Road infrastructure asset management strategy and its impact on the environment

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Abstract. The development of the economic sector is determined by services to the public through reforms that aim to place public satisfaction through the management of road infrastructure assets. Some research on road infrastructure assets still requires a deepening of studies related to the delivery of public services related to asset management systems. The purpose of this study is to find an appropriate road infrastructure asset management strategy through an integrated asset management system and asset management policies that can provide public satisfaction. This comprehensive approach to management strategies ensures that the performance of service provider assets is in line with the expectations of stakeholders including road users. This descriptive qualitative research is based on the perspective of road users as respondents, consisting of vehicle drivers from 50 transportation companies (people or goods) through interviews and observations. The results show aspects of asset performance based on the user's perspective are five aspects, namely productivity, efficiency, effectiveness, use of resources and institutions and this performance is integrated in the asset management system related to policies from the management authority through service delivery namely quality and mobility, risk and use and maintenance of resources. The conclusion of this research is that road infrastructure asset services can be improved through the concept of road infrastructure asset management strategies in an integrated management system with five aspects of performance and more directed towards asset management policies related to the provision of road infrastructure asset services.

1. Introduction
Economic growth needs to be supported by efforts to reduce the occurrence of infrastructure gaps with a framework for understanding the ability of project owners [1]. The Public Works and Public Housing Office of West Java as the owner of infrastructure asset projects in strategic planning has a mission that is in line with the demands of the community as road users for transportation infrastructure needs. Strategic planning includes plans or strategic actions in managing road infrastructure to ensure the delivery of services by the demands of asset users and stakeholders, including capital investment, maintenance, and removal of road infrastructure with short and medium-term implications.

The mission of the Public Works and Public Housing Office of West Java as an institution responsible
for the existence of road infrastructure assets is to increase regional accessibility and mobility in supporting economic growth and improving people's welfare by providing reliable, integrated and sustainable road networks through Minimum Service Standards (MSS). West Java is the area chosen in this research because it has a road network with an index below the MSS requirements so it requires efforts to increase accessibility and mobility needs. The demand for road users is very high considering that in West Java there are 20% of the 260 million population of Indonesia. There is a significant gap between high demand and supply of road infrastructure network assets whose index is below the MSS, resulting in congestion and increased transportation costs.

The study of strategic management in road infrastructure assets has been carried out. First, the challenge in infrastructure asset services is how to create a reliable transportation network (strong, safe, comfortable, and efficient) with limited resources (human, financial, and organizational resources), to be able to provide adequate and synergistic transportation service benefits, increase the accessibility and mobility of goods or services, and can increase competitiveness. Resolving this challenge needs to involve the community of road users and the private sector in addition to government organizations that are authorized to produce quality road infrastructure following the interests of stakeholders [2]. Second, the benefits of the asset management process are increased customer satisfaction, governance and accountability, risk management, financial efficiency, and sustainability through an integrated and strategic approach to infrastructure asset management. This can be done through applied research in the practice of road infrastructure asset management which can be used to examine the institutional status of sustainable infrastructure asset management that focuses on future policy directions [3]. This is the reason why strategic management in road infrastructure assets is needed to achieve the long-term goals of management institutions and effectiveness through dynamic alignment of infrastructure assets needed to meet changing customer needs [4].

This research is expected to contribute to the study as a novelty of road infrastructure asset management research strategy through a comprehensive approach, namely through the integration of asset management systems as measured through five aspects of asset performance with asset management policies that are assessed from service delivery in accordance with the expectations of stakeholders including users Street. Previous research on asset management systems emphasizes more on Visual Condition Index (VCI) and Remaining Pavement Life (RPL) [4], not on efficient and effectiveness performance. This study also links the integrated asset management system with public service policies which in previous studies only set the infrastructure assets to support economic development [3]. So this article discusses how this strategy can be implemented through considering five aspects to get good performance so that the services delivered from road infrastructure assets are in accordance with the demands of road users and the objectives of the asset owners.

2. Literature review

2.1. Road infrastructure asset management
Roads are transportation infrastructure for land traffic that are regulated by law, including buildings above, on the surface and under the ground, and/or water as a complement and equipment. Managing infrastructure assets for the transportation sector requires system-level performance measures, models and database operations to make evidence-based decisions. The main function of the highway is to serve traffic to enable the movement of vehicles that transport people and goods from one place to another, and have an impact on regional and economic development of cities and regions. A good performance system for road assets is to maintain good performance and good service without reducing the value of the structure or reducing the remaining life of the road assets [4]. This can be done through the management of road infrastructure assets by guiding the planning, acquisition, operation and maintenance, renewal and sale of assets. Refers to Indonesia Infrastructure Initiative, the goal of road infrastructure asset management is to maximize service delivery while at the same time managing risks and minimizing costs over the useful life of the assets.

The performance of road infrastructure assets that have a life cycle at a good operation and
maintenance phase will result in increased cost efficiencies and provide longer effectiveness in operations, which means there are effective benefits in managing infrastructure assets. The life cycle of a road asset is a systematic process that starts from the planning, acquisition, operation, maintenance and transfer of assets. The concept of an infrastructure asset management framework that includes planning-design, procurement-construction, use-operation-maintain-renewal-refurbish, and deconstruction. Service delivery as a last resort in the framework of asset management strategies in this road infrastructure is service quality consisting of technical quality and functional quality. Technical quality is a measure of what results can be delivered from services, while functional quality is a measure of how the service delivery process [5]. Infrastructure management is needed to get the level of infrastructure services needed by the community through efficient ways of managing assets with an asset life cycle. Through the management of road infrastructure assets, the performance of road infrastructure assets will be measured in the quality of technical and functional services so that what is planned by managers is the same as the quality of services that can be received by users.

Based on the view of road infrastructure, the transportation sector is very promising while bringing potential challenges to the current performance of road infrastructure services [6]. Strategic performance measurement is not like other measurement frameworks, because it does not only have the focus of a single project that is in line with current organizational goals [7].

2.2. Strategic infrastructure asset management

The strategic role of the management of state assets including the strategy for managing road infrastructure assets is an important indicator in controlling the state budget and efforts to achieve accountability in the management of a state's finances. Asset management does not merely take the form of maintaining its condition but also includes management to achieve the objectives of the owner's organization.

The strategic approach to making infrastructure asset management better understood is to know how the concept of assets is most appropriate to meet the needs of service delivery from consumers at this time and then with the performance of the assets being evaluated that are more related to asset managers. This road infrastructure asset management strategy requires a holistic or comprehensive process that is designed to achieve organizational goals in operational delivery through clear responsibilities between asset owners, asset managers and service providers [8]. The strategic asset management framework needs to be designed to assist the organization in making decisions about assets needed to achieve asset performance, and to support service delivery in developing strategic asset management policies.

The strategic role of managing state assets including strategies for managing road infrastructure assets is an important indicator in controlling the state budget and efforts to achieve accountability in managing state finances. Asset management does not only take care of the condition of the assets but also includes management to achieve the objectives of the asset owner organization. Managers must have a proactive strategic role; able to predict organizational needs and develop medium and long-term plans to achieve institutional goals.

The strategic approach to making infrastructure asset management more understood is to find out how the concept of assets is most appropriate for meeting the service delivery needs of consumers today and then with the performance of the assets being evaluated related to asset managers. Road infrastructure asset management strategies require a holistic or comprehensive process designed to achieve organizational goals in operational delivery. This concept is rooted in newer holistic approaches that 'impact on investment' by underscoring how the performing organization must deal with the "blended-value" management process [9].

The strategic asset management framework needs to be designed to assist organizations in making decisions about assets needed to achieve asset performance and support service delivery in developing strategic asset management policies. The main objective of the strategic asset management framework is to integrate the organization's asset management policy and make it more accessible and make a strong connection between the needs of asset planning and the implementation of asset decision making. This framework highlights the need for institutions to drive the organizational planning process integrated
with the road infrastructure asset planning process through institutions related to management. The strategic approach to infrastructure asset management is the approach of the owner, operator, and maintenance of infrastructure assets, infrastructure organizations that are assumed to be significantly responsible for ensuring the performance of assets that are successful following stakeholder expectations. Therefore, infrastructure organizations must be able to improve their operations, user satisfaction, productivity, asset quality, and environmental performance.

3. Methodology
To ensure that assets are given effectively and efficiently and the needs of stakeholders are met, consistent measurement of performance through the life cycle of a project is needed to ensure that they are 'proven in the future' [10]. The sampling technique used was cluster random sampling, because the population consisted of business groups in 27 cities/regencies in West Java as road users who transported goods and or passengers, so with an average of 2 companies the number of respondents was 56. measured from valid collected data, there are only 50 freight transport companies and/or passengers, each represented by the management of the transport company.

Asset performance measurement consists of productivity aspects including indicators of expenditure / budget-work and savings, efficiency aspects have indicators of the average cost of maintenance, development and operation of roads, and employee expenditure per year, aspects of effectiveness include procurement, maintenance, programs and security, aspects usage includes material resources, replacement rates, fuel consumption, and exhaust / particulate emissions, as well as institutional aspects for contract expenditures.

4. Results and discussion
The level of performance of road infrastructure assets is maintained through good service quality, both of which have a moderate relationship between asset performance and asset service quality. The performance of the quality of road infrastructure asset services can increase competition between regional road management units so that competitive advantage can be achieved through investors who enter the area. The concept of road infrastructure asset service quality was subsequently developed into the concept of a strategic asset management framework (SAMF), which is a guideline of best practice in describing a systematic approach to managing asset performance and meeting organizational service needs.

Road infrastructure asset management strategies are made through a comprehensive or integrated asset management system approach and policies in asset management so that service performance is in line with the expectations of stakeholders including road users. An explanation of how the Road Infrastructure Asset Management Strategy is presented in Figure 1, which consists of an integrated asset management system and asset management policy. Box (1) is a road infrastructure asset management strategy that consists of an integrated asset management system and asset management policies. The integrated asset management system as a result of the ‘formulation’ box (2), namely the performance aspects of road infrastructure assets and asset management policies as an ‘implementation’ of the integrated asset system to be presented as a delivery of road infrastructure asset services (box 3).

This strategy is formulated and implemented through performance aspects so that the quality of services from road infrastructure assets can meet the demands of road users. The results show aspects to get good performance from road infrastructure assets based on the perspective of road users, namely productivity, efficiency, effectiveness, use of resources and institutional aspects.

The productivity aspect is a condition of the physical performance of road infrastructure assets that follows the quality of road construction services and road complements, information mobility for the Geography Information System, and network plans.

The efficiency aspect is technical performance in terms of road maintenance, development and operational costs, and employee expenses. This performance still leaves problems in the mismanagement of road infrastructure maintenance, despite efforts to improve and improve through
routine maintenance. The form of road damage is an operational condition that affects the life cycle of assets, especially in road construction so that services are not felt to the maximum by road users.

Figure 1. Road infrastructure asset management strategy.

Aspects of effectiveness for asset procurement (expansion of the road network, reduction of dense road space, sidewalk conditions), effectiveness of asset maintenance (maintenance standards, condition of the assets themselves), effectiveness of the program (benefits, savings-expense ratios, economic returns, the percentage of pending expenses), and the effectiveness of safeguards (percentage reduction in facilities, accidents, causes). Effective infrastructure performance in service delivery must pay attention to aspects of the effectiveness of procurement, maintenance, programs and safeguards which are interrelated.

Services related to the use of quality resources (materials, replacement rates, fuel consumption, and exhaust emissions / particular) still require ongoing efforts. Institutional aspects are represented through good services in the implementation of road construction contracts, related to decisions, regulations, and NSPM (Norms, Standards, Guidelines and Manuals) for the development of environmentally sound road infrastructure. The Committee for the Acceleration of Priority Infrastructure Provisioning and the Investment Coordinating Board are two institutions involved, with the task of ensuring the delivery of priority infrastructure projects with effective financing and the task of encouraging private investment to improve the ease of doing business. Aspects of planned performance will be conveyed to road users through service quality as measured by the quality and mobility, risk, maintenance and use of resources from road infrastructure assets. The explanation provides an overview of how the Road Infrastructure Asset Management Strategy can be realized through an integrated asset management system and asset management policies as presented in Figure 1.

5. Conclusion
The findings in this study of road infrastructure asset management strategies from not all aspects of performance can be used in the service delivery expected by road users and thus require an asset management policy. Considering the role of infrastructure is physically managed as an asset, through its cycle, the owner's organization can develop proactive management strategies to be able to predict the needs of the organization in the medium and long term to achieve the goals of the organization/institution. A proactive building maintenance system can be designed to prevent the owner from more expensive maintenance costs, road infrastructure assets are also smart buildings, the equipment can be installed to detect performance degradation symptoms and also make efforts to revitalize the construction industry, increase employee productivity work to increase competitiveness.

The network system can be improved, especially in asset damage techniques, decision-making strategies, time-variant analysis techniques, to compute varying risk levels over time on a real-time basis, and also techniques to estimate damages and losses sustained from the point of an attack to the final recovery to be identified through the asset management framework [11]. It is expected that with the
identified performance aspects service delivery can be carried out to road users in a road infrastructure asset management strategy with the Integrated Asset Management System and Asset Management Policy.

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