

## OPTIMIZATION STRATEGY FOR SOLID TOXIC AND HAZARDOUS WASTE MANAGEMENT DURING THE COVID-19 PANDEMIC

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**Abstrak.** The increase in the number of hospitals in Indonesia has resulted in an increase in medical waste. Hospital activities have resulted in an increase in B3 waste which manages various problems. This research focuses on finding solutions and strategies in the framework of optimizing solid medical waste (B3) management. In particular, the optimization of medical waste management (B3) services involves several special analyzes, namely: priority needs, opportunities and constraints, and innovative work formulation programs. This study utilizes the Interpreted Structural Model (ISM) method to generate a priority scale in the management of solid B3 waste. This study found an analysis of the priority needs of mass education for all employees regarding the handling of solid B3 waste. Analysis of opportunities to increase stakeholder awareness of the dangers of B3 waste. The priority for solving the problem is that the organizational staffing is not complete according to the job description.

**Keywords:** constraint analysis, ISM, needs analysis, opportunity analysis

### I. INTRODUCTION

The increase in the number of hospitals in Indonesia has, in an increase in medical waste (Purwanti [1]; Nofrianty [2]; Sholihah [3]; Sitompul [4]). Uncontrolled waste management can lead to an increase in management operational costs (Sitompul [4]; Sholihah [3]). Management of medical waste, especially B3 waste, requires optimizing basic capacity or adding spare capacity to meet needs (Prihartanto [5]; Absori and Latif [6]; Nofrianty [2]). Waste management requires collaboration between stakeholders to minimize health threats, especially to the community, both inside and outside the hospital. There is an urgency to fix the medical B3 waste management methods that have been stipulated. The existence of data related to problems in hospital medical waste management is very important because it relates to the potential for the spread of disease even to occupational health and safety on employees, visitors or patients and also the community around the hospital (Sutanto [7]). Technical problems cannot be solved immediately with technical steps, but more strategic steps are needed so that problems can be completely resolved. Several analyzes are needed for handling waste, especially B3 requires an analysis that considers the problem of location, processing technology, institutions and financing.

High accessibility to information related to B3 waste is an opportunity that is more prioritized in terms of the opportunity for high government pressure and an increase in the number of research related to B3 waste. Meanwhile, the opportunity for increased government pressure on B3 waste management is still less necessary than the opportunity for increasing stakeholder awareness of the dangers of B3 waste and increasing technological developments in the field of B3 waste management. However, between increasing

government pressure and the number of related studies, both are opportunities that need to be followed up together. The first opportunity related to accessibility to information becomes a top priority, except for the condition of increasing the level of awareness of stakeholders on the dangers of B3 waste. Meanwhile, the factor of increasing government pressure on efforts to properly manage B3 waste is more of a priority than increasing the number of studies related to B3 waste, but it loses priority to the opportunity for increasing the level of stakeholder awareness of the dangers of B3 waste and increasing technological developments in the field of B3 waste management. The assessment of the obstacles faced by hospitals in B3 waste management varies widely. The main infrastructure constraints for B3 waste management are not yet optimal and the duties and responsibilities of the Internal Affairs Division are still overlapping. Both are important to the attention of the relevant parties in the hospital. Limited land is an obstacle but is not a priority to be addressed immediately, but the implementation of the duties and responsibilities of the manager is not yet optimal. Another thing that is important to note is the existence of organizational personnel who are also not yet specialized in terms of their duties and authorities. Organizational oversight is an urgent matter and a priority needs to be taken for corrective action. The problem of infrastructure that is not optimal with the problem of overlapping authorities requires priority in terms of management.

Factors of need, management, and constraints are the focus of observation to produce a B3 waste management strategy. Several previous researchers have conducted observations and research that resulted in B3 management studies (Kasdjono [8]; Kristanti [9]; Siddik and Wardhani, [10]; Putra [11]; Purwanti [1]; Rachmawati [12]). The researchers utilized an exploratory methodology and

statistical description. In contrast to previous researchers, this study utilizes the ISM methodology for research completion. This study utilizes a data analysis methodological approach that involves the Interpretative Structural Model (ISM) to structurally analyze the important elements of all elements, both opportunities and constraints. ISM is a computer-based analysis technique that can help groups identify the relationship between ideas and structure on a complex issue, where the process of this method is a focus learning process (Santoso [13]). In general, this research focuses on finding solutions and strategies in the framework of optimizing solid medical waste (B3) management. In particular, the achievement of optimization of solid medical waste (B3) management involves several special analyzes, namely: (1) analyzing priority needs in B3-19 waste management, (2) analyzing opportunities and constraints in B3 waste management, and (3) formulating innovations work program.

## II. RESEARCH METHODS

The research was conducted by Dr. Hospital. Mintohardjo at Rumkital Dr. Mintohardjo Jl. Dam Downstream 17 Central Jakarta. The research time starts from December 2021-March 2022. This research focuses on the acquisition of program innovation formulas in the context of optimizing hospital solid B3 waste management during the Covid-19 pandemic, a global tragedy which has changed many people's behavioral patterns and our subsequent impact of nature and the environment (Priatna & Monk [14]).

### Data Needs

This study builds a strategy for optimizing B3 waste management by utilizing the data identified from the Focus Group Discussion (FGD) activities. The FGD was held in February 2022 involving representatives from Mintoharjo Hospital management, Green Hospital Experts, Environmental Health, Policy Formulators, field implementers, academics and the relevant Health Office. The FGD produced a summary which was categorized into elements of needs, opportunities, and constraints for solid B3 waste management

### Expert Survey

The expert assessment involved 7 respondents, each of whom had expertise in the health sector. Indept interviews were conducted with 7 (seven) experts who used survey forms from elements needs, opportunity elements, and constraint elements.

### Data analysis

The analytical methodology to obtain the key sub-elements of the optimization strategy for B3 waste management involves ISM with the following steps (Santoso [13]):

1. Identify sub-elements of the strategy for optimizing B3 waste management by conducting Focus Group Discussions (FGD).
2. Summarizing the results of the FGD and combining them with a literature review to produce key elements and sub-

elements of the B3 waste management optimization strategy.

3. Determine the contextual relationship of the optimization strategy for B3 waste management.
4. Develop a self-interaction matrix (SSIM) structure that shows pairwise relationships between sub-elements
5. Indept-interviews to obtain expert opinions and generate consensus answers between different experts into one answer. Indept interview involving hospital directors, green hospital experts, environmental health, field implementers, academics and representatives from the relevant Health Office.
6. Develop reachability matrix based on SSIM and check transitivity and consistency level
7. Develop a strategic structure for the optimization of B3 waste management

## III. RESULTS AND DISCUSSION

### Analysis of needs in Hazardous Waste Management

Analysis of needs in B3 waste management in Mintohardjo Hospital found the element "Mass education for all employees regarding the handling of B3 waste" as the strongest controller and the level of dependence is low. Meanwhile, the "B3 waste management scenario/master plan" has controlling power which is dependent on the middle level. B3 waste management must always be updated in accordance with existing technological developments. This is evidenced by the results of the analysis that places "Modernization of B3 waste management technology" at the level of medium power control and high dependency. The factor of "Adding human resources for field implementers; and the concept of utilization and monetization of B3 waste" has the same level of need. This means that the two elements can be run simultaneously in B3 solid waste management.

The summary of all expert assessments produces a Structure Self Interaction Matrix (SSIM) and Reachability Matrix (RM) which have been cross-checked by the Transitivity Rule. The Cartesian coordinate system describes information about the position of the distribution of points of need (N) that requires a priority level decision. The consistency of all expert answers leads to driven power and dependence (Figure 1).

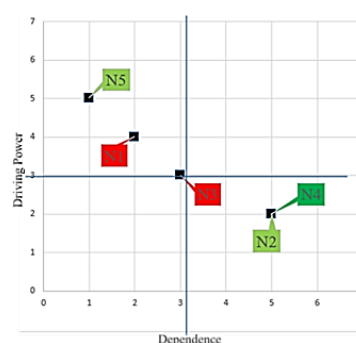


Figure 1. Position of needs analysis sub-elements in solid B3 waste treatment

At the level of importance, the elements of need in B3 waste management can be summarized as a hierarchical structure, namely presenting a priority order in terms of handling B3 waste at Mintohardjo Hospital. The analysis resulted in N5 (Mass education to all employees related to the handling of B3 waste, occupies a key element in optimizing B3 waste management at Rumkital Dr. Mintohardjo. Then at the second and third levels, respectively, is the creation of a scenario/master plan for B3 waste management and continued with the modernization of B3 waste management technology. Meanwhile, the activity of adding human resources for field implementers and formulating the concept of utilization and monetization of B3 waste can be carried out in parallel (simultaneously) so as to produce an effective and efficient B3 waste management system.

*Analysis of Opportunities and Constraints in Hazardous Waste Management*

The Cartesian coordinate system is a point identification system in a plane using a series of numbers using perpendicular axes as the measurement, so the Cartesian coordinate system is also called a point coordinate system. The Cartesian system in this research is used to describe the position of the point distribution which will describe which opportunity value (O) needs to get priority or not. To ensure that the binary matrix has met (consistent) it is checked with the transitivity rule. Marimin [15] states that transitivity rules are the completeness of a causal-loop, for example A affects B and B affects C, then A must influence C. Transitivity rules or transitivity rules are an attempt to assess the consistency of expert opinion. Checks with the transitivity rule are carried out on cells whose value is 0 (zero). The results of the examination with the transitivity rule will obtain a new matrix which is a revision of the reachability matrix (RM). The results of checking the transitivity rules on the binary matrix, obtained an acceptable and satisfactory (consistent) assessment result, so that driven power and dependence can be determined (Figure 2). In detail, the hierarchical/level structure of the elements of opportunity in hospital B3 waste management.

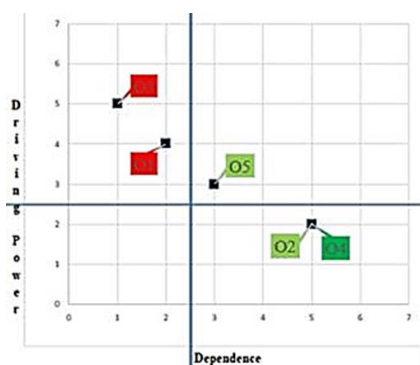


Figure 2. Cartesian Graph of Opportunity Analysis in Hospital Hazardous Waste Management.

Efforts to increase the level of awareness of stakeholders on the dangers of B3 waste, according to experts,

are important and crucial to be carried out immediately, so that they become a key element in the analysis of this opportunity. It can be seen that the stakeholders already fully understand the extent of the hazard and the impacts if B3 waste is not managed properly, but the fact is that in daily practice there are still many violations that are not in accordance with the provisions that have been jointly determined. This awareness becomes very urgent to do.

The next opportunity that can be utilized is to take advantage of the accessibility of information related to B3 waste. All hospital employees must be able to use the internet and other information technology. The cost of the internet is getting cheaper and easier to get, which has provided an opportunity for the intelligence of mankind, including hospital employees. This is in line with the third opportunity, namely the development of technology in the field of waste management which is increasing. Meanwhile, increasing government pressure on efforts to manage B3 waste properly; and increasing the number of research related to B3 waste is a priority at the same time but remains very important to accelerate the acceleration of B3 waste management for the better. The order of priority or as a driven power that can influence the existing opportunity selection policy.

*Analysis of Obstacles in B3 waste management*

The Cartesian coordinate system is a point identification system in a plane using a series of numbers using perpendicular axes as the measurement, so the Cartesian coordinate system is also called a point coordinate system. The Cartesian system in this research is used to describe the position of the point distribution which will describe the value of the constraint (C) which needs to be prioritized or not to be overcome immediately. In order to ensure that the binary matrix has meet (consistent) then it is checked with the transitivity rule. Marimin [15] states that transitivity rules are the completeness of a causal-loop, for example A affects B and B affects C, then A must influence C.

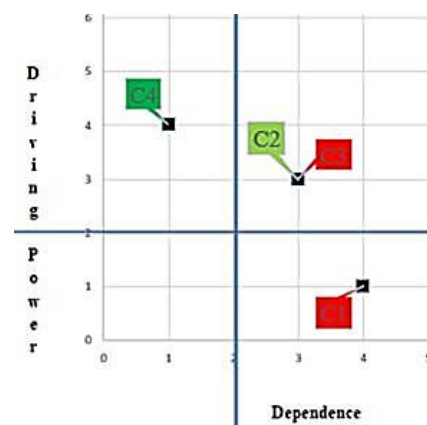


Figure 3. Cartesian Graph of Obstacle Analysis in Hospital Hazardous Waste Management

Transitivity rules or transitivity rules are an attempt to assess the consistency of expert opinion. Checks with the transitivity rule are carried out on cells whose value is 0

(zero). The results of the examination with the transitivity rule will obtain a new matrix which is a revision of the reachability matrix (RM). The results of checking the transitivity rules on the binary matrix, obtained an acceptable and satisfactory (consistent) assessment result, so that driven power and dependence can be determined. The ordination position obtained is then depicted in the form of graphs and levels as shown in Figure 3. In detail, the hierarchical/level structure of the constraint elements in hospital B3 waste management. The results of the priority order or as a driven power that can influence policies in overcoming the UT constraint are C4 or organizational staffing that has not been completely filled in according to the job description, which must be fulfilled immediately. This will slowly but surely hinder the performance of other employees. It can be interpreted that the workload of B3 waste management employees in the field becomes bigger and heavier, coupled with the pandemic situation which causes the volume of B3 waste to increase drastically more than 2 times pre-pandemic.

Furthermore, the main infrastructure for B3 waste management needs to be optimized effectively and efficiently. Focus on this without leaving the administrative system which is still not satisfactory. One of them is still overlapping duties and responsibilities with the Internal Affairs Section. Actually it is not impossible to do, but the fact is still happening. Another obstacle that must not be abandoned is related to the limited land for the safer handling of B3 waste. This obstacle is a priority and it is still possible to find a way out, for example by doing WTP (Willingness to Pay) or something else.

#### IV. CONCLUSION

This study found that the needs analysis resulted in the priority of mass education for all employees regarding the handling of solid B3 waste. Opportunity analysis results in an increase in the level of stakeholder awareness of the dangers of B3 waste. The priority for solving the problem is that the organizational manpower has not been completely filled in according to the job description.

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