The Influence of Safety Culture Maturity Level with Site Safety Performance:

Case Study at PT. Bukit Makmur Mandiri Utama (BUMA)

Site Binungan and Lati by 2022

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ABSTRACT

The embedment of safety behavior and a safe environment for employees, could be assessed by using Safety Culture Maturity (SCM) model. SCM model is a descriptive model that describes a key factor of an organization's safety culture at a certain level. Throughout the stages, the organizations could see a sequential breakthrough by creating strategies to strengthen and remove the weaknesses. Therefore, organizations needed to obtain the current SCM level as the baseline to reflect actual organizational safety performance and as a provision, base to compare the maturity stages' progress annually. This research aims to outline the result of the SCM survey on current sites safety performance from two sites who has similar characteristic. The methodology of this research was using descriptive analytics with a cross-sectional study concerning primary and secondary data sourcing. Statistical test ANOVA was used to analyze the influence between the site's SCM level on the overall safety performance, leading indicator, and its sub-indicators, thus lagging indicator and its sub-indicators. This research found that SCM level contributes to the behavior and strategies of the site to lower the rates of incidents. Then the result would become an endorsement to assess current organizations' strategy and their safety performance indicator.

Keywords: *Safety Culture Maturity, Safety Performance, Mining Industry*

INTRODUCTION

1. General

Safety Culture Maturity (SCM) has become one of the company's PT Bukit Makmur Mandiri Utama (BUMA) considerations to enhance their safety performance. By implementing SCM, the company expected the reduction of incidents and the improvement of safety performance among their job sites. Thus, the benefit of SCM measurement was expected to address the company's position in defining the appropriate strategy specifically based on safety maturity level. It is a self-measurement and diagnostical practice to define our next improvement to increase BUMA's excellence in the field of Occupational Safety and Health (OSH). Prior to this study, research conducted at Oil & Gas Company in Indonesia showed that the SCM alone cannot be considered to have a direct correlation to safety performance [12]. Meanwhile, a study at Mining Industry in Ghana, found that mines with lower incidence rates consistently had higher safety culture maturity scores for the elements than mines with higher incidence rates [14]. However, limited sources of SCM measurements toward Safety Performance in the mining industry, especially in Indonesia, became the objective of this research, to enrich the SCM view in matters of the mining industry.

2. Scope & Objective of The Research

This research was conducted only in two BUMA job sites at the company using 3 years of safety performance data. This research

aims to assess the connection of site safety culture to the empirical records of safety performance within the organization.

3. Problem Statement

PT Bukit Makmur Mandiri Utama (BUMA) first measured Safety Culture Maturity (SCM) in 2019 using a third party as the assessor. The results of this measurement demonstrate that in the leadership aspects, beliefs that the injuries could be prevented, involvement in safety activities, and recognition for safety achievement need to be considered. It also gets along with the process and actions aspect, due to the extent of safety training, presence of safety meeting attendance, and involvement in safety audits. In the structure aspect, satisfaction within the safety performance of the organization needed to be considered. For the past 3 years since the SCM measurement, the company had followed up on the recommendation, and safety performance has constantly showed an achievement (within the range of 85%-100%). In 2022, an SCM assessment was conducted to acknowledge whether the improvements that have been made are running effectively and affecting the company's safety performance. Thus, to determine the exact efforts that the company shall be taken according to the performance of each element in the safety culture.

4. Hypotheses of The Research

The hypothesis of this research is there is an influence between the safety culture maturity (SCM) level and the company safety performance.

LITERATURE REVIEW

1. Mining Industry

Nowadays, most of the countries in the world rely on energy production, despite clean energy or still using fossil fuels. The availability of energy has been the most significant need that shall be provided to each country to keep running life. Each industrial ector, consumes energy, both renewable and non-renewable energy sources. The common-most produced and consumed and unlocked still depends on fossil fuel. Even though all kinds of energy transformations such as nuclear, geothermal, hydropower, and others, fossil fuel is still the most wanted consumed energy.

Indonesia is also sitting at the top rank position with high mineral reserves, one of which is a fossil fuel. Some records indicate that Indonesia has been one of the world's enormous producers of coals since 2005 after shifting Australia as the rival in fossil fuel producers [1]. Indonesia also supplies coal stock to European countries and Asian countries, which makes Indonesia renowned for its black diamond.

Based on data from Indonesia Power Supply Company (Perusahaan Listrik Negara), it depicts that Indonesia contributes 25GW of coal-fired power plants which equals to 260% increasing in 14 years. This foresee the needs of coal production in the near future which significantly needs coal infrastructure is subjected to meet increased energy demand worldwide, around 18,21 Million Ton of Coal are forecasted to supply domestic needs [13]. This would imply that coal mining is still a demanded business in Indonesia due to international and national demand. In addition, to upkeep production on a proper track, each coal mining company shall preserve Safety, Health, and Environmental performance to evade disruption of coal production.

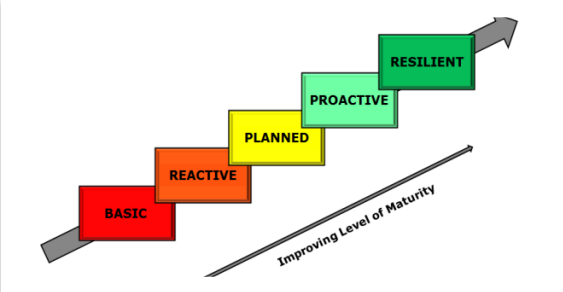
2. Safety Culture

According to Hopkins (2005) cited in Stemn, Bofinger and Cliff (2019) safety culture is about organizational collective practices. Good Safety Culture improves the functioning of a safety management system [14]. Citing Edward Burnett (1972) Culture itself is a complex system of nature and human-made which includes knowledge, beliefs, art, norm, law skills, and habit that are inherited from one generation to another [9]. While on the other hand, as a result of the long-term experience of the organization in successful problem solving, various personalities and conditions related to both past and present are called culture [5].

3. Safety Culture Maturity Model

There are 5 stages of SCM, Basic, Reactive, Compliant, Proactive, and Resilient that adopted in this research from UK Coal Journey Model as follows: [7]

Figure 1. UK Coal Journey Model for



Safety Maturity Model

The UK Coal Journey Model has been tested and showed that it successfully

measured the baseline. To expand the use of this model, the researcher tends to use it as an audit tool after this research to all Jobsites in BUMA so that top management could also measure the business productivity and made the exact policy to be implemented.

4. Safety Culture Maturity in Mining Industry

Indonesia's government regulates the implementation of the mining safety management system in Decree of the Director General of Mineral and Coal Ministry of Energy and Mineral Resources No. 185. K/ 37.04/Djb/2019 on Technical Guidelines for The Implementation of Safety Mining and Implementation, Assessment, And Reporting of Mineral and Coal Mining Safety Management Systems. Safety Culture has become one of the requirements that need to be fulfilled by all mining companies. Modestly, safety culture within this regulation is entailed as the initial study to identify the strength of each mining company in implementing Good Mining Practices based on the issued decree [18].

Besides the compliance obligation that all mining companies shall follow, the importance of Safety Culture implementation seems also like a phenomenon as a contribution to SHE Performance. Most of the mining companies in Indonesia has abided to implement Good Mining Practices based on local regulations, and also implemented international standards for SHE such as ISO. However, it is found that even though years of implementation have been undertaken, the incident case sometimes is inevitable. It practically occurs that law enforcement is fulfilled due to absolutism of regulation, meanwhile, it does not bring profound impact to acquiring the essential meaning of SHE implementation.

While each organization in the mining industry is incited with how safety culture shall perform to leverage the SHE performance, still, each organization is entitled to the obligation to keep running the business, obey the relevant laws, and minimize the number of incidents. This, somehow, comes to confusion about finding the suitable practice of safety culture, without direct guidance within the regulations. According to Geertz, 1973; Alvesson, 2007; Martins, 1992, they denoted that culture is rarely possible to be changed easily and may be difficult to be assessed using particular scientific methods [6]. This may be due to some logical reasons such as data collations and approaches are obtained through interviews, field observation, document review, and analysis.

The plausibility of certain roadblocks to assessing safety culture emerges because it requires the solid comprehension and knowledge of assessors or facilitators when they assess whether the safety culture has arisen to the surface or not. Different assessors or facilitators may have different perceptions in concluding the final say during interviews and field observations. What someone sees and listens to during assessment may be different as well from others.

Nevertheless, each mining company still encourages itself to stipulate the common practice that fits their organization in many ways, beginning by incorporating with company culture, creating a stand-alone definition of safety culture, or even merging with a safety management system.

While a study in the mining industry in Ghana explores the relationship of cultural maturity with accident rates. The safety culture maturity framework used consisted of 3 person and 10 system elements across five levels of cultural maturity. A survey comprising the 13 elements was conducted among 828 employees of four large-scale gold mines in Ghana [14]. Through principal component analysis, the structure of the framework was found valid and produced a good fit after testing the model through confirmatory factor analysis. One-way ANOVA showed that the mines had statistically significant differences in their mean incidence rate and the pairwise comparison test revealed specific statistically significant mines. Similarly, the Kruskal-Wallis H test also showed that the mines' safety culture maturity scores differed significantly from each other and a pairwise test identified specific mines with significant differences. It was found that mines with lower incidence rates consistently had higher safety culture maturity scores for the elements than mines with higher incidence rates. Also, correlation analysis indicated a strong negative correlation between the incidence rate and most elements of the safety culture maturity framework. The model/framework used was found useful and practical to both employees and management, enabling the identification of weak areas that require improvement interventions [14].

Careful consideration shall be taken into account regarding the specific requirements in the decree of Good Mining Practices as mentioned above. It indicates that the implementation of a safety culture is not by culture only, but also needs to conclude the

maturity of the safety culture that each organization implements. While a range of safety culture maturity could be adopted from many theories, e.g., Hudson, UK Coal Journey, James Reason, etc., determination of maturity level from safety culture shall be made clear on what stage the organization is.

From time to time, any research on safety culture was broadened into 5 levels, with 2 additional levels, reactive and proactive within the level (Reason, 1997 in Stemn, Bofinger and Cliff, 2013) [14]. Expanding the framework to adjust to the current era, entails a better classification with an easier definition, so each organization would not face such issues in identifying and determining the safety culture maturity level.

Citing from the decree of Good Mining Practices No. 185 Year 2019, Safety Culture Maturity Level to be implemented in Energy, Resources and Mineral Sectors, including coal encompasses the following: [18]

Table 1. Description of Safety Culture Maturity Level

Level	Description of Level
Basic	▪ The current system within organizations is applicable just to fulfill regulations. ▪ The implementation within the organization remains available when supervision is taking place.
Reactive	▪ The current system within the organization is performed based on accidental cases or incidents. ▪ Only focus on the issue/problem/ event.
Compliant	▪ There is a planned and developed system, however, those focus to reduce the number of accidents, dangerous events, occupational diseases, or ill-health. ▪ Focus on only the occupational mining practices program which is planned.
Proactive	▪ There are a determination of objective and target in each department or function and these are the main point to stipulate all planning actions. ▪ The current system within organizations is undertaken to fulfill the needs of the business.
Resilient	All the workers, either management level or non-management level, have successfully carried out the daily activities based on certain regulations and occupational mining practices culture.

In addition to the description above, most mining companies realize that safety culture maturity brings the thrust to the linearity of a diminishing number of incidents. Safety culture maturity itself has been a ray of sunshine in occupational health and safety so it is studied by many researchers. At the very beginning when this subject arose, it consisted of 3 levels, pathological, calculative/ bureaucratic, and generative [10]. Based on such theories from Weick, 1987; Westrum, 1991; Westrum and Adamski, 1999, citing Hudson (2021) pathological means the companies are being careless about safety, and when they find any failures, they would easily smother the problem. The bureaucratic/ calculative means, modestly, in the comfort zone. The organization would not wish to improve safety practices even when they know there is room for improvement. The final level, generative means, that when we talk about safety, it is incorporated into their lives, and demonstrated through real actions [10].

However, since there is no vivid method on how to create such a methodology and a set of criteria to establish a safety culture maturity model, these seem unfavorable to the interest of management to determine a suitable safety culture maturity model. Most of the top management in any organization prefer to adhere to the common practices which exist already within the organization, provide instruction to their middle management, and fulfill all the requirements based on instructions, instead of making a conscious effort to enhance SHE performance through a safety culture.

METHOD, DATA, AND ANALYSIS

1. Method, Data, and Analysis

The researcher decided to specify PT Bukit Makmur Mandiri Utama (BUMA) two biggest sites as the sample, to obtain a brief illustration of how Safety Culture Maturity (SCM) affects their SHE performance. The specific method is attained to this study using descriptive-analytic study, whereas descriptive is to indicate the relation of influence between Safety Culture Maturity and SHE Performance. Furthermore, an analytical study is conducted to determine which determinant factors contribute the most or which determinant factors affect SHE

Performance. SHE Performance encompasses 2 categories based Leading Indicators and Lagging Indicators.

Leading Indicator consists of several sub-indicators, such as (1) observation and coaching; (2) compliance inspection; (3) near miss reporting; (4) Site Featured Program; (5) Self Health Declaration & Follow Up. Lagging Indicator consists of (1) Fatality; (2) TIFR; (3) Environmental Compliance; (4) Positivity Rate of COVID-19.

Meanwhile, Safety Culture Maturity also has 2 elements encompassing abstract elements and concrete elements. These 2 (two) elements also consist of sub-elements. The researcher formulated 20 sub-elements by combining Hudson Theory and UK Coal Journey Model. Concrete Element consists of (1) standard setting; (2) safety reward; (3) SHE existence; (4) trend and statistics; (5) audit and review; (6) safety report; (7) training and competency; (8) procedure development; (9) work permit; (10) Accident Investigation; (11) Hazard Management Technique; (12) Contractor Management; (13) Safety Inspection. On the other hand, Abstract Element consists of (1) procedure objective; (2) accident follow-up; (3) safety socialization; (4) safety priority; (5) safety meeting; (6) accident causes; (7) commitment.

In addition to the population of this research, 2 (two) locations were selected and clustered, Lati (LAT) and Binungan (BIN). All employees from level 1 (office boy, office girl, cleaning service level) until level 6 (Manager Level). Exclusion criteria are applied to this study, which includes level 1. Others remain available for involvement in the survey of safety culture maturity. The reason why level 1 was excluded in this study, is due to a few numbers of level 1 can be found at each site under the responsibility of PT Bukit Makmur Mandiri Utama (BUMA). The organization itself is using a manpower agency as the vendor to manage the hospitality and security at the Jobsite, therefore, the responsibility falls under each vendor.

1.1. Sampling and Data Collection

The sampling method is subjected to the use of Slovin, see the equation below (1)

$$n = \frac{N}{1 + Ne^2}$$

*) n means sample size; N means population size, and e means the margin of error

The total population of Lati Site is around 3453 workers, at all levels, excludes the sub-contractors, while the total population of Binungan Site is around 2925 workers, at all levels, as well as Lati Site, this excludes sub-contractors. Sampling for the questionnaire may directly be involving the total population due to technology, whereby the questionnaire deployment was circulated using a link from the online platform.

2 types of data were necessarily obtained for this study. Besides primary data that was collected through questionnaire, secondary data was necessary to be enumerated from SHE Index and analyzed the correlation with Safety Culture Maturity primary data. The exclusion criteria would seem applicable to mark the selected respondents, encompassing as follows:

Table 2. Sampling Exclusion Criteria

Exclusion Criteria	Justification	Binungan Site	Lati Site
Active Roster	All the workers that are on their schedule to work at the Site	1434	1782
Position Level	There are only a few numbers of level 1 can be found at each site under BUMA direct responsibility.	20	20
Working Period (<3 years)	To define culture workers for less than 3 years were not included because the research used 3 years of data.	624	458
Point of Hire Jakarta	All hiring process was centered in Jakarta and the person will be placed in Jakarta based.	613	820
Population Size (N) to be counted by Slovin Equation		177	484
Sample Size (n) by Slovin		122	219
Total Sample		**341**	

1.2. Measures

The content of the questionnaire was based on 20 variables that have been stipulated, designating to the adoption of

Hudson Theory and UK Coal Journey Model. Each element provides questions to measure workers' safety culture (see Table 3) [7].

Table 3. Safety Culture Maturity Variables

No.	Topics
1	OSH Trend & Statistic
2	Audit dan Review
3	Incident/Accident Reporting, Investigation, and Analysis
4	Hazard Report
5	Management's View of the Causes of Accidents
6	The follow-up to Recommendations for Accident Reports/Investigations
7	Safety Meeting (P5M, Toolbox Meeting, Safety Committee Meeting)
8	Work Plan and Work Permit System
9	Third-Party Management (Sub Contractor)
10	Establishment and Implementation of Company Standards
11	OSH Trend & Statistic
12	Audit dan Review
13	Incident/Accident Reporting, Investigation, and Analysis
14	Hazard Report
15	Management's View of the Causes of Accidents
16	The follow-up to Recommendations for Accident Reports/Investigations
17	Safety Meeting (P5M, Toolbox Meeting, Safety Committee Meeting)
18	Work Plan and Work Permit System
19	Third-Party Management (Sub Contractor)
20	Establishment and Implementation of Company Standards

All the answer was enumerated by coding the collected data. The coding range was using a Likert scale from 1 to 5 which 1 value would be compared to SHE Performance, in this case by analyzing TIFR means using the F Test which came out from the ANOVA test result.

mean (very disagree) and 5 mean (absolutely agree). There may be code 1 is correct, and there may be code 5 is correct. This depends on the statements in the questionnaire whether it is positive or negative statements.

2. Research Methodology

The research design for this study is using a cross-sectional design, like the non-experimental study, where the measurement of the variables is undertaken at the same time and only one time. The rationale behind this selected design is to capture momentum as per local regulation under Ministry of Energy, Resources and Minerals require to do so, under the implementation of Good Mining Practices (GMP) [18]. The further intention of this study is to compare the pre-post intervention, to acquire the gradual progress of how the organization's safety culture may develop over some periods of time.

Data collection and management encompasses the following:

a) Coding occurs to classify data and code raw data by defining the answer in a form of a numeric symbol. Coding aims to simplify data processing in particular applications.

b) Entry is subjected to inputting the coding data to the application, along with recording the data.

c) Cleaning is intended to recheck and reassure that the data that are going to process are clean already including the undertaken coding.

All data are processed through SPSS (Statistical Package for the Social Sciences) and Microsoft Excel both for independent and dependent factors. Data analysis which was undertaken for this study is one-way ANOVA to denote the statistical figures to each of them, while the SHE Performance is applied with the Kruskal Wallis test due to uneven distribution of data.

This research is similarly analyzed based on a specific journal citing Stemn, Bofinger, and Cliff (2019) [14] and was divided into two stages. In the first stage, Safety Culture Maturity variables normality data were tested with Kolmogorov Smirnoff, and then all the normal variables shall be tested to one Way ANOVA to see whether there is an influence on the SCM level. In the second stage, SCM means

RESULT AND DISCUSSION

It was found that all the data from 20 variables were normally distributed (various ranges between 0.06 – 0.2), then the results were further examined using One Way

ANOVA statistically to find the influence of each independent variable on the dependent variable. Based on the test, it was found that there was an influence of all safety culture maturity variables, marked by the results of p-value < 0.05, where the p-value obtained was 0.000.

Table 4. Stage I Analysis of each safety culture maturity variable

No	Independent Variable (Scale 1-5)	Mean	Normality Test Result (Min – Max Value)	Dependent Variable (Scale 1-5)	Interpretation (p-value: 0.05)	ANOVA Test Result	Annotation (p-value: 0.05)
1	OSH Trend & Statistic	3.32	0.103-0.135	Safety Culture Maturity (SCM)	All Independent Variable were distributed normally	0.000	There is a different means value of each variable toward Safety Culture Maturity (SCM)
2	Audit dan Review	3.52	0.119-0.182				
3	Incident/ Accident Reporting, Investigation, and Analysis	3.87	0.104-0.209				
4	Hazard Report	3.58	0.134-0.212				
5	Management's View of the Causes of Accidents	3.90	0.084-0.186				
6	The follow-up to Recommendations for Accident Reports/ Investigations	3.67	0.140-0.191				
7	Safety Meeting (P5M, Toolbox Meeting, Safety Committee Meeting)	3.94	0.125-0.201				
8	Work Plan and Work Permit System	3.89	0.089-0.183				
9	Third-Party Management (Sub Contractor)	4.00	0.125-0.178				
10	Establishment and Implementation of Company Standards	3.13	0.110-0.180				
11	Training and Competence	3.60	0.117-0.181				
12	Workplace Hazard Management	3.89	0.100-0.168				
13	OSH Inspection	3.99	0.120-0.150				
14	OSH vs. Cost	3.72	0.100-0.156				
15	OSH Communication between Management and Employees	3.37	0.114-0.201				
16	Commitment and Awareness for OSH	3.88	0.092-0.166				
17	Establishment and Improvement of Procedures	3.50	0.097-0.181				
18	Purpose of The Procedure	3.52	0.090-0.177				
19	Status and Authority of the OSH Department	3.36	0.068-0.159				
20	Appreciation of the Implementation of OSH (Safety Reward)	3.42	0.075-0.183				

Since there is an influence between all variables in SCM, the researcher also conducts a statically test using the Kruskal Wallis method towards SHE performance indicator to determine the influence of each element. According to the statistical test, the system could not generate the results. This may happen due to the current data do not have any variance and the researcher cannot mention it as a variable. In consequence, the TIFR value was taken as part of the SHE performance under this research.

Table 5. Stage II Analysis of Safety Culture Maturity (SCM) towards Total Incident Frequency Rate (TIFR).

SCM Mean Value	Statistic Test (F Result)	Degree of Freedom (Df)		F Standard (Refer to F Table)	Interpretation (F Result: F Standard)
		Df 1 (Number of the independent variable)	Df 2 (N-Df1-1)		
3.6	1.631	20	328	1.604	Statistically proven (F Result > F standard)

Based on the above table, the average value comparison is carried out using the Simultaneous Test / F Test, whereabout 20 sub-elements in SCM as the independent variable and TIFR as the dependent variable. The use of data on TIFR was using the nearest year data (2019-2021).

Moreover, the Simultaneous test / F test is used to determine whether there is a joint or simultaneous influence between the independent variables towards the dependent variable. As for the results of the F test, the calculated F results are 1.631 and the F table is 1.604 (df1 = 20; df2 = 328), therefore it can be concluded that SCM has a significant effect on TIFR.

SCM mean value (3.6) indicates the average total score of each sub-variables score. It depicts that there are 9 sub-elements of SCM which need further attention to rectify, consisting of (1) OSH Trend and Statistic, (2) Audit and Review, (3) Hazard Report, (4) Establishment and Implementation of Company Standard, (5) OSH Communication between Management and Employee, (6) Establishment and Improvement of Procedure, (7) Purpose of the Procedure, (8) Status and Authority of OSH department, (9) Appreciation of the implementation of OSH.

Highlighting the lowest mean value in Table 5, there are 2 lowest mean value subjecting to sub-elements, composed of "The Establishment and Implementation of Company Standards", and "OSH Trend & Statistics".

In the sub-element Establishment and Implementation of Company Standards, it was found that the company carries out a leadership role and strives to comply with minimum standards/requirements. Workers are involved in standard setting and approved by management. Whilst in the sub-element OSH Trend & Statistics element, an in-depth analysis of the indicators shall be arranged and defined in such a way as to describe the actual conditions in the company. In particular, comprehensive data is required in a certain time to obtain an adequate trend analysis. The benefit of this analysis is to predict the trend of future events (predictive analysis) so that the company can prevent unwanted events.

Subsequently, not only can be used to highlight what needs to be improved, but SCM mean value also portrays the maturity level, which is in a position towards the Proactive Level. Notwithstanding the current SCM position is in the Proactive Level, still, there are sub-elements that are entitled to be taken into account.

CONCLUSION

This research is conducted to determine the current sites' SCM level towards their safety performance. Over 341 respondents among Lati site and Binungan site completed answering questionnaires, formulated on the adoption of Hudson Theory and the UK Coal Journey Model. The study found that Safety Culture Maturity (SCM) level contributes toward the performance of sites' TIFR, which represented the SHE performance indicator. At this point, it was decided that an applicable SCM model would be developed for the company with help from the experts inside and outside the organization.

IMPLICATION/LIMITATION AND SUGGESTIONS

There are no major flaws in this study, however, some limitations are disclosed such as:

1. The sampled sites were owned by the same customer, consequently the samples were homogenous. It would not be possible to obtain a comparison between different customers. Further study may include analyzing the difference between a site that falls under the different characteristics of the owner.
2. There was no previous safety culture maturity assessment data that might be used to compare past and recent studies, to indicate whether there is any significant alteration in SHE performance.
3. SHE performance indicator shall be managed by considering the statistically proven indicator and research-based.
4. This research was conducted by the end of Q2 year 2022; therefore, the study cannot include TIFR data in the Year 2022. The next research shall be managed by the end of the year, to thoroughly used the data.

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