasing a company's competitive advantage, performance, resilience, and supply chains (Schuster et al., 2021; Gligor et al., 2019; Lambourdiere & Corbin, 2020; Li et al., 2021; Sheel & Nath, 2019). The application of technology in the company's supply chain can improve alignment, agility, and adaptability (Azmi et al., 2022; Min, 2019; Queiroz, Telles, & Bonilla, 2019; Sheel & Nath, 2019). Improving supply chain adaptability positively influences resilience and performance. Therefore, a company's adaptability correlates with the robustness of resilience and performance (Sheel & Nath, 2019). Increased supply chain agility is associated with improved resilience and performance (Gligor et al., 2019; Li et al., 2021; Sheel & Nath, 2019).

Additionally, alignment contributes to enhanced resilience and company performance (Skipworth et al., 2015). A company's supply chain resilience directly impacts its performance (Abeysekara, Wang, & Kuruppuarachchi, 2019; Chowdhury, Quaddus, & Agarwal, 2019; Juan, Li, & Hung, 2022). The research aims to determine the extent to which supply chain resilience mediates the impact of blockchain capabilities on company performance. The research questions include, firstly, the direct impact of blockchain capabilities on performance and the indirect influence through supply chain resilience. Secondly, the relationship between supply chain resilience and its impact on performance is analyzed. The hypotheses tested include the examination:

H_1: Supply chain alignment influences supply chain resilience.
H_2: Supply chain agility influences resilience.
H_3: Supply chain alignment influences LSP-Performance.
H_4: Supply Chain agility influences LSP-Performance.
H_5: Supply chain resilience influences LSP-Performance.
H_6: Supply chain resilience mediates the influence of alignment on LSP-Performance.
H_7: Supply chain resilience mediates the influence of agility on LSP-Performance.

Even though numerous previous studies show a positive impact of implementing blockchain on performance of logistics service company (Sheel & Nath, 2019), the adoption remains slow. The specific objectives include examining the influence of blockchain capabilities on LSP-Performance and considering resilience.

II. METHODS

The research applies a quantitative method, using causal and cross-sectional surveys (Bougie & Sekaran, 2020; Hair et al., 2019). The focal point of analysis is LSP, and the units of observation comprised logisticians (logistics experts) in Indonesia and Switzerland, including employees or leaders, blockchain experts, as well as logistics and supply chain experts. Data are collected through an electronic questionnaire (g-form) by using a purposive sampling technique and then processed through Smart-PLS software with a sample size of 60 respondents. The respondent pool is comprised of 45 and 15 individuals based in Indonesia and Switzerland.

The determination of the sample size for each country is grounded in a comparative analysis of the population figures of LSP in Indonesia (1,535 companies) and Switzerland (538 companies). The sample size is based on 10 times the largest number of formative indicators used to measure a single construct or 10 times the largest number of structural paths directed at a particular construct in the structural model (Hair Jr. et al., 2021). The questionnaire comprised 16 questions or statements, using a 1-5 Likert Scale for response evaluation and data collection spanned two months in 2022. In testing the validity and reliability, the criteria used are outlined in Table 1, incorporating standardized factor loadings (SFL), average variance extracted (AVE), composite reliability (CR), and Cronbach's alpha (CA). Meanwhile, the significance criteria are based on a t-statistic value of more than 1.96 or a p-value of less than 0.05 (Bougie & Sekaran, 2020; Hair Jr. et al., 2019; Hair Jr. et al., 2021; Sundjaja, 2018).

Table 1 Validity and Reliability Test Acceptance Criteria

Items	Validity	Reliability	Criteria
SFL	≥ 0.7	-	Valid
AVE	≥ 0.5	-	Valid
CR	-	≥ 0.7	Reliable
CA	-	≥ 0.7	Reliable

The model consisted of two exogenous, one mediating, and one endogenous variable. The two exogenous variables are blockchain-capabilities, namely alignment, and agility. Resilience is a mediating variable, while performance of LSP-Performance constitutes an endogenous variable. As seen in Table 2, alignment has three indicators,

Table 2 Measurements & Factor Loading (FL)

Construct		Items	FL
Alignment (Supply Chain Alignment)	1	Blockchain application will improve ability of logistics service company in integrating their supply chain function with other internal functions	0.806
	2	Blockchain application will improve ability of logistics service company in integrating their supply chain function with suppliers.	0.703
	3	Blockchain applications will improve the ability of logistics service company to integrate supply chain functions with customers.	0.842
Agility (Supply Chain Agility)	1	Blockchain applications will improve ability of logistics service company to change delivery time as customers' requirements.	0.868

Table 2 Measurements & Factor Loading (FL) (Continued)

Construct		Items	FL
	2	Blockchain application will improve ability of logistics service company in changing variation or scope of logistics services as customers' requirements.	0.795
	3	Blockchain application will improve ability of logistics company in changing service level as customers' requirements.	0.817
	4	Blockchain application will improve ability of logistics service company in changing service reliability as their customers' requirements	0.832
Resilience (Supply Chain Resilience)	1	Blockchain application will improve ability of logistics service company in carrying out relevant information exchange with their customers if disruption occurs.	0.787
	2	B Blockchain application will improve ability of logistics service company in carrying out real-time information exchange with their customers when disruption occurs.	0.734
	3	Blockchain application will improve ability of logistics service company in carrying out accurate information exchange with customers when disruption occurs.	0.822
	4	Blockchain application will improve ability of logistics service companies in carrying out collaborative planning with customers when disruption occurs.	0.844
	5	Blockchain application will improve ability of logistics service companies in adapting flexibility operation process when disruption occurs.	0.775
LSP-Performance	1	Operation costs will be reduced by using blockchain	0.714
	2	The service level provided to customers will be improved using blockchain.	0.870
	3	The services provided to customers will be faster by using blockchain	0.788
	4	The value creation for customers will increase by using blockchain	0.773

namely customer, internal, and supplier integration. Supply chain agility has four indicators consisting of customization, lead time, reliability, and customer service. Meanwhile, resilience has five indicators, namely timely information, relevant information, accurate information, flexibility information, and collaborative planning. LSP-Performance has four indicators, including service level, operation cost, service speed, and customer value.

III. RESULTS AND DISCUSSIONS

Referring to Table 1, Table 3, Table 4, and Figure 1, the data shows validity and reliability, as shown by standardized loading factors (SFL), average variance extracted (AVE), composite reliability (CR), and Cronbach's alpha (CA) metrics.

Internal consistency reliability demonstrates reliable values, as indicated by CA and CR values greater than or equal to 0.7 ($\geq$ 0.7). These CA and CR values also confirm the absence of measurement issues or unidimensionality. The data also fulfil the requirements for convergent validity, with AVE values exceeding or equal to 0.5 ($\geq$ 0.5). Furthermore, the research data demonstrate good discriminant validity. This is evident from the Fornell-Larcker Criterion values, which indicates that each construct's values are greater than the correlations with other variables (see Table 4). Additionally, the cross-loading values for each indicator on their respective constructs are higher than the cross-loading values, while the heterotrait-monotrait ratio of correlations (HTMT) values remains below 0.9. Meanwhile, variance inflation factor (VIF) values below 5 ($\leq$ 5) indicate the absence of multicollinearity issues.

Figure 1, Figure 2, and Table 5 show that all hypotheses (H_1, H_2, H_4, H_5, H_6, and H_7) are accepted except hypothesis 3 (H_3). Alignment (supply chain alignment) has a positive and significant direct influence on resilience with an effect size of 50.1%, while the remaining 49.9% is influenced by other variables. Agility (supply chain agility) has a positive and significant direct effect on resilience with a size of 32.3%, while the remaining 67.7% is influenced by other variables. Alignment (supply chain alignment) has a direct insignificant effect on performance of LSP-Performance with a size of 21.9%, while the remaining 78.1% is influenced by other variables. Furthermore, agility (supply chain agility) has a positive and significant direct effect on LSP-Performance with a size of 46.7%, while the remaining 53.3% is influenced by other variables. Alignment has a positive indirect effect on LSP-Performance with a size of 12.6%,

Therefore, a one-unit rise in alignment can increase LSP-Performance indirectly through resilience by 12.6%. In this context, agility (supply chain agility) has a positive indirect effect with a size of 8.1%. This shows that a one-unit rise in agility can increase LSP-Performance indirectly through resilience by 8.1%. The total effect of alignment on LSP-Performance is 0.346. This implies that if alignment increases by one unit, LSP-Performance can increase both directly and indirectly through resilience by 34.6%. Meanwhile, the total effect of agility on LSP-Performance is 0.548. This suggests that if agility increases by one unit, LSP-Performance can increase both directly and indirectly through resilience by 54.8%.

Table 3 Validity and Reliability Test Results

Items	CA	rho_A	CR	AVE
LSP-Performance	0.795	0.810	0.867	0.621
Agility	0.848	0.856	0.897	0.686
Alignment	0.700	0.722	0.828	0.617
Resilience	0.854	0.866	0.895	0.630

Table 4 Discriminant Validity (Fornell-Larcker Criterion)

Items	Agi.	Alg.	Res.	Perf.
Agility	0.828	-	-	-
Alignment	0.659	0.786	-	-
Resilience	0.776	0.707	0.788	-
Performance	0.653	0.714	0.714	0.794

Note:
Agi. : Agility
Alg. : Alignment
Res. : Resilience
Perf. : Performance

The simultaneous influence of alignment, agility, and resilience on LSP-Performance is 0.697, with an adjusted R-squared value of 0.681. This indicates that all exogenous constructs collectively influence LSP-Performance by 0.697 or 69.7%. Since the adjusted R-squared is greater than 67%, it suggests that the influence of all exogenous constructs, including alignment, agility, and resilience, on LSP-Performance is strong. Furthermore, based on the f-square values, it is evident that the influence of agility on LSP-Performance has a large effect size (≥ 0.35), while the influence of agility on resilience and the influence of alignment on resilience have medium effect sizes (0.15 to 0.35). The influence of alignment on LSP-Performance is relatively small (≤ 0.15). Additionally, when assessing the model's suitability for the data, it is apparent that the model fits well. This is supported by the standardized root mean square (SRMR) value being less than 0.10 and the normed fit index (NFI) exceeding 0.9.

Table 5 Path Coefficients

Items	Path Coefficients
Alignment → Resilience	0.501
Agility → Resilience	0.323
Alignment → LSP-Performance	0.219
Agility → LSP-Performance	0.467
Resilience → LSP-Performance	0.252
Alignment → Resilience → LSP-Performance	0.126
Agility → Resilience → LSP-Performance	0.081

In line with the results, blockchain capabilities have a positive and significant impact on resilience. Therefore, the application of the technology plays an important role in developing capabilities of this company, particularly by improving alignment and agility. Regarding direct effects on LSP-Performance, agility has a positive and significant impact, while

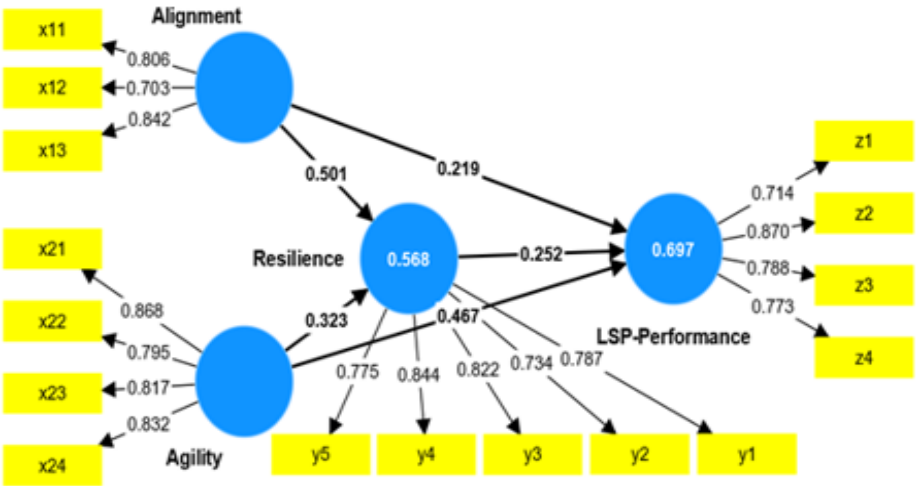

Figure 1 PLS-Result (Algorithm)

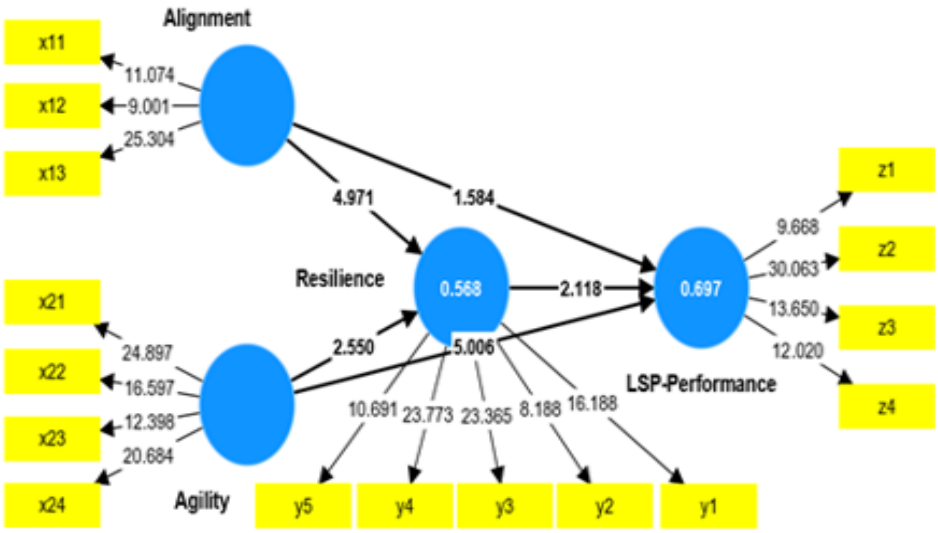

Figure 2 PLS-Result (bootstrapping)

alignment has an insignificant influence. These results show that resilience mediates the effects of agility and alignment on LSP-Performance.

Other results reported that resilience has a positive and significant impact on LSP-Performance. This shows the important role of resilience in enhancing the performance of logistics service company. The results also show that resilience partially and fully mediates the influence of alignment and agility on LSP-Performance.

Blockchain technology can improve alignment, particularly through customer and internal integration. This technology improves agility through customization, lead-time, reliability, and customer service. In addition, resilience is enhanced through relevant information, accurate information, flexibility information, and collaborative planning, while LSP-performance can be improved by service level, service speed, and customer value.

Blockchain technology is widely discussed in the context of digital transformation, specifically its application in the supply chain. Some experts argue that blockchain is the heart of digital transformation. There is no study on empirical analysis regarding the application of the technology in the logistics services industry and the model was developed based on (Sheel & Nath, 2019).

Some technologies applied to the supply chain logistics services industry include artificial intelligence, big data analytics, and internet of things (IoT). The research can be used as a reference to analyze the effects of blockchain technology on supply chains. Further research should be developed in other specific industries experiencing disruption, such as cooking oil, empty containers, and hospitality. Blockchain technology can improve alignment, agility, and resilience of the supply chain. The framework or model serves as a basis for future research to analyze the effects of blockchain technology adoption on other important supply chain parameters such as flexibility, complexity, service climate, marketing, and orientation.

Logistics service company is expected to better understand blockchain technology and actively work to provide supply chain solutions. The implementation of the approach necessitates comprehensive socialization and training programs for every employee within the logistics service company. This initiative aims to increase motivation among employees to enhance the understanding of blockchain technology and its application in refining business processes, including tracking and tracing, ensuring immutability, and incorporating smart contracts. Additionally, emphasis should be placed on empowering employees to make informed decisions using blockchain technology. Regulatory aspects also need to be considered in its application, hence the technology is supported by comprehensive, integrative, and systematic regulation. The research is constrained by the relatively small sample size, a limitation arising from the familiarity among practitioners with the application of blockchain technology in Indonesia and Switzerland. The number of variables is limited to performance, resilience, agility, and alignment. Therefore, further research should be carried out with a larger sample size, including respondents from various countries and industries. The variables can be expanded to include aspects of sustainability, adaptability, immutability, transparency, and flexibility.

IV. CONCLUSIONS

In conclusion, alignment and agility are reported to improve LSP supply chain resilience. Agility and resilience are correlated with improved LSP-Performance. Meanwhile, resilience partially and fully mediated the impact of agility and alignment on LSP-Performance. The key indicators of alignment included customer integration, internal integration, and supplier

integration, while the significant indicators of agility consisted of customization, lead time, reliability, and customer service. Conversely, the important indicators of resilience are timely information, relevant information, accurate information, flexibility in information, and collaborative planning. The critical aspects of LSP-Performance included service level, operational cost, service speed, and customer value.

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