Business Intelligence Model of Regional Hospitals using HGOD Discovery

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Abstract— **Based on data from the Regional General Hospital in the Bangka Belitung Islands province, the Gross Death Rate (GDR) is the general death rate for every 1000 patients discharged of 108,430 compared to the health department standard of <45. The Net Death Rate (NDR) is the death rate 48 hours after being treated for every 1000 patients discharged of 67,388 compared to the health department standard of <25. TOI (Turn Over Interval) is the average turnover period of days where a bed is unoccupied from being filled to the next time it is filled of 19,832 days compared to the health department standard of 1 to 3 days. The solution offered by the researcher develops Business Intelligence (BI) optimization with a new model called the HGO (Hierarchy, Governance, Outlook) Discovery approach as a framework model for developing business intelligence for regional general hospitals in Indonesia. This model is expected to be able to solve or reduce the dimensional problems that exist in hospitals, namely the main patient management, HR Key Resources, and the quality of inpatient health services. The HGO Discovery approach is able to find patterns in a series of events called sequences by sorting the work patterns that exist in the hospital so that the business process of regional general hospitals is faster and more interactive in decision making. The Business Intelligence approach carried out by regional hospitals with HGOD is expected to make patient health services more integrated through the hierarchy of patient services, governance and outlook in decision making.**

Keywords— *Business Intelligence, HGOD Discovery, Hospital, Optimatization, Governance.*

I. INTRODUCTION

Business intelligence covers almost all information system ecosystems today, but not all sectors utilize Business Intelligence, such as the Regional General Hospital Information System (SIRSUD). Business Intelligence (BI) uses techniques for consolidating data, storing, analyzing data, designing data logic in decision making in multidimensional data using data mining. Currently, regional general hospitals are the main and mainstay facilities used by people in Indonesia. The business intelligence function organizes a decision support system where this system converts and extracts data contained in the hospital (implicit data and explicit data) into knowledge management or knowledge. Business intelligence technology has the potential to develop and explain complex problems in business processes in organizations [1]. Hospitals have an obligation to be fast and agile in making decisions regarding patients and processing data in an important role in the process of taking patient action using technology so that the accumulation of patient data is quickly obtained to extract timely, credible and fully researched information regarding patient data at hospital [2]. Business intelligence is not a product tool but a new approach proposed to make difficult decisions in business as quickly as possible [3]. Business Intelligence (BI) will become an important investment and have an important role in today's hospital management, technology implementation This is very challenging and requires resources, strategy, management and skills [4].

Regional General Hospital patients who generally use BPJS health generally have problems with slow registration and treatment processes at the hospital, researchers have even seen how many cases resulted from delays in treatment causing patients to die. After the outbreak of Covid-19, hospitals had to adopt technology and systems to address the slowness of hospital services that had occurred so far [5]. The BPJS feature used by Indonesian society still has various problems that cause patients to queue for hours at regional public hospitals. Apart from that, in general there is no Business Intelligence technology, especially a decision-making feature that contains patient history where the user of the history system is the patient. Most hospitals, especially the emergency department, have inefficiencies in human resource management and data processing, resulting in slow follow-up by the hospital front line to assist their work [6]. Usually regional hospital system users currently try various support patterns to view patient history which results in the process of searching or mining patient data being long and repetitive and the current approach to the data display process is not interactive.

Here are some of the original things in this research as follows : Developing a Business Intelligence model with the HGOD (Hierarchy, Governance, Outlook) Discovery approach, which previously hospitals used more of the decision-making Simulation approach or model which had the weakness of a gap between medical resources and patient needs. Developing a model that is integrated into a framework with 3 approaches, namely HGO (Hierarchy, Governance, Outlook)

There is a gap between medical resources and patient needs, managers need to obtain productivity information to optimize

resource allocation. The value of this study is that the information provided by the dashboard allows hospital managers to respond quickly. We recommend that the study can integrate more data (such as temperature data, national death population data records), so that it is covered for hospital operating cost control and to estimate patient needs.

II. LITERATURE REVIEW

Smart Business Intelligence is a set of models and technologies designed to efficiently extract and process useful information from data. its application to integrate and operate with various institutional or institutional data sources. Apart from that, BI (Business Intelligence) is a step in the decision-making process that is supported by integration and analysis of organizational data resources. BI (Business Intelligence) plays an increasingly important role in several types of institutions and institutions because various kinds of information have been identified as the most valuable asset in an institution and a fundamental resource.

Business Intelligence has an important objective, namely to provide services with quality organizational intelligence and the purpose of this research is to assess organizational intelligence in hospitals which is carried out based on Karl Albrecht's organizational intelligence components. Research tries to provide service quality status based on these components [7].

Healthcare systems face enormous challenges, essentially due to the amount of data generated every day in the hospital environment, which forces entities to think about how to organize and use the same data.

The business ecosystem becomes complex in industrial development. Therefore, to provide a fast response in this dynamic era, companies need innovation and advanced technology. In this context, Smart Business Intelligence (SBI) is needed to process information and make the right decisions at the level of all institutional lines or institutions. This technology is applied in an organization, it can provide several benefits such as architecture, efficient information, and customer data management. With this approach, agencies can get a clearer picture of how important BI is in all agency sectors

Currently, the number of studies at this level is growing, with a focus on innovations to be implemented, so that the same sector can adopt new methodologies, architectures and technologies that allow more efficient support of existing hospital processes, as well as their results to be provided for all professionals involved in this field. In this research, an Adaptive Business Intelligence architecture is proposed, whose contribution is supported by the realization of an adequate conceptual and technological framework that describes its development at various levels. Thus, the possibility of modernization of several work approaches begins, with the introduction of an architecture capable of contributing to several factors, both at the clinical and administrative level, meeting the needs of the hospital system, regarding design, development, implementation and demonstration of the results [8].

Business Intelligence can provide effective and useful insights for investors and business owners to utilize more

appropriate BI tools and functions to achieve more ideal organizational excellence. It also allows managers to better understand the application of BI functions in the process of achieving specified managerial support benefits [9].

The current implementation of Business Intelligence has an impact and influences the current economy, intangible assets have gained considerable appreciation for the continuity of organizations and institutions. Therefore, important parts of business value, such as intellectual property strategy, play a vital role in defining, creating and maintaining a superior business strategy. This allows the creation of value and strengthening various strategic aspects for business continuity. The implementation of a combination of BI (Business Intelligence) and AI (Atificial Intelligence) has emerged as a new approach to assessing and creating real-time technologies such as weather technology and capital markets throughout the world. Then there is also Big Data technology which is able to create value and show the potential for transformation in organizations and for improving business processes.

Each recognized hospital patient management unit (PMU) has focused its efforts on improving clinical patient care, with a process approach, analyzing everything from adult emergency crowding to length of stay in clinical services. This results in many patients waiting for beds in emergency services. PMUs do not have a business intelligence (BI) platform that provides real-time information, creating a blind search problem. The aim is to demonstrate the need for a BI platform using Artificial Intelligence (AI) to analyze in real-time relevant information for decision making.

Hospital Management Information System (SIM-HM) application, which can manage daily operational data, but the information produced is still very limited, so the use of technology and information is not optimal. The role of IT can be increased by implementing a system that can extract and change information business from existing operational data, so that later it can provide support for strategic business decisions in hospitals. The Business Intelligence Road Map approach is an approach to describe the steps and procedures for developing and implementing Business Intelligence [10].

There is a gap between medical resources and patient needs, Hospital Managers need to obtain productivity information to optimize resource allocation [11]. The Hospital Business Intelligence produced lacks analysis, especially for conducting analysis and reporting [12]. The findings show that all three factors of organization, process, and technology equally influence the implementation of business intelligence. However, it is not explained what the results of the information system/application follow-up from the research findings area[13].

Business Intelligence developed and used in hospitals, and user surveys showed positive results. In addition, top management support and involvement in the development of HBIS were found to be critical success factors, and the implementation of the system enabled the hospital to significantly improve the performance of managerial indicators. However, it does not contain key human resource resources managed to assist BI technology to improve the Hospital's

services [14].

The design science research methodology was developed and used in hospitals, and user surveys showed positive results. Additionally, top management support and involvement in the development of HBIS was found to be a critical success factor, and implementation of the system enabled the hospital to significantly improve performance on managerial indicators.

However, it does not contain key HR resources that are managed to help BI technology improve hospital services [15].

The healthcare system faces enormous challenges, essentially due to the amount of data generated every day in the hospital environment, which forces concentration on how to organize and use the same data. Currently, the number of studies at this level is growing, with a focus on the innovations to be implemented, so that the same sector can adopt new methodologies, architectures and technologies that allow more efficient support of existing hospital processes, as well as the results provided for all professionals involved in this field. In this research, an Adaptive Business Intelligence architecture is proposed, whose contribution is supported by the realization of an adequate conceptual and technological framework that describes its development at various levels. Thus, the possibility of modernization of some work approaches begins, with the introduction of an architecture capable of contributing to several factors, both at the clinical and administrative level, meeting the needs of the hospital system, regarding design, development, implementation and meaning of the results.

III. RESEARCH METHODOLOGY

HGOD Discovery is a approach in hospitals referring to the balancing and monitoring mechanisms that form the process of making important decisions in serving Public Health. Hospital management is responsible for ensuring the best performance for patients. Therefore, it is important to understand the characteristics of organizational and provide services to contribute positively to the outlook and performance of the hospital.

Hierarchy (H) is a sequence of processes based on highest to lowest priority. Usually, an organizational hierarchy consists of various levels, starting from the top to the bottom. Hierarchy in this case is a focus on activity processes that are focused on urgent and non-urgent matters. A hierarchy can connect parts either directly or indirectly or either vertically or horizontally. The existing levels will be arranged based on predetermined business processes, resulting in an arrangement of processes that are considered priorities. Hierarchies help in organization, decision making, and resource allocation, and provide a clear structure for understanding relationships between entities.

The hospital governance (G) framework is becoming increasingly important considering the rapid development of health services in general and hospital services in particular. Governance in hospitals refers to the balancing and monitoring mechanisms that form important decision-making processes in serving public health. Hospital management is responsible for ensuring the best performance for patients. Therefore, it is important to understand the characteristics of organizational governance, and provide services to make a positive contribution to the hospital's outlook and performance.

- *Implementing the organization and coordination of the formulation of technical policies for the RSUD Strategic Plan (Renstra) in line with the strategic plan of the Provincial Government which is used as a reference guideline in carrying out tasks.*
- *Implementing the organization and coordination of the formulation of policies for the vision, mission and objectives of the RSUD based on references from the Government's vision and mission*
- *Implementing and coordinating work to the hierarchical structure in accordance with the duties and responsibilities of each for the quality of service at the RSUD UPTD.*

Outlook (O) is an attitude or view towards a situation. In this research, you can have an optimistic or pessimistic outlook about the future. Decision outlook refers to the view, prospect, or expectation of the outcome or consequences of a decision taken. This can include how the decision is expected to affect the future in a particular context.

- *Impact Projection: Estimating the short-term and long-term impacts of the decision on the organization, individual, or situation.*
- *Risks and Opportunities: Identifying potential risks and opportunities that may arise as a result of the decision.*
- *Strategy and Action Plan: Developing strategies to address challenges and take advantage of opportunities based on projections from the decision.*
- *Outcome Evaluation: Measuring and evaluating actual results against initial projections to assess the success of the decision.*
- *External Context: Considering external factors that influence the Decision.*

Conducting Business Intelligence updates and building the existing Regional General Hospital Information System with a Dimensional approach, namely Hierarchy, Governance and Outlook. The steps for completing HGO Discovery are as follows:

$$HGOd_{ij} = \begin{cases} \dfrac{(Xhg_{ij})}{(Max\ X_{ij})} \\ \dfrac{(Min\ X_{ij})}{(Xhg_{ij})} \end{cases}$$

The following are existing policies in regional general hospitals, namely: Implementing the implementation and coordination of the preparation of technical policy formulations for the Regional General Hospital Strategic Plan (Renstra) that are in line with the strategic plan that serves as a reference guideline in carrying out tasks. Implementing the implementation and coordination of the preparation of policy formulations for the vision, mission and objectives of the Regional General Hospital based on references from the Government's vision and mission. Implementing and coordinating work to the hierarchical structure in accordance

with the duties and responsibilities of each for the quality of service at the Regional General Hospital.

This model performs simulations with 2 aspects, namely positive (+) and negative (-) with the result that the value 0.000 is the highest value and the value 1 is the lowest value.
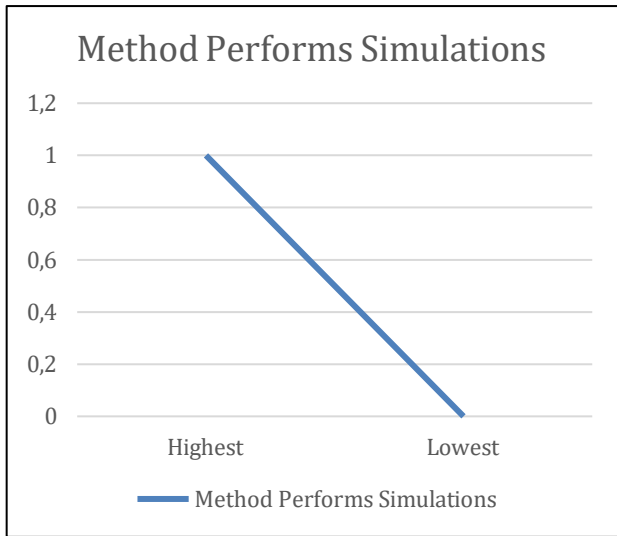

Fig 1. Method Performs HGOD Simulations

Above the image of the results of 0.000 is the highest value or low risk and 1 is the lowest or high risk value. The results of the equation above provide a new picture or perspective on hospital, how an intelligent business is able to provide priorities for what will be done.
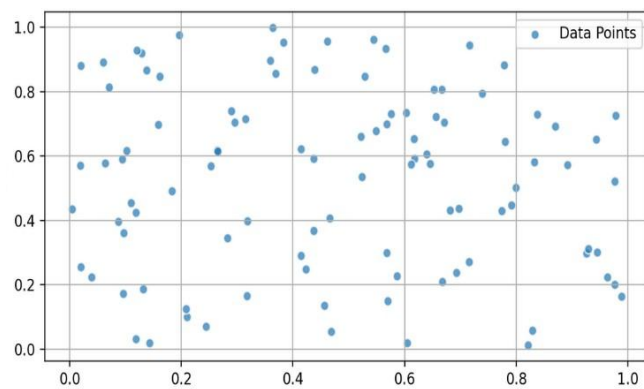
Fig 2. Values of HGOD Model

The following describes how the performance of this model from start to finish produces a dashboard Business Intelligence.
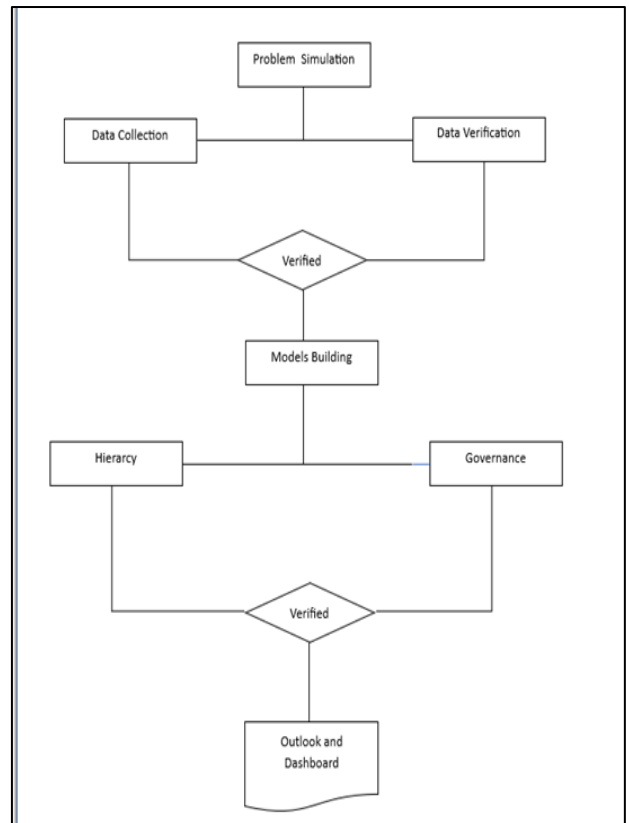

Fig 3. HGOD Discovery

HGOD discovery works starts from problem sumulation where the regional hospital performs data collection and data verification. after that, the system will build building models associated with priority hierarchy and HGOD so as to produce information in the form of outlook and dashboard. The dashboard produced by the data and information processing process which will become a decision-making technique that will be implemented by the general hospital.

Table 1. Comparison of Business Intelligence Model

No	Reference	WT	LS	CO	DD
1	DES (Discrete-Event Simulation)	X	X		X
2	DSRM (The design science research methodology)	X	X		
3	HBIS (hospital-based business intelligence system)	X		X	
4	MCS (Cross-Sectional)	X			
5	GRD (Group Related Diagnostics)	X	X		X
6	ABS (Agent-Based Simulation)	X	X		
7	HGOD Discovery	X	X	X	X

The identified gaps show that there are 4 focal points that are used as a comparison with other methods, namely WT (Wait Time), LS (Length of Stay), CO (Cost), and DD (Door to Doctor). In these 4 points, each method has its own characteristics that you can see in the table above for comparison.
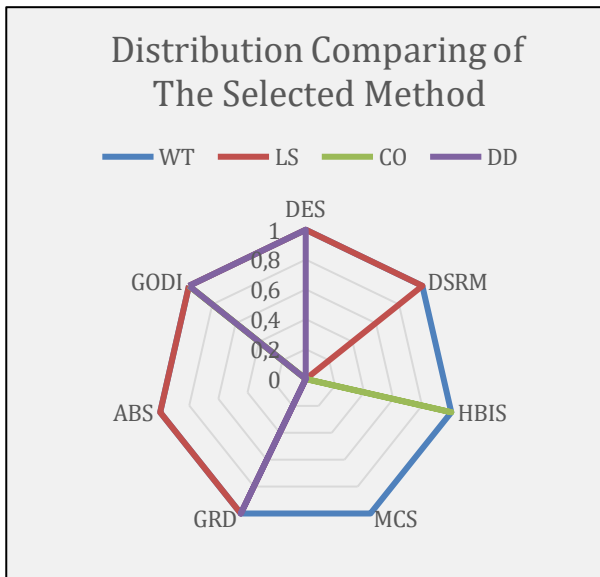

Fig 4. Distribtion Comparing Method

From the comparison results, DES (Discrete-Event Simulation) has 3 points, DSRM (The design science research methodology) has 2 points, HBIS (hospital-based business intelligence system) has 2 points, MCS (Cross-Sectional) has 1 point, GRD (Group Related Diagnostics) has 3 points, ABS (Agent-Based Simulation) has 2 points and HGOD Discovery has 4 points.

In this finding, the focus becomes clear that the increasing importance of simulation analysis in improving hospital services with business intelligence. The finding is the importance of a method that considers and emphasizes what happens in a hospital system so that patient management is maximized and the involvement of health care professionals in validation and verification simulations. In addition, this study proposes a HGOD Discovery framework that offers valuable insights into management, technology, human resources, and policies.
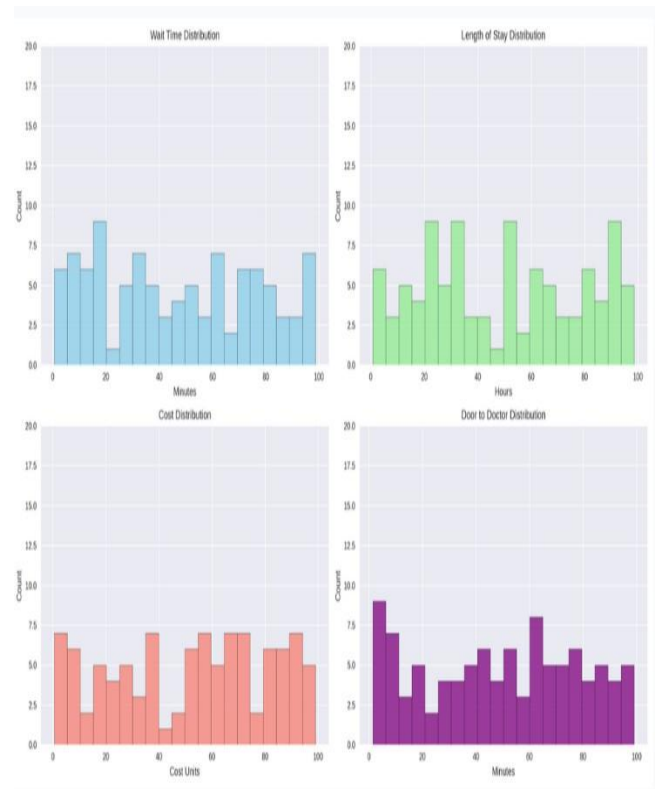

Fig 5. Simulation dashboard criteria HGOD

The following is a simulation of the dashboard graph for WT (Wait Time), IS (Length of Stay), CO (Cost), and DD (Door to Doctor) with a value range of 0 to 100.
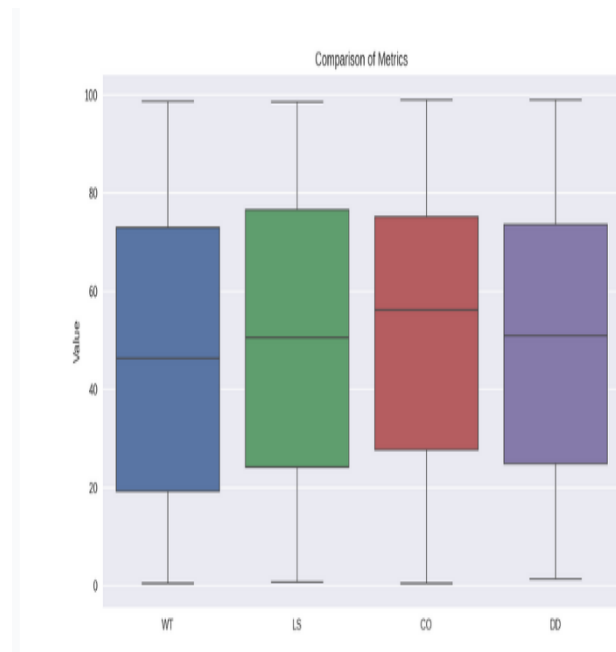

Fig 6. Simulation Comparing of Metirc

IV. CONCLUSION

From the research conducted, several important conclusions were obtained, including:

1. The hospital HGOD Discovery Model is becoming increasingly important given the rapid development of health services in general and hospital services in particular. HGOD in hospitals refers to the balancing and oversight mechanisms that shape the process of making important decisions in serving Public Health.

2. This method performs simulations with 2 aspects, namely positive (+) and negative (-) with the result that the value 0.000 is the highest value and the value 1 is the lowest value. Above the image of the results of 0.000 is the highest value or low risk and 1 is the lowest or high risk value. The results of the equation above provide a new picture or perspective on hospital, how an intelligent business is able to provide priorities for what will be done.

3. The identified gaps show that there are 4 focal points that are used as a comparison with other methods, namely WT (Wait Time), LS (Length of Stay), CO (Cost), and DD (Door to Doctor). In these 4 points, each method has its own characteristics that you can see in the table above for comparison.

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