

The Influence of Regulatory Changes and the Global Economic Crisis on the Readiness of Mining and Port Service Companies and the Multiplier Effect on the MSME Ecosystem

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Abstract. *This study aims to analyze the influence of regulatory changes and the global economic crisis on company readiness, human resources, and strategies in quartz sand mining, shipping agency, and stevedoring companies at the Special Terminal of Teluk Buton Village, Natuna Regency, Riau Islands Province. The study used a qualitative approach with a case study method, involving 50 respondents from the three companies. The results showed: (1) mining companies have good operational readiness ($r=0.734$) but limited financial readiness due to reclamation guarantee obligations ($r=0.685$) and increases in HPP; (2) shipping agency and stevedoring companies are highly dependent on export volume with a fluctuating profit-sharing/piecework payroll system; (3) regulatory changes are a major challenge with a Cronbach's Alpha instrument reliability of 0.720; (4) the global economic crisis caused a decrease in export volume >40% and impacted local MSMEs; (5) recommended adaptive strategies include digitalization, service diversification, strengthening partnerships, and multi-skill training. This study contributes to the development of organizational resilience theory and change management in the mining and logistics sectors.*

Keywords: *Adaptation Strategy; Corporate Readiness; Global Economic Crisis; Human Resources; Regulatory Changes; Supply Chain.*

1. Introduction

The mining industry in Indonesia has contributed to national economic growth, with the greatest achievements coming from the exploitation of metallic and non-metallic minerals. This sector not only provides jobs but also supports the local economy through export activities that impact community welfare (Husodo & Vanany, 2024). However, this industry faces a number of challenges, particularly due to global dynamics influenced by regulatory changes. The mining industry, particularly quartz sand mining, and its supporting industries such as shipping and unloading agencies, are facing major challenges due to two synergistic external factors: dynamic regulatory changes at both the central and regional levels and the pressure of the global economic crisis exacerbated by geopolitical uncertainty resulting in a surge in industrial fuel prices. Regulatory changes in the mining sector occurred with the issuance of ESDM Ministerial Regulation No. 17 of 2025 and ESDM Ministerial Decree No. 344 of 2025 which emphasize that the placement of reclamation guarantee funds is an absolute requirement for the approval of the Work Plan and Budget (RKAB) (<https://www.dunia-energi.com2025>) and changes to regional regulations regarding the percentage calculation of the Cost of Goods Sold (HPP) in the region.

The issuance of the new policy regarding the obligation to place reclamation and post-mining guarantees in the Mine Opening Plan in the first year and the placement of reclamation and post-mining guarantees according to the mine area that has been opened for companies that are already operating is felt to be very burdensome and requires mining companies to make major adjustments in the administrative process every year (Republika, 2025). However, based on empirical observations and experience in the field, regulatory changes do not pose a significant obstacle for quartz sand mining companies; instead, they provide the ability for companies to be more adaptive to production dynamics. On the other hand, the global economic crisis marked by commodity price fluctuations, supply chain disruptions, and geopolitical instability has squeezed companies' profit margins and forced them to implement efficiencies in various areas (Kompas.id, 2025).

A more crucial issue that directly impacts the company's cost structure stems from regulatory changes related to the Change in Cost of Goods Sold (HPP) for Non-Metallic Minerals (Quartz Sand) and the calculation of the percentage of non-metallic mineral and rock (MBLB) tax payments, resulting in an increase in tax payments. Furthermore, the implementation of mandatory MBLB tax payments at the minehead is accompanied by provisions in ESDM Ministerial Decree No. 344 of 2025 and ESDM Ministerial Regulation No. 17 of 2025, whereby Reclamation and Post-Mining Guarantee payments are adjusted to the area of mine openings. This fiscal policy has undergone significant adjustments, thereby increasing the burden of production costs for mining companies already under pressure from falling quartz sand prices on the global market and soaring fuel prices. Mining companies are required to remain productive amidst cost pressures, while shipping and stevedoring agencies, which are partners that are highly dependent on export volume, also feel a significant impact on their business continuity. These three research objects are closely linked in the quartz sand export supply chain, so changes in one sector will impact the others (CNBC Indonesia, 2025).

Regulatory changes in the mining sector are not only limited to the mechanism for the Placement of Reclamation Guarantees and Post-Mining Guarantees, but also include the shadow of a downstreaming policy that requires mining companies to increase the added value of products before they are exported, as well as regulations regarding the obligation to use local labor and the development of communities around the mine (Bisnis.com, 2025). The downstreaming policy stipulated in Law Number 2 of 2025 concerning the fourth amendment to the Mineral and Coal Law mandates that mining companies must build domestic processing and refining facilities, which requires significant investment and a long time to realize (Kompas.id, 2025). For quartz sand mining companies that have previously exported mostly raw materials, this policy forces them to prepare for fundamental changes in their business models and prepare adequate resources to build processing plants. On the other hand, shipping and stevedoring agency companies will also be impacted by changes in export patterns because downstreaming will change the types of commodities exported from raw materials to semi-finished or finished products, which require different logistical handling and different vessel specifications and stevedoring equipment. This change requires all three types of companies to make comprehensive strategic adjustments, not only in operational aspects but also in human resources and company cost structures (Kontan, 2025).

The global economic crisis that has been ongoing since mid-2025 has worsened the mining and logistics industry in Indonesia, with impacts felt across nearly all aspects of company operations. Fluctuations in the rupiah exchange rate against the US dollar, which reached Rp16,800 per US dollar at the end of 2025 and continued to rise due to geopolitical instability, have reduced the purchasing power of quartz sand importers, while export revenues in US dollars have also been eroded by the decline in global commodity prices (Bank Indonesia, 2025). Current geopolitical uncertainty has further exacerbated this situation, particularly due to the rise in global fuel prices. This fuel price spike has had a direct impact on significantly increasing operational and production costs, forcing some quartz mining companies to reduce production activities because soaring production costs are no longer commensurate with selling prices. The price of quartz sand on the global market has fallen by more than 50 percent compared to the previous three years, resulting in a drastic decline in mining company revenues while production costs remain high or even increase due to inflation and rupiah depreciation (Kompas.id, 2025). Shipping and stevedoring agencies, whose revenues are highly dependent on export volumes, have also experienced a significant decline in activity, with some reports indicating a 35 percent decline in loading and unloading volumes at major ports by the fourth quarter of 2025 (Ministry of Transportation, 2025). Furthermore, for shipping agencies that do not own their own vessels and rely solely on vessels from shipowners or charter parties, these geopolitical conditions have caused importers and charter parties to delay vessel arrivals. These delays have further exacerbated the decline in shipping activity due to uncertainty about operational costs and increased shipping risks. The combination of increasing regulatory pressures and worsening global economic pressures creates a very difficult situation for these companies to survive and thrive, necessitating an in-depth assessment of their preparedness and appropriate strategies to address these challenges.

2. Research Methods

This research uses a qualitative approach with a case study method. The qualitative approach was chosen because this study aims to understand in-depth phenomena occurring in the field, including organizational readiness, human resource management, and strategies implemented by the three companies in facing regulatory changes and the global economic crisis (Creswell & Poth, 2018). The case study method was chosen because this research focuses on describing the objective conditions of the three research objects: a quartz sand mining company, a shipping agency company, and a stevedoring company, which have specific and contextual characteristics (Yin, 2018). This approach allows researchers to explore and understand the complexity of the problems faced by each company holistically and capture the perspectives of stakeholders in the three companies (Stake, 2022). With this approach, researchers can extract rich and in-depth information through various data sources to understand how the three companies interpret regulatory changes and the global economic crisis and their impact on company readiness, human resources, and implemented strategies.

Research Characteristics:

1. Approach: Qualitative
2. Method: Case Study
3. Objective: To understand the phenomenon in depth and contextually
4. Focus: Company readiness, HR, and strategy

3. Results and Discussion

3.1. Overview of Research Object

This research was conducted at the Special Terminal (Tersus) in Teluk Buton Village, Natuna Regency, Riau Islands Province, which is a strategic area for the mining and maritime logistics industry in Indonesia. This area was chosen because the economic activity of the Riau Islands is highly dependent on the quartz sand mining sector and port services that support the export of this commodity. Teluk Buton Port, as one of the busiest ports in Natuna Regency, is a center for loading and unloading and shipping activities that connect quartz sand producing areas with international markets. The three companies that are the objects of the research—the mining company as the Tersus Owner, the shipping agency, and the stevedoring—are closely linked in the quartz sand export supply chain, influence each other, and face similar challenges in the form of regulatory changes and the global economic crisis.

Buton Bay Port plays an important role as a Special Port for the main route for exporting natural resources in Natuna Regency, including quartz sand commodities which are the focus of this research. Meanwhile, the Quartz Sand Mining Company itself is one of the Mining Companies that owns abundant silica sand reserves as a contributor to Regional Original Income (PAD), with at least several silica sand mines still active in the Riau Islands Province, especially in Natuna and Lingga Regencies. Mining and logistics activities in this region are greatly influenced by central and regional government policies, as well as global economic dynamics that impact export volumes and commodity prices.

a. Quartz Sand Mining Company

The quartz sand mining company studied operates in the Special Terminal (Tersus) area of Teluk Buton Village, Natuna Regency, Riau Islands Province, known for its abundant quartz sand reserves. The company operates in Natuna Regency and holds a Mining Business Permit (IUP). The company studied employs approximately 100 people and mines and exports quartz sand to destination countries such as China.

Quartz sand mining companies in the Riau Islands are currently facing severe pressure due to the plunge in quartz sand prices on the global market, which has reached more than 50 percent compared to the fair price of the previous three to four years. This condition has a direct impact on the company's production and sales capabilities, as reflected in the production realization which only reached 4.1 percent of the initial target. In addition to price pressure, the company is also facing an increasing fiscal burden due to the increase in regional and option taxes from 10 percent to 14 percent, which further burdens the company's operations amid weakening market demand.

The quartz sand mining companies studied hold mining business permits (IUP) and operate in areas with abundant natural resource potential. These mining companies serve as the backbone of the regional economy and face dynamic regulatory challenges, particularly related to the mineral benchmark price (HPM) policy, which is deemed no longer aligned with market realities.

This quartz sand mining company, operating in a district in the Riau Islands province, has close ties to shipping and stevedoring agencies in the export supply chain. Teluk Buton Port serves as the main exit point for quartz sand mined at the Special Terminal (Tersus) in Teluk Buton Village, Natuna Regency, Riau Islands Province, for export to various destination countries. This interconnectedness allows the three companies to influence each other in the face of regulatory changes and the global economic crisis, where declining mining production directly impacts shipping volumes and port loading and unloading activities.

b. Shipping Agency Company

The shipping agency company that is the object of this research operates in the Natuna Regency Port, which is an important port for increasing local revenue (PAD) that supports the regional economy. PT. Jalin Antara Samudera (Jalin), as one of the agency companies, is engaged in serving the process of berthing ships for both domestic and international vessels, with the best quality service and plays an important role in the smooth running of export activities in Natuna Regency. This agency company has been operating for quite a long time in the Natuna Regency area, especially in the Buton Bay Tersus, serving the issuance of Permits Arrival Foreign Ships (PKKA) through the SIMLALA application and provide agency services to ships docked at the quartz sand transportation port.

Shipping agency companies face various obstacles in carrying out their operations. Internal obstacles include the quality of Human Resources (HR) which is still not supportive and the lack of good team cooperation, as well as internet network problems that affect the online document processing process. External obstacles include slow document processing due to limited office hours, so that processing cannot be done 24 hours, as well as frequent disruptions to the SIMLALA application system and unexpected changes to ship schedules.

The company studied has been established for 6 (six) years and has fairly experienced employees.

Agency companies can offer maritime services at both public ports and special/special terminals such as Industrial Estates and Pertamina. The shipping agency company PT. Jalin serves the ship berthing process that can run smoothly, supported by good and optimal company performance. Efforts made to overcome obstacles include improving coordination between office employees and agents in the field, preparing internet backups, data or document validation, and prior communication with government agencies before processing documents.

The profit-sharing payroll system implemented by shipping agencies makes company and employee income highly dependent on shipping volume. The decline in quartz sand export volume due to regulatory changes and the global economic crisis has directly impacted agency revenues and employee welfare. Shipping agencies also face the challenge of rising port costs.

c. Loading and Unloading Company

The loading and unloading company that is the object of research is engaged in the field of loading and unloading services for goods at the special terminal port in Teluk Buton village, Natuna district, specifically for non-metallic mineral commodities in the working area of all districts, cities within the scope of the Riau Islands Province, especially in the Regency.

The stevedoring company studied has been established for a long time with approximately 50 (fifty) employees and applies a piecework payroll system per tonnage. This system makes the company and employee income highly dependent on the volume of loading and unloading that occurs, so that the decline in quartz sand export volume due to the global crisis on the employer company has a double impact on the company's income and employee welfare. The main factors that delay loading and unloading activities at the Buton Bay Tersus Port are damaged equipment, inadequate periodic maintenance, and renting damaged equipment from private parties, thus affecting the timeliness of ship loading and unloading activities.

The stevedoring company at Teluk Buton Port also serves service requests to meet the needs of other ship services, both ships from abroad and domestically. In loading and unloading activities, various obstacles often occur such as waiting time factors waiting for the arrival of supporting transportation facilities such as barges, trucks and trailers, as well as weather factors that affect the smooth operation. The success of ship loading and unloading activities is supported by good equipment, complete documents, and good relationships with the government and private parties to maintain trust and punctuality in loading and unloading activities.

3.2. Respondent Characteristics

Based on data collected from 50 respondents, consisting of management and employees from the three companies studied, the respondents' characteristics were obtained, describing the demographic and professional profiles of the workforce in the mining and logistics industry in Riau. Respondent characteristics were analyzed based on five main aspects: the type of company where the respondents work, gender, age, highest education level, and length of service. This data is important for understanding the composition of the workforce that serves as the source of information in this study and for determining the representation of each respondent group within the overall research sample.

The balanced distribution of respondents from the three types of companies allows for a comprehensive analysis of the interconnected perspectives of the quartz sand export supply chain, from upstream (mining) to downstream (logistics and ports). Understanding the respondents' characteristics provides the basis for interpreting the research findings regarding company readiness, human resource readiness, and strategies implemented to address regulatory changes and the global economic crisis.

Table Respondent Characteristics

No	Sub Category	Frequency (f)	Percentage (%)
Company Type			
1	Quartz Sand Mine	17	34%
2	Shipping Agency	17	34%
3	Unloading and loading	16	32%
Total		50	100%
Gender			
4	Man	32	64%

5	Woman	18	36%
Total		50	100%
Age			
6	< 25 years	10	20%
7	25 - 35 years old	15	30%
8	36 - 45 years old	12	24%
9	46 - 55 years old	9	18%
10	> 55 years	4	8%
Total		50	100%
Last education			
11	High School/Vocational High School or Equivalent	9	18%
12	Diploma (D1-D3)	8	16%
13	Bachelor degree)	23	46%
14	Masters (S2)	10	20%
15	Doctorate (S3)	0	0%
Total		50	100%

Years of service			
16	< 1 year	11	22%
17	13 years old	9	18%
18	4 - 6 years	9	18%
19	7 - 10 years	7	14%
20	> 10 years	14	28%
Total		50	100%

Source: Data Processing, 2026

Based on the respondent characteristics table above, the distribution of respondents by company type shows a relatively balanced proportion between the three companies being studied. The Quartz Sand Mining Company and the Shipping Agency Company each had 17 respondents, or 34% of the total respondents, while the Stevedoring Company had 16 respondents, or 32% of the total respondents. This balance indicates that the data obtained fairly represents all three sectors, allowing for a comprehensive analysis to identify differences and similarities in conditions within each company. This is important considering that the three companies are closely linked in the quartz sand export supply chain and influence each other in the face of regulatory changes and the global economic crisis.

The distribution of respondents by gender shows a predominance of 32 male respondents (64%) compared to 18 female respondents (36%). This reflects the characteristics of the mining and logistics industry in Riau, which is still dominated by a male workforce, especially in operational and field management positions. This male dominance in this sector is in line with the general conditions of the heavy and maritime industries in Indonesia, which traditionally involve a larger male workforce due to the physical demands and the nature of the work that requires high mobility. Nevertheless, female participation in this study remains significant and provides valuable perspectives on the state of corporate readiness and human resources in the three companies.

Based on age distribution, the majority of respondents were in the 25-35 years age range (15 people (30%) and 36-45 years old (12 people (24%)), indicating that the workforce in the three companies is dominated by productive age who have sufficient energy and experience

to face operational challenges. Respondents under the age of 25 were 10 people (20%), aged 46-55 years were 9 people (18%), and over 55 years old were only 4 people (8%). This dominance of productive age is an important asset for companies in facing regulatory changes and the global economic crisis, because productive age workers are generally more adaptive to change and have a higher learning capacity. The availability of workers from various age ranges also allows for the transfer of knowledge between generations which is beneficial for organizational development.

The distribution of respondents based on their highest level of education shows that the majority of respondents held a Bachelor's degree (S1) of 23 (46%), followed by a Master's degree (S2) of 10 (20%), a High School/Vocational High School equivalent of 9 (18%), and a Diploma (D1-D3) of 8 (16%). There were no respondents with a Doctorate (S3) of 0%. This indicates that the workforce in all three companies has a relatively high level of education, reflecting the demands of competence and knowledge required in the increasingly complex mining and logistics industry. This high level of education is an important asset for companies in facing regulatory changes and the global economic crisis, as a highly educated workforce generally has better analytical skills in understanding and responding to policy changes. The absence of respondents with a Doctorate (S3) indicates that the workforce in this sector does not yet require doctoral-level academic qualifications for existing positions, but this can also be an opportunity for future human resource development.

The distribution of respondents based on length of service shows that the majority of respondents (14 people) have worked for more than 10 years, followed by 11 respondents (22 people) with work experience of less than 1 year, 9 people (18 people) with work experience of 1-3 years, 9 people (18 people) with work experience of 4-6 years, and 7 people (14 people) with work experience of 7-10 years. This indicates that all three companies have a workforce with considerable experience in the industry, reflecting workforce stability and significant knowledge accumulation in all three companies. This long experience is a valuable asset for the companies because the workforce has a deep understanding of operations, regulations, and industry dynamics. However, the presence of 11 respondents (22%) with work experience of less than 1 year indicates a relatively high workforce turnover or the addition of new workers during the period, which may be caused by business expansion or the need to replace departing workers. This condition presents a challenge for companies in maintaining operational continuity and knowledge transfer from senior workers to new workers, especially amidst regulatory changes and the global economic crisis that requires rapid adaptation.

3.3. Validity and Reliability Test Results

a. Validity Test

Validity testing was conducted to measure the extent to which the research instrument was able to measure what should be measured. Validity testing was conducted using the Pearson Product Moment correlation formula. The testing criteria used the r table value with a significance level of 5% ($\alpha = 0.05$) and degrees of freedom ($df = n - 2 = 50 - 2 = 48$), resulting in an r table of 0.279. A statement item is declared valid if the calculated r value is $> r$ table (0.279). This research instrument consists of 30 statement items divided into three variables, namely Regulatory Changes (X1) with 10 items, Global Economic Crisis (X2) with 10 items, and Company and HR Readiness (Y) with 10 items. Validity testing was conducted on all statement items to ensure that each item is able to measure the indicators of the variables studied accurately and consistently. The results of the validity test are presented in the following table which contains the distribution of respondents' answers, the calculated r value, and information on the validity of each statement item.

Table Results of the Validity Test of the Research Instrument

No	Statement	SS	S	N	TS	STS	Total	r count	r table	Information
A. REGULATORY CHANGES										
1	The obligation to place reclamation and post-mining guarantee costs upfront according to the first year's land opening plan excessively burdens the company's initial cash flow.	10	18	11	9	2	50	0.685	0.279	Valid
2	The calculation of reclamation and post-mining guarantee costs, which is set at hundreds of millions of rupiah per hectare based on the area that has been cleared, is not proportional to the realization of reclamation progress	5	12	9	16	8	50	0.512	0.279	Valid

No	Statement	SS	S	N	TS	STS	Total	r count	r table	Information
	in the field.									
3	The increase in Cost of Goods Sold (COGS) due to regional policies significantly increases the burden of company production costs.	6	24	13	6	1	50	0.723	0.279	Valid
4	Changes in the method of calculating the percentage of non-metallic mineral tax payments make it difficult for companies to plan their finances.	9	15	8	13	5	50	0.654	0.279	Valid
5	The downstreaming policy requires companies to fundamentally change their business models.	15	20	10	4	1	50	0.801	0.279	Valid
6	The company has adequate resources to support the downstreaming policy.	4	16	15	10	5	50	0.445	0.279	Valid
7	Minister of Manpower Regulation Number 7 of 2026 concerning restrictions on outsourcing workers affects the company's operational cost structure.	12	22	11	4	1	50	0.756	0.279	Valid

No	Statement	SS	S	N	TS	STS	Total	r count	r table	Information
8	The company has adjusted its payroll system to new employment regulations.	10	25	10	5	0	50	0.689	0.279	Valid
9	New port regulations increase companies' operational costs	5	20	15	8	2	50	0.523	0.279	Valid
10	The company is able to adapt to various regulatory changes that occur dynamically.	8	22	12	7	1	50	0.712	0.279	Valid
B. GLOBAL ECONOMIC CRISIS										
11	Fluctuations in the rupiah exchange rate against the US dollar significantly increase the cost of importing equipment and spare parts.	12	25	8	4	1	50	0.745	0.279	Valid
12	The company has an effective strategy to manage the risk of exchange rate fluctuations.	6	14	15	10	5	50	0.498	0.279	Valid
13	The decline in quartz sand prices in the global market has significantly reduced the company's revenue.	14	20	10	5	1	50	0.782	0.279	Valid
14	The decline in commodity prices has forced companies to implement efficiencies	8	22	12	6	2	50	0.634	0.279	Valid

No	Statement	SS	S	N	TS	STS	Total	r count	r table	Information
	in various operational lines.									
15	Geopolitical instability disrupts the smooth flow of shipping and loading and unloading activities.	10	25	10	4	1	50	0.718	0.279	Valid
16	The company has a strategy to address global supply chain disruptions.	5	15	14	11	5	50	0.467	0.279	Valid
17	The increase in global fuel prices has significantly increased the company's operational costs.	15	25	6	3	1	50	0.803	0.279	Valid
18	The increase in world fuel prices has forced companies to stop some production activities.	2	8	15	15	10	50	0.389	0.279	Valid
19	The company was able to maintain profitability despite the global economic crisis.	6	14	15	12	3	50	0.556	0.279	Valid
20	The company has contingency plans to deal with various global economic crisis scenarios.	8	16	14	10	2	50	0.621	0.279	Valid
C. COMPANY AND HUMAN RESOURCES READINESS										

No	Statement	SS	S	N	TS	STS	Total	r count	r table	Information
21	The company has good operational readiness to face regulatory changes.	10	20	12	6	2	50	0.734	0.279	Valid
22	The company has good financial readiness to face the global economic crisis.	6	14	15	10	5	50	0.512	0.279	Valid
23	Company administration systems and procedures support compliance with changing regulations.	8	22	12	6	2	50	0.698	0.279	Valid
24	The company has an organizational culture that is adaptive to change.	6	18	14	10	2	50	0.645	0.279	Valid
25	The workforce has multiple competencies and skills (multi-skills) that support operational flexibility.	4	16	15	12	3	50	0.456	0.279	Valid
26	The company regularly conducts training to improve the competence of its workforce.	10	20	12	6	2	50	0.723	0.279	Valid
27	The company was able to retain its workforce amidst global economic pressures.	8	14	14	10	4	50	0.567	0.279	Valid
28	The workforce has mental readiness to face regulatory	5	15	15	12	3	50	0.489	0.279	Valid

No	Statement	SS	S	N	TS	STS	Total	r count	r table	Information
	changes and economic uncertainty.									
29	The company has implemented a service or product diversification strategy to reduce dependence on one commodity.	8	18	14	8	2	50	0.678	0.279	Valid
30	The company has strengthened strategic partnerships with stakeholders to enhance business resilience.	10	20	12	6	2	50	0.701	0.279	Valid

Source: Data Processing, 2026

Based on the validity test results table above, all 30 statement items consisting of three research variables are declared valid because they have a calculated r value greater than the r table (0.279). In the Regulatory Change variable (X1), the highest calculated r value is found in item number 5 regarding the downstreaming policy which requires companies to fundamentally change their business models with a calculated r value of 0.801, which indicates that this item is the strongest indicator in the variable. The lowest calculated r value in this variable is found in item number 6 regarding the readiness of resources to support downstreaming with a calculated r value of 0.445, which indicates that this item is still the weakest indicator but is still valid because it is still above 0.279. All items in the Regulatory Change variable have a calculated r value range between 0.445 and 0.801, which indicates that all items are able to measure regulatory changes consistently.

In the Global Economic Crisis variable (X2), the highest calculated r value is found in item number 17 regarding the increase in world fuel prices which increases the company's operational costs with a calculated r value of 0.803, which is the highest value among all items of the three variables. This shows that the increase in fuel prices is the strongest indicator in the global economic crisis variable felt by respondents. The lowest calculated r value in this variable is found in item number 18 regarding the increase in fuel prices which forced the company to stop some production activities with a calculated r value of 0.389, which shows that even though the impact of the increase in fuel prices is felt, the company is still trying not to stop production significantly. All items in the Global Economic Crisis

variable have a calculated r value range between 0.389 to 0.803, which indicates that all items are able to measure the global economic crisis consistently.

In the Company and HR Readiness variable (Y), the highest calculated r value is found in item number 21 regarding the company's operational readiness in facing regulatory changes with a calculated r value of 0.734, which indicates that operational readiness is the strongest indicator in this variable. The lowest calculated r value in this variable is found in item number 25 regarding the multi-skill competency of the workforce with a calculated r value of 0.456, which indicates that multi-skill competency is still the weakest indicator in company and HR readiness. All items in the Company and HR Readiness variable have a calculated r value range between 0.456 to 0.734, which indicates that all items are able to measure company and HR readiness consistently. Overall, the results of the validity test indicate that this research instrument is suitable for use because all statement items are declared valid and are able to measure the variables studied well.

Table Results of the Research Instrument Validity Test (Expert Judgment) for the MSME Variable

No Statement	Statement Instrument Item /	Expert 1	Expert 2	Expert 3	Total Score	Average	Category	Information
Indirect Effect								
1	The decline in mining activity has resulted in a decrease in orders for catering/boat rental services.	4	4	4	12	4	Valid	Worthy
2	The decrease in the frequency of quartz sand exports has reduced the demand for boat rental and small logistics services.	3	4	4	11	3.67	Valid	Worthy
3	The decline in mining employee income reduces purchasing power for MSME products/services.	4	3	3	10	3.33	Valid	Worthy
4	The surge in global fuel prices has significantly increased the	4	4	4	12	4	Valid	Worthy

No Statement	Statement / Instrument Item	Expert 1	Expert 2	Expert 3	Total Score	Average	Category	Information
	operational costs of MSMEs.							
5	Inflation and economic uncertainty make it difficult for MSMEs to determine selling/service prices.	3	3	4	10	3.33	Valid	Worthy
Multiplier Effect								
6	The decline in MSME turnover reached more than 40% since the implementation of regulations and the global crisis.	4	4	3	11	3.67	Valid	Worthy
7	The multiplier effect causes MSMEs to lose their main source of income from the mining supply chain.	3	4	4	11	3.67	Valid	Worthy
8	The reduced frequency of ship docking reduces the intensity of transactions between MSMEs and core companies.	4	3	4	11	3.67	Valid	Worthy
9	The location of special ports and geographical remoteness cause MSMEs to be trapped in a single dependency (captive market).	4	4	4	12	4	Valid	Worthy
MSME Adaptation Strategy								

No Statement	Statement / Instrument Item	Expert 1	Expert 2	Expert 3	Total Score	Average	Category	Information
10	MSMEs are implementing efficiency measures by reducing workforce and operating hours.	4	4	3	11	3.67	Valid	Worthy
11	MSMEs reduce raw material and logistics costs to maintain profit margins.	3	3	4	10	3.33	Valid	Worthy
12	MSMEs are renegotiating contract/catering prices with mining companies.	4	4	4	12	4	Valid	Worthy
13	MSMEs are trying to find customers outside the mining ecosystem despite being hampered by remote locations.	3	3	3	9	3	Valid	Eligible (Minor revision)
14	MSMEs take advantage of partnership programs or capital assistance from the government/core companies.	2	3	3	8	2.67	Invalid	Revised/Drop
Average Total		3.57	3.57	3.64	-	3.6	Valid	Worth Using

Source: Data Processing, 2026

The instrument validity test for the MSME variable in this study was conducted through an expert judgment approach involving three competent experts in the fields of strategic management, maritime economics, and public policy. The three experts were asked to assess the relevance of each statement item to the indicators and variables measured using a Likert scale of 1–4, where a score of 1 means "Not Relevant" and a score of 4 means "Very

Relevant". The instrument was declared valid if the average assessment score from the three experts was ≥ 3.00 , and was declared invalid if the average score was <3.00 . This method was chosen because the MSME population at the study location was limited and specific (only 10 respondents from two types of businesses), so that parametric statistical approaches such as the Pearson Product Moment correlation did not meet the minimum sample size assumption ($n > 30$).

Based on the recapitulation of the results in Table 4.3, all statement items in the Indirect Effect variable—which includes decreased orders, decreased purchasing power, and cost pressures due to fuel and inflation—obtained an average score between 3.33 and 4.00, so that all were declared valid and suitable for use. Similarly, in the Multiplier Effect variable, the five items (Nos. 6–9) that measure decreased turnover, loss of main income sources, and the reality of single dependency due to isolated special ports also obtained an average of 3.67 to 4.00, indicating a very high level of validity. In the MSME Adaptation Strategy variable, of the 5 items tested, 4 items (Nos. 10–13) were declared valid with an average score ranging from 3.00 to 4.00, reflecting the consistency of expert assessments of adaptive strategies such as labor efficiency, raw material cost reduction, contract renegotiation, and efforts to find alternative customers.

Overall, of the 14 statement items tested, 13 items (92.86%) were declared valid and suitable for use as data collection instruments, with an overall average of 3.60, which falls into the "Valid" and "Suitable for Use" categories. Only one item, namely statement No. 14 regarding the utilization of partnership programs or capital assistance from the government/core companies, obtained an average of 2.67 and was declared invalid, so the item had to be dropped or revised. The low validity of this item was caused by the inconsistency between the statement and the empirical reality in the field, where the remote and isolated location of the special port resulted in MSMEs never having been touched by capital assistance programs or formal partnerships from the government or core companies. Thus, the instrument consisting of 13 validated statement items has met the methodological requirements and can be used operationally to dig up data in depth regarding the indirect impacts, multiplier effects, and adaptation strategies implemented by MSMEs in facing the decline in economic activity in the upstream quartz sand export sector.

b. Reliability Test

Reliability testing was conducted to measure the level of consistency and stability of the research instrument. Reliability testing was conducted using the Cronbach's Alpha method, which is the most commonly used method to measure instrument reliability with a Likert scale. An instrument is declared reliable if the Cronbach's Alpha value is ≥ 0.60 . A reliable instrument indicates that the statement items in the research instrument have good internal consistency, meaning that the items are correlated with each other and measure the same construct consistently. Reliability testing was conducted on three research

variables, namely Regulatory Changes (X1) with 10 items, Global Economic Crisis (X2) with 10 items, and Company and HR Readiness (Y) with 10 items. The results of the reliability test are presented in the following table which contains the Cronbach's Alpha value and reliability information for each variable.

Table Results of the Reliability Test of the Research Instrument

No	Variables	Number Items	Cronbach's Alpha	Information
1	X1 (Regulatory Changes)	10	0.720	Reliable (Good)
2	X2 (Global Economic Crisis)	10	0.667	Quite Reliable
3	Y (Company and HR Readiness)	10	0.689	Quite Reliable
Average		30	0.692	Quite Reliable

Source: Data Processing, 2026

Based on the reliability test results table above, the Regulatory Change variable (X1) has a Cronbach's Alpha value of 0.720. This value is above 0.70 so this variable is declared reliable with a good category. This indicates that the 10 statement items in the Regulatory Change variable have high internal consistency and are able to measure regulatory changes consistently. A good Cronbach's Alpha value in this variable indicates that respondents provide consistent answers to statement items that measure aspects of regulatory change, including reclamation guarantee policies, increases in HPP, changes in mineral taxes, downstream policies, labor regulations, and port regulations. This consistency is important because the Regulatory Change variable is one of the main external variables that influence company readiness.

The Global Economic Crisis variable (X2) has a Cronbach's Alpha value of 0.667. This value is in the range of 0.60 - 0.70, so this variable is declared quite reliable. Although not as high as variable X1, the value of 0.667 still indicates that the 10 statement items in the Global Economic Crisis variable have quite good internal consistency and are suitable for use in research. This variable measures various aspects of the global economic crisis such as exchange rate fluctuations, falling commodity prices, supply chain disruptions, rising fuel prices, and geopolitical instability. The fairly reliable Cronbach's Alpha value for this variable

indicates that respondents provided fairly consistent answers to the items measuring the impact of the global economic crisis on company operations.

The Company and Human Resources Readiness (Y) variable has a Cronbach's Alpha value of 0.689. This value is also in the range of 0.60 - 0.70 so this variable is declared quite reliable. This variable measures various aspects of company and human resources readiness such as operational, financial, administrative readiness, organizational culture, multi-skill competency, training, workforce retention, mental readiness, diversification, and strategic partnerships. The fairly reliable Cronbach's Alpha value for this variable indicates that respondents provided fairly consistent answers to items that measure company and human resources readiness in facing regulatory changes and the global economic crisis. Overall, the average Cronbach's Alpha value of the three variables is 0.692 which is included in the fairly reliable category, so the research instrument as a whole is declared reliable and suitable for use in research.

Table Instrument Reliability Test Results (Inter-Rater Reliability)

No Statement	Statement Instrument Item /	Expert 1	Expert 2	Expert 3	Average Score	Standard Deviation (SD)	Reliability Level	Information
Indirect Effect								
1	The decline in mining activity has resulted in a decrease in orders for catering/boat rental services.	4	4	4	4	0	Reliable	Very high consistency
2	The decrease in the frequency of quartz sand exports has reduced the demand for boat rental and small logistics services.	3	4	4	3.67	0.47	Reliable	High consistency
3	The decline in mining employee income reduces purchasing power for MSME products/services.	4	3	3	3.33	0.47	Reliable	High consistency

No Statement	Statement Instrument Item /	Expert 1	Expert 2	Expert 3	Average Score	Standard Deviation (SD)	Reliability Level	Information
4	The surge in global fuel prices has significantly increased the operational costs of MSMEs.	4	4	4	4	0	Reliable	Very high consistency
5	Inflation and economic uncertainty make it difficult for MSMEs to determine selling/service prices.	3	3	4	3.33	0.47	Reliable	High consistency
Multiplier Effect								
6	The decline in MSME turnover reached more than 40% since the implementation of regulations and the global crisis.	4	4	3	3.67	0.47	Reliable	High consistency
7	The multiplier effect causes MSMEs to lose their main source of income from the mining supply chain.	3	4	4	3.67	0.47	Reliable	High consistency
8	The reduced frequency of ship docking reduces the intensity of transactions between MSMEs and core companies.	4	3	4	3.67	0.47	Reliable	High consistency

No Statement	Statement Instrument Item /	Expert 1	Expert 2	Expert 3	Average Score	Standard Deviation (SD)	Reliability Level	Information
9	The location of special ports and geographical remoteness cause MSMEs to be trapped in a single dependency (captive market).	4	4	4	4	0	Reliable	Very high consistency
MSME Adaptation Strategy								
10	MSMEs are implementing efficiency measures by reducing workforce and operating hours.	4	4	3	3.67	0.47	Reliable	High consistency
11	MSMEs reduce raw material and logistics costs to maintain profit margins.	3	3	4	3.33	0.47	Reliable	High consistency
12	MSMEs are renegotiating contract/catering prices with mining companies.	4	4	4	4	0	Reliable	Very high consistency
13	MSMEs are trying to find customers outside the mining ecosystem despite being hampered by remote locations.	3	3	3	3	0	Reliable	Very high consistency
14	MSMEs take advantage of partnership programs or capital assistance from the government/core	2	3	3	2.67	0.47	Reliable	Invalid (Drop)

No Statement	Statement Instrument Item /	Expert 1	Expert 2	Expert 3	Average Score	Standard Deviation (SD)	Reliability Level	Information
	companies.							
Average Total (13 valid items)		3.62	3.62	3.69	3.64	0.33	Reliable	Very good consistency

Source: Data Processing, 2026

The instrument reliability test for the MSME variable in this study was conducted using an inter-rater consistency approach by analyzing the level of agreement among three experts who had assessed the relevance of each statement. Unlike conventional statistical reliability tests such as Cronbach's Alpha, which require multiple respondents and responses from research subjects, this approach calculates the standard deviation (SD) value from the scores given by the three experts. The smaller the standard deviation value, the higher the consistency of assessments between experts, indicating that the instrument has a good level of reliability. In this study, an item is declared reliable if the standard deviation value is ≤ 0.50 , which means there is no significant difference in assessments among experts on the item, so the instrument is considered to have stability and accuracy in measuring the intended construct.

Based on the data in Table, all tested statement items, both in the Indirect Effect, Multiplier Effect, and MSME Adaptation Strategy variables, showed standard deviation values ranging from 0.00 to 0.47. These values were all below the threshold of 0.50, so overall the items were declared reliable. A total of five items (Nos. 1, 4, 9, 12, and 13) obtained a standard deviation value of 0.00, which indicates very high assessment consistency because the three experts gave exactly the same score to these statements. Meanwhile, the other nine items (Nos. 2, 3, 5, 6, 7, 8, 10, 11, and 14) obtained a standard deviation value of 0.47, which is still categorized as high consistency. This finding shows that there are no significant differences of opinion among experts in assessing the relevance of each statement to the measured variable, so that the instrument is considered to have good reliability in terms of assessor agreement.

Overall, the average standard deviation of all 14 items tested was 0.33, which falls into the "Very Good Consistency" category. This indicates that the research instrument for the MSME variable has very strong inter-rater reliability and is methodologically sound. However, it is important to note that statement item No. 14, which discusses the utilization of partnership programs or capital assistance from the government/core companies, although consistently reliable (SD = 0.47), was still declared invalid in the previous validity

test because the average expert assessment score only reached 2.67 (below the validity threshold of 3.00). Therefore, this item was still dropped from the final instrument even though it demonstrated consistency in reliability. The results of this reliability test complement the previous validity test, so that of the total 14 items tested, 13 items that were substantively valid were also proven to be consistently reliable. Therefore, the entire instrument consisting of 13 statements is suitable and reliable for use in exploring in-depth data on the indirect impacts, multiplier effects, and adaptation strategies implemented by MSMEs in the research location.

4. Conclusion

Based on the results of research and discussions that have been conducted regarding the influence of regulatory changes and the global economic crisis on the readiness of quartz sand mining companies, shipping agency companies, and stevedoring companies, the following conclusions can be drawn:

1. First, the three companies' readiness, human resource (HR) readiness, and strategies implemented in response to regulatory changes and the current global economic crisis show varying results. The Quartz Sand Mining Company has good operational readiness, supported by an experienced and highly educated workforce. However, financial readiness remains limited due to the obligation to place reclamation guarantee costs upfront, which burdens cash flow, and the increase in cost of goods sold (COGS) due to regional policies. This company's HR readiness demonstrates limited multi-skill competency and low workforce mental readiness. The implemented strategy focuses more on cost efficiency and regulatory compliance but lacks flexibility in responding to rapid changes. The Shipping Agency Company demonstrates good operational readiness but is highly dependent on shipping volume, with limited financial readiness due to a fluctuating profit-sharing system. This company's HR readiness also demonstrates limited multi-skill competency and low mental readiness, with a strategy that is still limited to single-commodity services and does not yet have a mature financial strategy to face the crisis. The Stevedoring Company demonstrates good operational readiness with adequate equipment, but financial readiness is very limited due to the fluctuating per tonnage contract system, with HR readiness also limited to multi-skill competencies and strategies that are still focused on one commodity and one port.
2. Second, appropriate and effective strategies to improve company readiness, optimize human resource management, and formulate adaptive business strategies for the three companies going forward include three main approaches. Strategies to improve company readiness include strengthening flexible procedural systems, increasing operational efficiency through technology adoption, comprehensive risk and compliance management, and digitalization and technological innovation. HR optimization strategies include multi-skill training programs and specific competency development, strategic

succession and recruitment planning, improving welfare and motivation through a more stable compensation system, and competency-based performance management. Adaptive business strategies include service and product diversification, strengthening strategic partnerships, adapting to changing export patterns due to downstreaming, and market development and business expansion. Specifically, for shipping agency companies, a more stable base salary component is needed to complement the existing profit-sharing system, while for stevedoring companies, a base salary component is needed to complement the per-tonnage contract system. Utilizing multi-skilled employees for reclamation activities is also an effective alternative strategy when export activity declines. This is a unique practice that has been implemented and needs to be further developed.

3. Based on the qualitative findings matrix, it was concluded that MSMEs in the research location—especially catering and boat rental services—experienced a very significant indirect impact due to regulatory changes and the global economic crisis, as reflected in a decline in orders of more than 40% and erosion of profit margins between the surge in operational costs due to fuel price increases and pricing pressures from core companies. The multiplier effect of these external shocks further exacerbated the situation because MSMEs were trapped in a single dependency (captive market) due to the isolated location of the special port and its distance from the city center, leaving them without alternative customers outside the mining ecosystem. In responding to these conditions, the adaptation strategies implemented by MSMEs were still short-term defensive, such as labor efficiency, reduced operating hours, and renegotiation of contract prices, while efforts to find customers outside the mining ecosystem were very limited and ineffective due to structural barriers in the form of geographic isolation and the closed status of the special port. Overall, these conditions confirm that MSMEs in the research location are in a very vulnerable position, where their adaptation strategy options are structurally limited, so that the sustainability of MSME businesses does not only depend on their own internal capacity, but is also very much determined by the strategic decisions of the core company and the active intervention of the local government in providing economic recovery programs, access to capital, and targeted business assistance.
4. Based on the results of strategic gap mapping in Table 4.10 which are sourced from in-depth interviews with 52 respondents from three types of companies (quartz sand mining, shipping agencies, and stevedoring), this study formulates a proposed integrated improvement model TRI-ADAPT as a solution to four identified main gaps, namely: (1) a reactive business strategy gap without a structured contingency plan, (2) a gap in HR management with sporadic training programs and incentives that have not been integrated, (3) a compliance-driven regulatory compliance gap without long-term financial planning, and (4) a gap in MSME support that has not been systematically identified in partnership programs. The novelty of this study lies in the integrative approach that combines three levels of analysis at once—the corporate level, the HR

level, and the MSME ecosystem level—in a single framework for responding to dual external shocks (regulatory changes and the global economic crisis), which has not been widely adopted in mining management literature in Indonesia, so that this model is an original contribution that is not only analytical but also prescriptive-applicable with three-phase implementation guidelines and measurable success indicators for companies and stakeholders.

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