

# Preliminary Study of Optimization Model of Local Government Infrastructure Asset Management to Improving the Sustainable Development Performance

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**Abstract-** Infrastructure development is an important aspect in the process of accelerating national development. The availability of adequate infrastructure is needed in support of various economic, industry, and social activities in the community. The main weakness of both central and local government in the implementation of infrastructure development is the management of infrastructure assets. Good asset management will certainly be the right solution to optimize the functioning and sustainability of existing infrastructure assets. This research analyzes an optimization asset management model that can be applied by local government in improving the performance of sustainable development. The analysis used in this preliminary study is limited to the determination stage of factors and research variables, where the approach used is literature review approach with comparative analysis literature method. In its application, a number of literature were collected for comparisons of literary opinions as a basis for determining the variables and research factors. The result of the research shows that there are 6 factors of infrastructure asset management that influence to improve the performance of sustainable development such as planning, procure, operational and maintenance, monitoring and evaluation, renewal / rehabilitation and improvement, and asset disposal, which is then called life cycle infrastructure asset management. In addition, 56 research variables were also identified based on these factors. The approach that can be used in measuring the performance of sustainable development is to determine performance indicators as a reference comparison of development results that have been or are being implemented with strategic development goals. In addition, there is also a need to evaluate the performance of development that can be done by using Multivariate Regression Analysis, Data Development Analysis, or Iterative Generalized Least Square (IGLS) method.

**Index Term-** Infrastructure Asset Management, Model Optimization, and Sustainable Development.

## I. BACKGROUND OF RESEARCH PROBLEMS

Infrastructure system becomes the main supporter of social system function and economic system in society life. Infrastructure is a physical system needed to meet basic human needs in the social and economic sphere. The meaning of basic human needs can be in the form of water supply, electric power, waste disposal, transportation and similar services to facilitate social and economic goals.

Infrastructure development is an important aspect in the process of accelerating national development. The availability of adequate infrastructure is needed in support of various economic activities, industry, and social activities in the community. Infrastructure enables an area to work properly, so that the progress of a region can be seen from the successful development of its sustainable infrastructure.

The main weakness of both central and local government in the implementation of infrastructure development is the management of infrastructure assets. Generally, the government seems able to buy, but less able to maintain, so many infrastructure assets are damaged and not maintained. In this case, good asset management can be a solution to optimize the functioning and sustainability of existing infrastructure assets, without having to rebuild new infrastructure that would later be neglected as well because of weaknesses in the management of these infrastructure assets.

The management of infrastructure assets leads to a systematic process that monitors, maintains, upgrades, operates, and keeps valuable things to an entity or group in relation to the functioning of the asset. Infrastructure asset management can be defined as a combination of management, finance, economics, engineering, and other practices applied to physical assets of infrastructure with the aim of improving services in the most efficient and efficient way. In the public sector, physical assets and infrastructure can be in the form of production and generation of electricity, water and sewage

treatment services, distribution networks, transportation systems, buildings, and so on. The amount of investment embedded in the asset leads to the need for maximal management of the asset.

Among the physical asset classes in some infrastructure domains, such as roads and sidewalks, railroads, bridges, and distribution pipelines are about its existence as part of a network, as well as its continuous linearity. It is necessary to review because the failure or loss of infrastructure performance in a small segment of an infrastructure system can affect the whole system, if the asset is not monitored and the risk is not properly managed.

In general, regional infrastructure assets are an important resource for local governments as a key source of local revenue. Therefore, it is important for local governments to be able to optimize the functioning and sustainability of the region's wealth assets, so that an asset management model optimization that can be implemented by the local government in improving the performance of sustainable development.

The Asian Development Bank (2009) defines sustainable infrastructure development as a new infrastructure design and re-planning, rehabilitation and reuse and optimization of existing infrastructure including maximizing renewable energy utilization and minimizing environmental impacts, providing for local communities including the poor, controlling infrastructure expenditures and corruption, and finding the appropriate role for the government and the private sector in meeting the financing needs and management of infrastructure activities. Sustainable infrastructure development will pay attention to environmental, economic and social aspects.

This study is a preliminary study that examines the factors and variables of local government infrastructure asset management in improving the performance of sustainable development through literature review approach with comparative analysis method. This research will be continued by analyzing the ways or methods that can be done to measure the performance of sustainable development.

## **II. RESEARCH PROBLEMS**

Based on the above background, the subject matter in this study can be formulated, namely:

1. What are local government infrastructure asset management factors in improving the performance of sustainable development?
2. What are the variables of local government infrastructure asset management in improving the performance of sustainable development?
3. How to measure the performance of sustainable development?

## **III. LITERATURE REVIEW**

### **3.1 Infrastructure Asset Management**

Asset management is a new theory in the science of property that arises from the fact that a region especially Indonesia that has a wealth of resources, both natural resources, human and infrastructure. The following will explain the definition of asset management.

Management is a series of processes consisting of planning, organizing, actuating, controlling and budgeting (Nawawi, 2003). The definition of an asset is a thing or something that has economic value, commercial value or exchange value owned by a business entity, agency or individual. There are two types of assets: tangible and intangible assets (Siregar, 2004).

Intangible assets are non-financial assets that are identifiable and have no physical form and are held for use in the production of goods or services or used for other purposes including intellectual property rights, while tangible assets with a useful life better than twelve months for use in government activities or utilized by the general public. Tangible assets (tangible) include land, equipment and machinery, buildings and buildings, roads, irrigation, and networks.

The notion of asset management is clarified by Hastings (2010) arguing that asset management is a series of activities related to identifying what assets need, identifying funding needs, acquiring assets, providing logistical support and maintenance systems for assets, removing or renewing assets so that effectively and efficiently meet the objectives.

Asset management is the science and art to guide wealth management that includes the process of planning asset needs, obtaining, inventorying, legal auditing, appraising, operating, maintaining, renewing or eliminating to transfer assets effectively and efficiently (Sugiama, 2013).

Based on the above opinion, it can be seen that the management of infrastructure assets is a process or activity related to the management of infrastructure assets with the aim of streamlining and streamlining the functioning and sustainability of assets, either in the form of tangible or intangible assets.

### 3.2 Local Infrastructure Assets

Infrastructure assets are assets that serve the public interest, the cost of spending on infrastructure assets is determined by the continuity of the use of the assets concerned, such as roads, bridges, and so on (Hariyono, 2007).

Local infrastructure assets are derived from two sources, namely from APBD and from outside the APBD. In short, assets sourced from APBD implementation are the output / outcome of the realization of capital expenditure in one budget year, while assets sourced from outside APBD implementation is the acquisition of assets not due to the realization of local budgets, both capital expenditure budget and personnel expenditure and goods expenditure and services. These assets are usually obtained from World Bank, Corporate Social Responsibility (CSR), and other assistance.

### 3.3 Optimization of Regional Infrastructure Assets

Asset optimization is a work process in asset management that aims to optimize the physical, location, value, volume, legal and economic potential of the asset. In this stage of optimization, state-owned assets are identified and grouped based on the potential of the asset. Assets that have potential that can be grouped based on the leading sectors that become the foundation in the national economic development strategy, both short, medium and long term. Optimization of asset management must maximize asset availability, maximize asset utilization and minimize cost of ownership (Siregar, 2004).

The objectives of optimizing local infrastructure assets in general include identifying and inventorying all local assets (including form, size, physical, legal) as well as knowing the market value of each asset reflecting its economic benefits, the utilization of assets in accordance with its intended use, and create an information and administration system so that the achievement of efficiency and effectiveness in asset management.

### 3.4 Sustainable Development Performance

Brundtland in the World Commission on Environmental Development (WCED) in 1987 mentions the notion of sustainable development is development that seeks to meet the needs of today without reducing the ability of future generations to meet their needs.

The performance of sustainable development is the result of work that has strong links with strategic development goals that contribute to social and economic value. the performance control process generally consists of three basic steps, namely setting performance standards in the form of budgeted schedules and costs, measuring performance against standards by comparing actual performance with performance standards, and performing corrective actions in case of deviation standard set (Dipohusodo, 1996).

### 3.5 Relevant Research Results

Several selected research results as the basis of reference support in this study are shown in table 1 below:

**Table 1 Relevant Research Results**

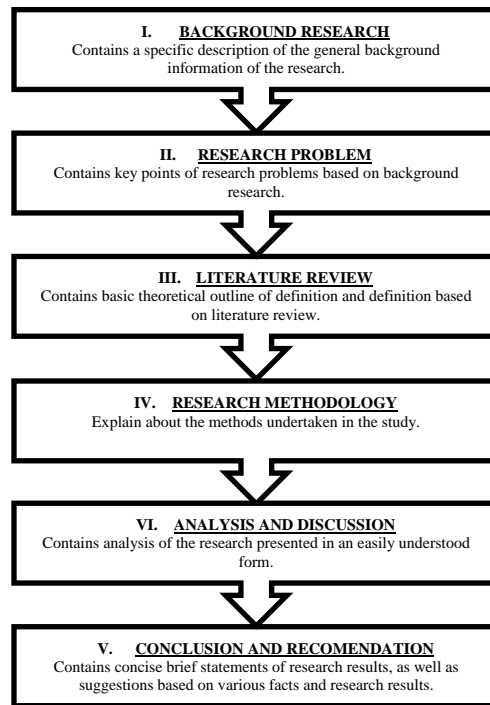
Research Topic	Relevant Essentials
Identifying Rehabilitation Options for Optimum Improvement in Municipal Asset Condition Zafar Khan, Osama Mosehli, Tarek Zayed – 2014	This study analyzes the most appropriate municipal asset rehabilitation techniques. Methodologies for addressing proposed asset management issues are model identification that illustrates the level of asset services, models for measuring the condition of assets based on performance, and fuzzy-logic models mapping the level of service to the assessment of asset conditions.
Asset Management Assessment Model for State Departments of Transportation Steven R. Cooksey, David Hyung Seok Jeong, Myung Jin Chae – 2011	This study develops a model for measuring the level of asset management implementation for benchmarking purposes. Models are developed through identification of indicators that demonstrate successful practices for an ideal AM system. The method used is Analytical Hierarchy Process (AHP).
Asset Management for Urban Wastewater Pipeline Networks Rita Ugarelli, Venkatesh, Vittorio Di Federico, Sveinung Saegrov – 2010	This study discusses the requirements and constraints of asset management implementation in the Oslo Vann og Avløpsetaten pipeline study case in the Norwegian Capital. The results show that a very effective information management system is the backbone of asset management.
Asset Management Perspective on the Duration of Public-Private Partnership Contracts: Cost Control Trade-off Marc van Buiten, Andreas Hartmann – 2014	This study adopts an asset management perspective on the issue of contract duration in public-private partnership (PPP) contracts with the aim of deepening the effect of network level assets of the most important contract parameters such as contract duration.
Life Cycle Asset Management Methodologies for Buildings Michael N. Grussing – 2013	This study identifies various approaches in building life cycle asset management, reviewing the benefits and challenges of current practice conditions, and proposing a framework for achieving better information facilities for decision-making facilities that can be acted upon.
Managing Ancillary Transportation Assets: The State of the Practice Margaret-Avis Akofio-Sowah, Richard Boadi, Adjo Amekudzi, Michael Meyer – 2013	This study analyzes the state of the management practices of additional traffic signs and barriers to assess the need for successful implementation of the program by highlighting data collection and cost strategies, data analysis tools, and data usage in making decisions.
Data Integration of Pavement Markings: A Case in Transportation Asset Management William E.S, William Rasdorf, Joseph E. Hummer, Hugh A. Devine – 2009	This study discusses integrated transportation asset management system combined with computerized software system. This system includes algorithms, which implements data structures and predictive models to estimate asset conditions at any point of time or space on the road system.
Event-Based Approach to Optimize the Timing of Water	This research analyzes the recommendation of asset management optimization to the municipality in

Main Rehabilitation with Asset Management Strategies E. Roshani, Y.R. Fillon – 2014	planning the rehabilitation of water resources more rationally, with the aim of developing an event-based approach in optimizing water resource rehabilitation time.
Importance of Workplace Relationships and Attitudes towards Organizational Change in Engineering Asset-Management Organizations Matthew J. Xerri, Silvia Nelson, and Yvonne Brunetto – 2015	This study analyzes the impact of workplace relationships (organizational support and perceived leader leaders) on organizational change attitudes, affective commitment, and psychological well-being for Australian asset managers, engineers and technicians working in the management of physical assets.
Building a Proactive, Engagement Culture in Asset Management Organizations Matthew J. Xerri, Silvia Nelson, and Yvonne Brunetto – 2015	The research develops a pathway model to examine the perceived impact of organizational support from a member-member exchange organization culture within an asset management organization in Australia. The model is analyzed by the smallest partial squares modeling method.

**IV. RESEARCH METHODOLOGY**

**4.1 Optimization of Research Framework Models**

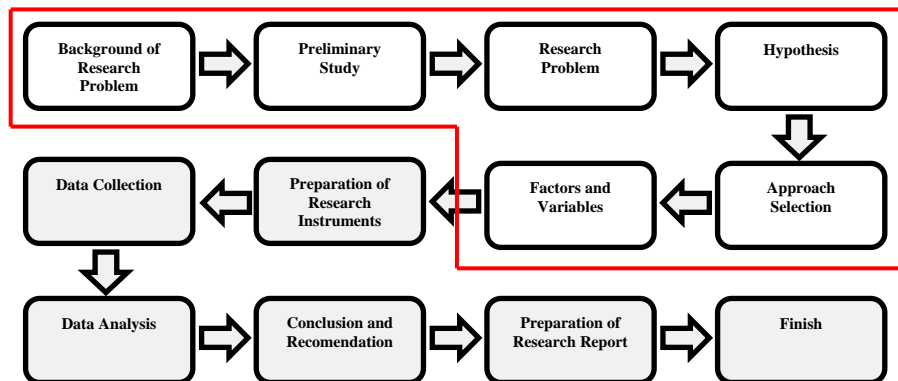
To understand more clearly this research, the optimization of the research framework model is done by grouping the material into several parts with the order as shown in Figure 1 below:



**Figure 1 Research Framework**

**4.2 Research Process**

The study was conducted using an explorative study approach consisting of literature study, questionnaire survey, and expert interview. In summary, the research process undertaken can be observed in Figure 2 below:



**Figure 2 Research Process**

This study is a preliminary study of optimization research model of asset management is limited to the determination phase of factors and research variables. Research begins with the selection of problems followed by a preliminary study with the intent to seek information required by the researcher to make the problem clear. The next stage is to formulate the problem so that research can be done best, and clearly must start from where. After formulating the problem, the study proceeds to formulate a basic assumption or something that is believed to be true by the researcher who will serve as the research reference, choose the type of approach to be used, and determine the factors and variables based on the source of research data.

### **4.3 Research Instruments**

The research instrument is a tool used by researchers to obtain data. In this study, the instrument to be used is a questionnaires. Questionnaires are designed based on information obtained in the previous research literature. The distribution of questionnaires was conducted to local government agencies involved in the management of infrastructure assets in Bengkulu and Jakarta Provinces. Distribution of questionnaires will be done at the next stage of research is the stage of data collection.

### **4.4 Data Collection Techniques**

Techniques or methods of data collection is a way done by researchers to obtain the necessary data in a study. Data is a collection of facts obtained from a measurement. A good decision-making is the result of drawing conclusions based on accurate data or facts. In general, the data in this study is divided into two data sources namely primary data sources and secondary data.

#### **4.4.1 Primary Data**

The primary data collection in this research will be conducted by questionnaire survey of research respondents involved in infrastructure asset management in Bengkulu and Jakarta Provinces.

#### **4.4.2 Secondary Data**

Secondary data collection conducted by researchers in a way not directly to the object of research, but through documents related to the object of research. Secondary data collection will be done through official website of Public Works Department of Indonesia, Central Bureau of Statistics, and other official elements involved in infrastructure asset management in Bengkulu and Jakarta Provinces.

#### **4.4.3 Measuring Instruments**

Measuring tool that will be used in this research is questionnaire with Likert scale. Likert scale is used to measure attitude, opinion, influence and perception of a person or group of people about social phenomenon. In the Likert scale procedure, a number of questions are constructed with the respondent's answer being in one continuum with a given weight.

### **4.5 Research Sites**

This research will be conducted at two research sites, namely Bengkulu and Jakarta Provinces by reviewing the management of infrastructure assets in both locations.

### **4.6 Research Respondents**

Respondents in this study are local government agencies as well as other administrative elements involved in the management of infrastructure assets in Bengkulu and Jakarta Provinces.

### **4.7 Research Analysis Methods**

The analysis used in this preliminary study is limited to the determination stage of research variables, where the approach used is literature review approach with comparative analysis literature method. In its application, a number of literature will be collected for comparisons of literary opinions as a basis for determining factors and research variables.

## **V. ANALYSIS**

### **5.1 First Research Problems Analysis**

The first research problem focuses on the influential infrastructure asset management factors in improving the performance of sustainable development. The research factor is the object of observation that plays a role in the event and the phenomena to be studied. The most influential indicator of asset management factors influencing life cycle infrastructure asset management is life cycle infrastructure asset management.

Within the scope of an area, asset management is regulated in PP. 6 of 2006 on Management of Regional Property, which is then followed up with Permendagri No. 17 of 2007 on Guidelines for Management of Regional Property. The scope of asset management involves planning of needs and budgeting, procurement, use, utilization, security and maintenance, valuation, deletion, alienation, administration and coaching, supervision and control.

In opinion of Hariyono (2007), the life cycle of an asset has three phases which include acquisition, operation, and disposal. Then an advanced process is the planning phase, which is an advanced process, in which the output of each phase is used as input for planning. An asset has a life cycle in order to differentiate responsibilities from each phase of its handling. In particular, the responsibility for the procurement decision of an asset in an organization differs from the responsibility for the operation and maintenance of the asset as well as with the responsibility for the removal of an asset.

Understanding of life cycle asset management is further explained by Campbell et al. (2011) stating that the life cycle of an asset is a strategy, plan, evaluate / design, procure, operate, maintain, modify, (dispose).

In opinion of Sugiama (2013), the life cycle of asset management includes asset asset planning, asset acquisition, asset inventory, asset audit, asset valuation, asset operation and maintenance, asset renewal / asset replacement, asset removal, asset transfer.

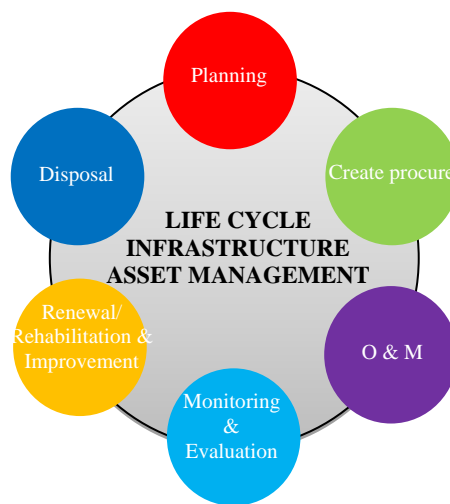
In infrastructure, life cycle asset management is also described in the 2002 International Infrastructure Management Manual (IIMM) which summarizes all practices related to management strategies as part of the asset life cycle, namely requirements definition, asset planning, asset creation, operations and maintenance, asset monitoring, renewal / rehabilitation, and disposal.

Table 2 below shows the literature compare analysis of the determination of research factors based on life cycle asset management indicators.

**Table 2 Literature Comparative Analysis**

Literary Opinion	Life Cycle Asset Management
PP No. 6 tahun 2006, Permendagri No. 17 tahun 2007	Needs Planning – Budgeting – Procurement – Utilization – utilization – Security and Maintenance – Assessment – Removal – Administration and Development – Monitoring – Control
Hariyono (2007)	Acquisition – Operation – Disposal
Campbell (2011)	Strategy – Plan – Evaluate/Design – Create Procure – Operate – Maintenance – Modify – Dispose
Sugiama (2013)	Needs Planning – Procurement – Inventory – Legal Audit – Assessment – Operation and Maintenance – Renewal / Rejuvenation – Removal – Asset Transfer.
International Infrastructure Management Manual (IIMM)	Requirements Definition – Planning – Asset Creation – Operations and Maintenance – Asset Monitoring – Renewal/Rehabilitation – Disposal

Based on the above opinion, infrastructure asset management factors in terms of life cycle asset management indicators are planning, procure, operational and maintenance, monitoring and evaluation, renewal / rehabilitation and improvement, and the disposal of assets shown in Figure 3 below:



**Figure 3 Life Cycle Infrastructure Asset Management**

**5.2 Analysis of Second Research Problems**

The second research problem is about the variables that affect the management of infrastructure assets in improving the performance of sustainable development. The research variables are the small parts of the research factors related to



the research focus to be studied. Determination of variables in this study was done by analyzing the opinions of literature as shown in table 3 below:

**Table 3 Research Factors and Variables**

Numb.	Research Factors	Research Variables	Source	
1.	Planning	X1	Resource Allocation	Cooksey et al. (2011)
		X2	Decision based on condition data	Cooksey et al. (2011)
		X3	Planning needs and budgeting	Grussing (2013)
		X4	Asset Mapping	Khan et al. (2014)
		X5	Risk estimation,	Ugarelli (2010)
		X6	Identification of assets	Hastings (2010)
		X7	Asset tracking	Hastings (2010)
		X8	Feasibility study	Hastings (2010)
		X9	Identify potential asset	Hastings (2010)
		X10	Market and financial analysis	Roshani & Fillon (2014)
2.	Create Procure	X11	Identify the asset needs	Grussing (2013)
		X12	Efficiency of asset needs procurement	Khan et al. (2014)
		X13	Utilization of asset	Buiten et al. (2014)
		X14	Analysis of asset potential	Sowah et al. (2014)
		X15	Developing and refining policies	Hastings (2010)
		X16	Determining the infrastructure delivery method	Hastings (2010)
		X17	Asset provided by others	Hastings (2010)
		X18	Project managing the asset procurement process	Hastings (2010)
		X19	Commissioning and handover of assets	Hastings (2010)
		X20	Evaluating the project (post-completion review)	Hastings (2010)
3.	Operation and Maintenance	X21	Level of asset service improvement	Hastings (2010)
		X22	Asset grouping	Hastings (2010)
		X23	Improvement organizational culture AM	Hastings (2010)
		X24	Increased asset productivity	William et al. (2009)
		X25	Asset integrated control	Brunetto et al. (2014)
		X26	Computerized inventory technology	Sowah et al. (2014)
		X27	Human resource development in AM	Sowah et al. (2014)
		X28	The design of an asset optimization program	Buiten et al. (2014)
		X29	Cost, quality, and time control	Buiten et al. (2014)
		X30	Physical Approach and Legality	Khan et al. (2014)
		X31	Asset condition assessment	Grussing (2013)
		X32	AM information system	Roshani & Fillon (2014)
4.	Monitoring and Evaluation	X33	Codification/labeling assets	Buiten et al. (2014)
		X34	Asset assesment	Cooksey et al. (2011)
		X35	Quality information and analysis	Cooksey et al. (2011)
		X36	Asset inventory	Cooksey et al. (2011)
		X37	Common referencing system	Cooksey et al. (2011)
		X38	Up-to-date data	Cooksey et al. (2011)
		X39	Data management and analysis	Cooksey et al. (2011)
		X40	Policy goals and objective	Cooksey et al. (2011)
		X41	Performance measure and targets	Cooksey et al. (2011)
		X42	Evaluation of asset performance	William et al. (2009)
		X43	Evaluation of asset manager liability	Brunetto et al. (2014)
5.	Renewal/Rehabilitation & Improvement	X44	Identifying rehabilitation options	Khan et al. (2014)
		X45	Level of service	Khan et al. (2014)
		X46	Performance indicators	Khan et al. (2014)
		X47	Asset inspection & condition assessment	Khan et al. (2014)
		X48	Condition assessment methods & protocol	Khan et al. (2014)
		X49	Rehabilitation strategies	Khan et al. (2014)
		X50	Policy development	Khan et al. (2014)
		X51	Corrective repairs, major overhauls, & renovations	Grussing (2014)
6.	Disposal	X52	Review of inventory results	Cooksey et al. (2011)
		X53	Highest and best use asset potential	Ugarelli (2010)
		X54	Disposition of asset arrangements	William et al. (2009)
		X55	Transfer of Asset	Roshani & Fillon (2014)
		X56	Asset deletion	Roshani & Fillon (2014)



### 5.3 Analysis of Third Research Problems

The third research issue is about the methods or ways that can be used to measure the performance of sustainable development. Measurement of development performance is an attempt to compare the objectives to be achieved at a certain time period with the progress of achievement that is being observed at a time on a material planning shown by a form of indicators and performance evaluation in the context of development.

United Nations (2007) mentions 8 criteria for determining indicators in the context of sustainable development, that is, especially within the national scope; relevant to assessing the progress of sustainable development; limited in number, but still open-ended and tailored to future needs; broad in scope and all aspects of sustainable development; easy to understand, clear and unambiguous; conceptual sound; to the extent possible representing international consensus; within the scope of the national government's ability to develop; and depending on known cost and quality cost data.

According to the opinion of Mayston in the book *Evaluation Guidance and Indicators of Development Performance*, Bappenas (2009), the way of general performance evaluation usually used Multivariate Regression Analysis or Data Development Analysis method. These two ways are usually used for educational evaluation because of the many complexities in the educational variables, but good for continuous audit performance. In addition, Iterative Generalized Least Square (IGLS) methods are also widely practiced, although not too common.

## VI. CONCLUSIONS AND RECOMMENDATIONS

### 6.1 Conclusions

Based on the analysis of research and discussion that has been done, there are at least 6 factors of infrastructure asset management indicated to have an effect on improving the performance of sustainable development, ie planning, procure, operation and maintenance, monitoring and evaluation, renewal / rehabilitation and improvement, and asset disposal. These factors are then called life cycle infrastructure asset management.

There are 56 research variables based on life cycle of infrastructure asset management consisting of 10 variables for planning factor, 10 variables for procure factor, 12 variables for operational and maintenance factor, 11 variables for monitoring and evaluation factor, 8 variables for renewal / rehabilitation and improvement factors, and 5 variables for assets disposal.

The approach that can be used in measuring the performance of sustainable development is to determine the performance indicators as a reference comparison of development results that have been or are being implemented with strategic development goals. In addition, there is also a need to evaluate the performance of development that can be done by using Multivariate Regression Analysis, Data Development Analysis, or Iterative Generalized Least Square (IGLS) method.

### 6.2 Recommendations

This research is expected to contribute to various stakeholders in the implementation of infrastructure asset management, both government, private, community, and other stakeholders, to better understand and consider factors and variables in life cycle infrastructure asset management and methods that can be recommended in the process of improving the performance of sustainable development.

Further research is needed by considering the factors of community involvement in infrastructure asset management through the approach of sense of ownership and demand responsive approach, so that people are treated not only as objects of development, but rather as subjects or actors in their own development process.

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