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Analysis of the Effect of Linac Determination and Institutional Coordination on Implementation Time Performance Based on Decision-Making Performance in Linac Room Construction

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Abstract

General Background: Government procurement of advanced medical equipment is a critical component of health infrastructure development, particularly in oncology services requiring radiotherapy technology. **Specific Background:** Dr. Soeradji Tirtonegoro General Hospital is constructing an Integrated Cancer Center financed through a foreign loan scheme under Islamic Development Bank regulations, where Linear Accelerator (LINAC) procurement must follow International Competitive Bidding procedures and the equipment type has not yet been determined. **Knowledge Gap:** Empirical studies examining how LINAC type determination and institutional coordination influence construction time performance through decision-making processes in specialized hospital projects remain limited. **Aims:** This study analyzes the role of LINAC equipment determination and institutional coordination in achieving project time performance in LINAC bunker construction. **Results:** Multiple linear regression using IBM SPSS 25 indicates that LINAC type determination is the most dominant factor affecting project time performance, supported by effective coordination in procurement planning and tender preparation. **Implications:** Timely technical decisions and coordinated procurement mechanisms are essential to prevent construction delays and minimize design adjustments.

Highlights:

- ♦ Equipment specification selection was the strongest factor linked to schedule attainment in bunker construction.
- ♦ Institutional collaboration under foreign loan procedures shaped tender preparation and planning.
- ♦ Regression analysis confirmed the importance of managerial decisions in meeting construction timelines.

Keywords: Linac Type Determination, Institutional Coordination, Project Time Performance, Decision-Making Performance, Medical Equipment Procurement

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Introduction

Health development is a crucial part of overall national development. [1] The goal of health development is to achieve a healthy lifestyle for every citizen, enabling them to achieve high-quality and equitable health services that can achieve optimal health. The goal of health development is to create a resilient, healthy, creative, and productive population.[2] To achieve this, the vision for health development in 2019 is to create a healthy society, nation, and state, capable of accessing quality health services fairly and equitably, and achieving the highest level of health throughout the Republic of Indonesia. The mission of health development is to implement promotive, preventive, curative, and rehabilitative efforts. These efforts are implemented in all service locations, from community health centers to hospitals, both government and private.[3]

Hospitals, as a public health service, have the primary task of providing public health guidance and health services. Currently, the distribution of hospitals, as the spearhead of secondary health services, has become more equitable. Each hospital serves 30,000–50,000 residents. (Ministry of Health of the Republic of Indonesia, 2003: 19). As a service element for the community, the implementation of hospital sanitation is closely linked to technical services and patient care. As a logical consequence of this position, hospitals also integrate environmental health administration/management, social engineering, epidemiology, and environmental health education for the community. In short, the determination.[4]

as part of a program based on the laws in force in the hospital[5]. In an effort to provide comprehensive health services, a strategic plan is needed that is in line with the Strategic Planning of the Indonesian Ministry of Health, where the medium-term development target for 2020-2024 is to realize an independent, advanced, just, and prosperous Indonesian society, especially in the health sector, characterized by: 1) guaranteed national health security through the ability to prevent, detect, and respond to global health threats, 2) continuously increasing community welfare, 3) increasing health and nutritional status of the community and optimal growth and development processes. The development of hospital management, both from the management and operational aspects, is greatly influenced by various demands from the environment ranging from quality, efficiency, equity, policies from the central government and regional autonomy, and so on. Meanwhile, hospitals themselves have limited resources to meet all these demands. Hospitals as producers of health services must be able to anticipate changes and know their position to take advantage of existing opportunities and avoid future threats. Hospitals that have a strategic plan will lead in hospital management and something that is expected to be realized in the future, strategic planning has an important role in being able to answer the demands of the environment around the hospital (Trisnantoro L, 2008). Strategic planning is a collection of strategic decisions and actions that take into account the influence of the external and internal environment to produce cross-functional system formulation and implementation including aligning policies and actions across management levels [6].

To support the vision and mission of the President and the Ministry of Health, Dr. Soeradji Tirtonegoro General Hospital has set a Vision of "Asia-class hospital that has comprehensive blood disorder management services with sustainable growth". While the mission of Dr. Soeradji Tirtonegoro General Hospital is: 1) improving patient experience through improving the quality of services and supporting facilities, 2) improving the quality of service providers through increasing work productivity, 3) improving the quality of clinical services through service standardization, 4) Improving hospital governance through service digitalization, 5) Providing support to increase the capabilities of the national hospital network, 6) Organizing quality, innovative and implicational education, training, and research. Dr. Soeradji Tirtonegoro General Hospital is striving to create an infrastructure, namely the Integrated Cancer Center Oncology Building. This building is intended as a treatment center and health center capable of providing services, examinations, treatment and care for diseases, especially cancer in Klaten. To accommodate all activities that can support the healing process and recovery of cancer patients effectively, the Integrated Cancer Center Oncology Building of Dr. Soeradji Tirtonegoro General Hospital was built so that the community can get the best service in their needs for health facilities, especially for cancer.[7]

Procurement of medical equipment is an effort by the hospital's procurement/logistics management to meet the needs of hospitals and users for medical equipment to improve the quality of hospital services. Meeting these needs requires consideration of the efficiency, effectiveness, and utilization of the medical equipment to be used. Dr. Soeradji Tirtonegoro General Hospital, Klaten, still faces challenges in the implementation of medical equipment procurement, as there has been no decision regarding the provision of linac medical equipment to be used for treatment/radiotherapy services for cancer patients. Therefore, budget planning needs to be improved, especially sourced from foreign loans[8]. The procurement of medical equipment at Dr. Soeradji Tirtonegoro General Hospital (RSUP) aims to improve the quality of hospital services, which ultimately supports improvements in public health. The central and regional governments are responsible for providing hospitals and regulating the distribution of high-tech and high-value medical equipment. Therefore, the government, specifically the Indonesian Ministry of Health, as the hospital owner, is responsible for providing medical equipment at the hospital by increasing the budget for the procurement of facilities and infrastructure at Dr. Soeradji Tirtonegoro General Hospital (RSUP) in Klaten.[9]

Facilities and infrastructure are essential resources in supporting the implementation of the duties of staff working in the field of medical equipment procurement in hospitals. With adequate facilities, staff will naturally work comfortably[8]. A comfortable working environment will also improve staff performance. Good staff performance will support the overall performance of the hospital (Kenedi, J., Lanin, D., & Agus, Z. (2018). One significant component in supporting treatment efforts is medical equipment. As outlined in Law of the Republic of Indonesia No. 44 of 2009, hospitals guarantee the availability of medical devices and equipment, and this will significantly impact the quality of healthcare services provided, including patient satisfaction[10]. To obtain appropriate medical devices and meet maximum utilization standards, good medical equipment logistics management is required. Procurement management is the strategic management process for the transfer and storage of goods, spare parts, and finished goods from suppliers, between company facilities, and to

customers. Conversely, procurement/logistics management in hospitals is defined as a strategic process for procuring, storing, distributing, and monitoring the inventory of materials (stock, materials, supplies, inventory, etc.) needed for the production of hospital services. Procurement of medical devices is a crucial component in supporting efforts to improve healthcare services. Law of the Republic of Indonesia Number 36 of 2009 concerning Health, in Articles 98 and 104, explains that the management of medical devices must be safe, efficacious/beneficial, high-quality, and affordable for the community[11]. The process of implementing medical device procurement that cannot be utilized effectively, efficiently, and effectively is said to be a failure in the process of implementing medical device procurement in hospitals. Therefore, it is necessary to analyze the procurement of determining the type of health linac equipment in hospitals to improve the quality of service to patients (Yusrani et al., 2023).

The procurement process for high-cost medical equipment and supplies in hospitals requires consideration of several factors beyond the basic contract between the supplier and the healthcare provider. These factors include user needs, technical maintenance, training requirements, adequate consumables, and disposal methods. The construction of the oncology building at Dr. Soeradji Tirtonegoro Hospital is a construction project using a foreign loan financing scheme as a solution to cover the burden of the increasingly deficit State Budget (APBN) (financing gap). Foreign loans are referred to as capital inflows from abroad into the country and have consequences for the APBN's deficit profile, namely when state spending or aggregate expenditure is greater than revenue. This deficit condition encourages developing countries to borrow abroad (Ningrum, 2018). Using foreign loans for infrastructure development is an alternative for the government to finance areas such as health, education, social services, and other sectors. The loan, provided by the Indonesian Ministry of Health, as the project owner and source of funding for the project, is a foreign loan through the Islamic Development Bank (IsDB) Financing Assistant, ID Number 1054.

This loan will significantly assist the government in funding development projects for ministries and agencies. Loans or debt are financing through debt obtained by the government from domestic or foreign lenders, bound by a loan agreement and not in the form of government securities, that must be repaid under specific conditions. (Ussa'diyah et al., 2022) From the explanation above, the Indonesian Ministry of Health is the owner of the project/owner. The construction of oncology buildings in four locations in Indonesia, namely Adam Malik General Hospital (Medan), Mohammad Hoesin General Hospital (Palembang), Kandou General Hospital (Manado), and Soeradji Tirtonegoro General Hospital (Klaten). PT. Ciriayasa Cipta Mandiri KSO PT. Arkonin Engineering Manggala Pratama is the Project Management and Supervision Consultant for the four oncology building construction locations. There has been a 300% surge in cancer incidence globally, with 70% of this increase occurring in developing countries, including Indonesia. Several sources indicate that there are approximately 190,000-200,000 new patients annually, and only 15% receive optimal treatment due to the limited number of cancer treatment centers. This necessitates radiotherapy, with more than 50% of cancer patients requiring it as part of their treatment[12][13].

Dr. Soeradji Tirtonegoro General Hospital strives to improve its services by offering a one-stop service offering premium services, including integrated cancer/oncology management. To achieve this strategic plan, RSST Klaten, as a Type A vertical hospital designated as a National Referral Hospital, possesses diverse potential and is ready to develop itself to provide services as a radiotherapy center. Radiotherapy at Dr. Soeradji Tirtonegoro General Hospital is expected to be able to compete with other radiotherapy centers in Central Java and Yogyakarta, and can become a leading service in the Solo Raya area (Boyolali, Karanganyar, Klaten, Sragen, Sukoharjo, Surakarta, Wonogiri) and has a big responsibility in providing the best radiation services by developing technology and capacity according to the conditions and needs of the community, as well as maintaining the accessibility of radiotherapy services for all levels of society. A Linear Accelerator (LINAC) is an example of a teletherapy device designed to accelerate the linear movement of electrons to produce photon and electron beams (Khan, 2005). Linac radiotherapy is a type of external radiation therapy using a linear accelerator to treat cancer. The advantages of linac radiotherapy include a high level of accuracy, time efficiency, and being an alternative to surgery. The budget allocation for the procurement of the linac medical equipment is separate in scope from the budget for the construction of the oncology center building at Dr. Soeradji Tirtonegoro General Hospital, Klaten. Because the auction stage for the procurement of linac medical equipment has not yet been completed due to budget constraints, the Indonesian Ministry of Health has not yet determined the brand of linac equipment to be used, which will hamper the construction of the linac/bunker room. Each brand chosen has different specifications, installations, and dimensions. If the construction of the linac/bunker room is completed and the linac equipment has not yet been decided, there is concern that the concrete floor slab of the linac room (pit table) will be damaged, potentially increasing the cost of the linac room construction.

Method

The type of research used is quantitative research with a survey method approach. The survey method aims to provide a detailed overview of the background, characteristics, and distinctive characteristics of a case or event of a general nature. Furthermore, it aims to create a systematic, factual, and accurate description or depiction of the facts, characteristics, and relationships between the phenomena being investigated. The instrument used is a closed-ended questionnaire. The indicators for the research variables are then elaborated by the author into a number of questions to obtain primary data. The object of this research is the linac room construction project located on Jalan. KRT. dr. Soeradji Tirtonegoro No. 1 Klaten, Central Java, where the discussion in this research is the analysis of the influence of determining the type of linac equipment and coordination with institutions on the performance of project implementation time through decision-making performance in the linac room construction work.

Results and Discussion

Based on the results of multiple linear regression analysis, it was found that the determination of the type of linac equipment was the most dominant factor among other factors influencing project implementation time performance through decision-making performance in linac room construction work. This finding explains that the determination of the type of linac equipment, including coordination with institutions, plays a crucial role in determining the procurement/determination of the type of linac to be used at Dr. Soeradji Tirtonego General Hospital, Klaten. A theory is an attempt to describe experiences or ideas to explain how events occur based on systematic observations. In scientific work or research, the presence of theory is absolutely essential; theory is as important as method. Theory is a tool for solving problems encountered in research, while method is the method used to solve them. Theoretical studies in research reports are intended to reveal a comprehensive framework of reference regarding the concepts, principles, or theories used as a foundation for solving the problems encountered or developing the desired product. This research is multidisciplinary in nature, as it combines various fields of practice to understand how project implementation time performance through decision-making performance related to procurement/determination of the type of linac equipment can achieve good procurement/determination performance. The multidisciplinary relationship includes:

1. Implementation of International Selection/Tendering in Government Procurement of Goods and/or Services: The concept of New Public Management (NPM) has changed the government's approach to improving public infrastructure. This is reflected in the increasing popularity of options such as contract auctions, privatization, asset sales, and the application of corporate principles in other state institutional systems. Collaboration between the private sector and the public sector has been established to reduce budget constraints in the procurement of goods and services. Procurement of goods and services plays a strategic role in providing protection and preference for domestic businesses. Another factor assisting the government in providing services to the public is the Public-Private Partnership (PPP) scheme. This can then be expanded because the private sector can be both national and foreign businesses. Furthermore, reinforced by the liberalization of procurement of goods and services, it cannot be denied that agreements in international forums have significant normative and economic implications for a country's procurement and service regulatory policies. The presence of international selection/tendering in the procurement of goods and services in Indonesia has implications for the processes/tenders that can be participated in by parties from other countries. There are several requirements to participate in international tenders/selections, namely the foreign business entity must enter into a business collaboration with a national business entity in the form of a consortium, subcontract, or other forms of cooperation. Furthermore, specifically for foreign businesses carrying out procurement of goods/construction work, they must collaborate with domestic industries in the manufacture of spare parts and implementation of after-sales services. Presidential Regulation Number 16 of 2018 itself does not specifically regulate international tender/selection mechanisms, so its implementation still refers to general tender provisions, which essentially include: qualification process; announcement and/or invitation; registration and collection of selection documents; providing explanations; submission of tender documents; evaluation of tender documents; determination and announcement of winners; and objections.
2. Time Performance and Decision-Making: Performance is the overall results of an individual or agency during a specific period in carrying out tasks, such as work standards, targets, or criteria that have been predetermined and mutually agreed upon[14].
3. Procurement Implementation: In the procurement planning process, determining the timing of goods/service utilization is a crucial step because it forms the basis for developing the implementation schedule, from procurement preparation, selection preparation, selection implementation, contract implementation, and handover. Time planning must take into account adequate requirements at each stage to ensure the process runs optimally. Lack of time in implementation has the potential to lead to inefficiencies, such as incomplete procurement, underutilization of the budget, or a decline in the quality of procurement results.
4. Procurement Planning: Procurement planning includes identifying needs, determining procurement types and methods, packaging, consolidation, utilization time, and budget. This process must involve users, procurement units, and finance departments to ensure comprehensive planning, including taking into account resources, market surveys, time, and risks. Determining the utilization time of goods/services serves as an important reference in preparing the schedule from preparation to handover.

Conclusion

Coordination Factor with Institutions, namely in the implementation of government procurement of goods and/ services financed by foreign loans, there are forms of requirements for IsDB (Islamic Development Bank) as the funder of the linac procurement method, namely International Competitive Bidding (ICB) so that the Indonesian Ministry of Health institution is still preparing the facilities and infrastructure for the auction activities for the procurement of linac equipment that are in accordance with the requirements of IsDB (Islamic Development Bank[15]. Considering that the Determination of the Type of Linac Equipment (x1) is the most dominant variable, decision-making from the institution is recommended for all parties involved in the provision of linac equipment at the Indonesian Ministry of Health to pay attention to and follow up on factors that cause delays in decision-making in order to minimize or eliminate these delay factors and find the best solution so that the process of implementing the provision of linac medical equipment and the construction of linac rooms can be carried out properly.

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