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# Towards a public sector asset optimization strategy: the case of Indonesia

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**ABSTRACT**

**Purpose**: Governments in developing countries manage their considerable state assets for public service delivery directly. In Indonesia, the Directorate State Asset Management responsible for developing the National strategy for state asset optimization requires the determination of key elements and prioritization tools. The purpose of this paper is to show that a simple calculation using the combination of the balanced scorecard (BCS) and analytical hierarchy process (AHP) will help in the prioritization of strategy development.

**Design/methodology/approach**: A questionnaire survey of 131 multi-stakeholder respondents to identify the most important key elements and the best alternative for asset optimization.

**Findings**: The respondents agree on the most important key elements, and that the best alternative for asset optimization is the efficient maintenance of assets. Competitive human resources comprise the recommended second key element, and that improvements in asset performance and value will improve public service as the second-highest alternative. The study also shows the importance of the integration of asset optimization in existing government strategic instruments supported by a comprehensive dataset related to public assets and their performance.

**Originality**: The paper provides a new contribution to integrating asset optimization strategies as the core of the organization's performance and prioritization strategies. Additional balanced scorecard (BSC) perspectives are suggested, with the inclusion of AHP for prioritization. In addition, the study includes the opinions of all the stakeholders, from external users to the central management. The flexibility of the tools to adapt to the existing strategic framework will allow their application by different agencies and in different countries.

**Keywords**

Assets, public sector, optimization, strategy, Indonesia

**Paper type**

Research paper

## Introduction

Government organizations in most countries are responsible for the control, supervision, and administration of state assets, together with the formulation of associated regulations and procedures.

However, although the management of assets may be covered by a comprehensive set of regulations (Laue et al., 2014), these are often not sufficiently integrated to cater for every facet in the asset life cycle, with the organization units involved not having a common standard. These issues often result in the failure to obtain the optimal economic use and potential benefits of assets, and an inability to control expenditure on their maintenance or refurbishment. What is needed is an interconnected database of assets to allow the full asset life cycle to be accurately recorded and avoid the governance of the management process interfering with the interactions between the asset managers and client/stakeholders involved. Moreover, to gain the maximum benefit, having an *asset optimization strategy* helps to improve public service delivery by resolving problems such as an excessive amount of unregistered and underutilized assets, maintenance and operation costs, and a lack of control over asset performance (Ali et al., 2015).

One option is to adopt a comprehensive optimization approach utilizing a suitable form of performance measurement (Chaiwat, 2014; Lavy et al., 2010; Muchiri et al., 2011; Shad & Lai, 2015; Støre-Valen & Lohne, 2016; Tucker & Pitt, 2010), such as the balanced scorecard (BSC): a popular strategic management tool introduced by Kaplan and Norton in 1990s (Laury et al., 2020), in which every strategy has key elements linking it with the organization's performance (Allen & Helms, 2006). We use this here to develop a robust asset optimization strategy in conjunction with an extension of the analytical hierarchy process (AHP) for the public sector in the context of Indonesia, particularly for public land and buildings. Developed by Saaty in 1972 for multi-objective decision making to prioritize key elements and alternatives, AHP provides clear rationale for choices made (Janeš et al., 2018), and its combination with BSC constitutes a novel approach by accounting for the contribution of various BSC perspectives to asset optimization. This use of AHP with the BSC fills the research gap in including asset optimization in the key elements of the organization's strategic plan as prioritized by all stakeholders.

The paper is structured as follows. First, we introduce asset optimization – its goals, framework, key elements, and the development of an asset optimization strategy – followed by an account of the application of the BSC as a strategy tool in the Indonesian Public Sector. Next, we present the general methodological approach used in the study, the data collection process in the form of a questionnaire survey of middle- to lower-level Indonesian asset managers using AHP, and the form of analysis. In the results section, we include the hierarchy, criteria weights, consistency checks, and identify the best alternative. In the final section, we provide a brief discussion of the results and their likely implications.

## Strategic asset management and optimization

### *Key aspects of asset management*

The definition of asset management in ISO 55 000 is 'the coordinated activities of an organisation to realise value from assets' (ISO, 2014). Asset management includes policy and strategy down to asset life cycle delivery activities (Lloyd and Corcoron, 2019). The life cycle delivery activities of an asset involve the creation and acquisition, operation, maintenance, and disposal of an asset (IAM, 2018). The whole-life cost justification is concerned with analysing costs and risks over the life of an asset, or group of assets, to identify the optimum way of delivering customer and stakeholder requirements at the lowest whole-life costs.

The key aspects of asset management can be found in Corporate Real Estate Asset Management (CREAM) (Warren, 2010c), the Queensland Strategic Asset Management Framework in Australia (Queensland Government Department of Housing and Public Works, 2017), Towards Better Asset

Management of Public Sector Assets in UK (Lyons, 2004), Government Accountability Office in USA (United States Government Accountability Office, 2004), and Total Asset Management Manual (TAMM) for optimizing public assets in Malaysia (TAMM, 2009), in which *important elements* (e.g., forms of awareness of the surrounding environment, climate change, and associated current rules and regulations) underpin internal and external stakeholders, their culture, and expectations. Of vital importance is elementary *asset data*, which includes the ability to apprehend internal resources by reliable systems and technology; a *skilled asset manager*, as a reflection of professional and competent human resources, for building a better strategy and good governance; and *budgeting*, as the key foundation of financial affordability. All elements (asset data and skilled asset management and budgeting) have been used in Australia, the United Kingdom, United States, and Malaysia, which represent a mix of developed and developing countries. Also highlighted are the various alternatives of an asset management *program* (value creation, efficient asset utilization, maintenance, refurbishment, and disposal), which can involve creating new assets to fulfil public interests. *Performance indicators* are equally important, with most being cross-referenced to a chosen program. These can involve such financial aspects as the amounts of benefits (revenue or cost-savings) in terms of currency or economic returns, the quality of services achieved, environmental sustainability, management of risk, and enhancements.

*Strategic asset management*

Adopting a *strategy*, on the other hand, is a process of developing objectives and the organization's mission, and a vision and mission are standard and critical elements as a foundation for establishing organizational strategies and a starting point of an organization's strategic planning. Vision provides a direction for the organization for the next 10 years, while the mission serves as a foundational guide in defining organizational objectives. A strategy is also important to focus organizational efforts and resources to achieve organizational objectives. Therefore, developing a strategy can create an ability to capture opportunities or benefits of assets, respond to barriers, and use organizational resources and time efficiently. Developing a strategy also means defining tools to assess organizational performance based on internal and external perspectives (Warren, 2010a).

*Strategic asset management*, therefore, can be expected to involve the long-term direction for an organization to manage its resources in fulfilling stakeholder expectations (Johnson et al., 2008). This incorporates key elements covering such financial resources and natural environment matters as corporate real estate asset management strategies (Haynes & Nunnington, 2010); efficient public sector asset management (Grubišić et al., 2009); managing government property assets (Kaganova, 2010); road asset optimization (Deix et al., 2012a, 2012b); improving physical asset performance in the process industry (Schuman and Brent, 2005); optimization of building maintenance, repair, and renovation activities (Grussing & Liu, 2014); asset management equipment optimization (Campbell et al., 2010); and facilities managers preparing for climate change-related disasters (Warren, 2010b).

Chiang et al. (2020) collect data using the Delphi approach to ask 20 experts to determine the first and second level of indicators to be used in their project. Of these, we can identify seven key elements as *asset data* (asset registry, ownership, construction detail, the cost of procurement, property value, location detail, amenities, current usage, and transactional data − history of ownership), *maintenance and performance monitoring* (maintenance schedule, maintenance resources, condition of the property, technical deterioration, any special requirements), *asset layout* (pattern of land and design space of land, landscape, number of floors, on-site facilities, parking lots), *budgeted fund* (budgeted costs of maintenance, capitalized expenditure, or renovations), *stakeholder requirements* (external and internal users and their important interests such as comfort temperature, cleanness, tidiness and standard facilities, lighting, and accessibility), the *natural and built environment* (awareness of the internal built environment aspect such as low carbon emission and renewable energy, together with awareness in anticipating environmental factors such as disastrous/climatic events and the associated contribution of the organization), and a *skilled asset manager* (human resources and other supporting aspects to improve the skill and expertise of asset managers).

*Asset optimization*

Asset optimization involves a specific design or plans to trade off benefits and resources or risks (Shivalingappa, 2014; Ward et al., 2014), with a blend of such activities as the utilization, maintenance, inspection, and refurbishment of assets (Woodhouse, 2010). The main goals are *optimal benefits* (the capability of an asset to generate an optimal function or benefits in its performance); *optimal costs, resources, or risks* (minimum operational costs or losses and a reduced amount of resources used); *efficient repairs or maintenance* (the ability of planned maintenance to optimize economic life and improve asset performance in the most efficient way); and *improving public services* (since the government is a public service provider, the benefits will contribute to improving public services generally).

There are at least four approaches to developing an optimization program that correspond with building performance and sustainable buildings in particular, including *computer simulation optimization* with new design optimization tools (Caldas & Norford, 2002), calibration of building energy simulation programs (Sun & Reddy, 2006), facade design optimization (Wang et al., 2007), and optimization of architectural design elements in tropical humid regions (Prianto & Depecker, 2003); *sensitivity analysis* in building energy simulations (Sanchez et al., 2014), design of sustainable buildings (Heiselberg et al., 2009), real-time whole building performance assessment (Pang et al., 2012), and multidisciplinary process integration and design optimization (Flager et al., 2009); *expert-based optimization* in engineering design optimization (Roy et al., 2008), cost-optimal and nearly-zero-energy building solutions (Hamdy et al., 2013), and optimized control systems for building energy and comfort management (Shaikh et al., 2014); and the generally accepted approach of *numerical simulation and mathematical optimization* by cost optimal analysis (Ascione et al., 2015) and metamodel-based optimization (Eisenhower et al., 2012), for example. A challenge of the optimization approach is the qualitative nature of objective functions (Roy et al., 2008).

*Asset optimization strategy*

The BSC is one of the strategic tools used in developing an asset optimization strategy to simultaneously improve productivity and the performance of an asset, being used by organizations to measure the significance level of strategic objectives (SOs) and each key element in terms of key performance indicators (KPIs). It integrates strategic position, strategic options, and strategy-into-action processes by combining the approach and functional management system to monitor performance in a balanced condition, both financially and non-financially (Franceschini et al., 2013). The BSCd is based on "the proper balance and alignment between the elements of global strategy and its operational elements" (Laury et al., 2020, p.2). The goal, vision, core values, perspective, and purpose are the global elements involved. The operational elements are the key performance indicators and strategic initiatives. BSC is not only used to measure performance but can also be used for the periodic evaluation of strategic objectives. The current strategic position is assessed from four BSC perspectives of *stakeholder*, *financial*, *internal process*, and *learning and growth* − connecting a strategic position analysis and choice process in terms of these perspectives and their KPIs, with strategy-into-action being indicated by the target performance of each KPI. The weight of each of the four BSC perspectives represents their level contribution to achieving the main objective (Kaplan & Norton, 2001) and is usually obtained by a multi-objective approach of systematically and simultaneously optimizing a collection of objective functions (Marler & Arora, 2004). Compared to the Political, Economic, Social, Technological, Environmental, and Legal (PESTEL) model; Strengths, Weaknesses, Opportunities, and Threats (SWOT) model; and Porter's generic strategy, the BSC is not only a more integrative strategic tool but also reliable and simple to use in the development strategy process, with significant aspects for developing a strategic management tool (Taylor & Baines, 2012). It is also useful for setting organizational priorities (Bloomquist & Yeager, 2008) and its capacity to influence personal motivation by linking performance measurement and rewards (Decoene & Bruggeman, 2006) – making it the most influential practical form of performance measurement.

The AHP assigns attributes or sub-attributes into a hierarchy using a ratio scale and pairwise comparisons (Saaty, 1990), and was first introduced for research-related asset optimization and strategy development in Indonesia by Sundari and Ma'rif (2013) to address the best usage of land based on the characteristic of the land. Its main advantage is that it allows complex problems with multiple and possible conflicting criteria to be addressed and can apply different weights to criteria based on their different importance. Emrouznejad & Marra (2017) categorize issues that use AHP in 7639 published papers between 2002-2017, the most using AHP related to group decisions related to consistency, and prioritization methodology, while Li et al. (2020) use a combination of entropy weight and AHP to determine the weight of the indices of an objective and effective environmental performance evaluation model of air pollution control.

When used in combination with BCS, the main benefits of AHP are in multi-criteria decision making, where it is one of the complementary tools that potentially fits the complexity and weakness of BSC by assuring the prioritization strategies for strategy execution and is more effective in executing the strategic plan (Bentes et al., 2012; Huang et al., 2011). Yao and Liu (2016) develop the performance evaluation of e-government projects in China from the core elements of the BSC, using AHP to calculate the weight of each index and the final score of a project. Kim et al. (2021) develop the BSC and AHP to measure the Management Performance Evaluation Indicators (MAPEIs) for small construction firms, which account for 96.7% of construction firms in Korea. Using BSC with AHP also minimizes subjectivity, particularly in assigning weights to contributions towards the main goal of asset optimization; can resolve problems of unstructured multi-criterion and multi-objectives during the process of classifying alternatives and hierarchy into the group; and is simple and applicable in asset optimization strategy and able to support the evaluation of alternative policies or projects (Saaty, 2008). Emrouznejad & Marra's (2017) study uses a combination of BSC and AHP to achieve the objectives of BSC and minimize inconsistency in using AHP for strategic asset optimization, the multi-objectives, and 31 criteria defined in five steps: *structuring the hierarchy*, *weighting criteria*, *calculating the weight*, *checking consistency*, and *selecting the best alternative*.

Finally, the conjunction of the AHP and ANP has had a role in developing and empirically verifying the BSC model (Janeš et al., 2018). Together, they can assist government sector decision makers to select a preferred alternative where the causal relationship is between inputs and outputs (objectives) and specific alternatives reflect a complex, dynamic, and budgetary restricted situation (Greenberg & Nunamaker, 1994), and can complete the implementation of BSC by establishing a strategy that considers all-important relevant criteria to achieve the goal and to achieve a sustainable organization where customer's satisfaction and a viable cost structure are important (Álvarez Pérez et al., 2017).

In summary, the Indonesian public sector uses the BSC as an organization performance management tool, while the use of BSC and AHP as an appropriate methodology for measuring organization performance is well recognized. In addition, the key elements are introduced to integrate asset optimization and AHP for prioritization.

## Application of the BSC as a strategy tool in Indonesian public asset management

Indonesian public asset management is led by Directorate General of State Asset Management (DGSAM) under Indonesian Ministry of Finance. Indonesia's Minister of Finance Regulation number 467/KMK.01/2014 states that measuring the performance of governmental activities (including asset management) must be based on the BSC, and the DGSAM has implemented BSC and uses the following perspectives: financial accountability, program products or output, standard of quality in service delivery, and client satisfaction. The current use of the BSC is framed by organizational vision, which is to manage governmental assets professionally and accountably to serve the nation. This study evaluates the integration of asset optimization strategies at the center of organization's performance and prioritization strategies. Three of the seven key elements in strategic asset management – *asset data*, *asset layout*, and *the natural environment* – are also missing in the existing DGSAM's BSC, while the KPIs are excluded for the SO of *accountable administration* and *control of assets*, as an interpretation of the asset data and asset layout key elements. The study includes all stakeholders (including internal and external stakeholders) to fill the gap identified from the studies by Yaghoobi and Haddadi (2016).

## Method

### *Approach*

We use the DGSAM's BSC as the basis for prioritizing the key elements of asset optimization and therefore several perspectives. SOs and KPIs are already determined. Financial, Stakeholder, Internal and Learning, and Growth perspectives are included. Several key elements of land and building optimization are adopted to determine the weight of each SO, which are identified by understanding the findings, limitations, evaluations, and arguments of previous research and the current use of asset optimization of certain countries. These comprise *Asset data* (AD), *Maintenance and performance* *monitoring* (MPM), *Asset layout* (AL), *Budgeted fund* (BF), *Stakeholder requirements* (SR), *Natural and built environment* (NE), and *Skilled asset manager* (SAM).

We use AHP to identify the level of significance of the key elements by weighting their degree of importance. Table 1 shows the hierarchy of the BSC using the AHP and the KPIs of each key element using AHP − within the ranking process, the main goal is broken down into criteria and sub criteria. As Fig. 1 shows, Level 01 of the hierarchy contains the objectives of the optimization strategy as the first criterion is based on the four perspectives and key elements. Level 02 contains the KPI of each objective based on its performance measurement as the sub criterion. The pairwise process at this level is only within the same objectives: pairwise among objectives with different criteria is not logically accepted and the comparison between objectives in this level is pairwised separately. Level 03 contains the rating after knowing the weight and ranking to choose alternative actions. The actions would be in the form of activity to improve the ranked KPIs − the highest KPIs score having the highest priority. There are 18 scales for the AHP questions, providing ordinal data.

<< insert Table 1 here >>

<< insert Fig. 1 here >>

The weight of each BSC perspective represents its level of importance developed in the hierarchy in contributing to the main objectives (Kaplan & Norton, 2001), which means the structured groups are ranked based on their level of importance or another criterion (Kaplan & Norton, 2004). This enables the SOs to be prioritized according to the contribution of each element or variable. The top hierarchy level is the customer perspective, where the SO is optimal asset management. The AHP-BSC model is shown in Figure 2 as the basis of research design of this study.

<< insert Fig. 2 here >>

Asset data requires basic data of land and buildings, including asset classification and function, land ownership and boundaries, and the value of land and buildings as asset data indicators. Total maintenance costs, and the physical condition and functional indices, are indicators of asset maintenance and the monitoring system. Asset layout has the building density and efficient land index as key indicators and is also in the *Learning and growth* perspective, which are a SO of a reliable management information system and conducive organization.

*Data collection*

We carried out a primary data collection from May to June 2017, with closed-ended questionnaires to identify the key elements of asset optimization involved, and then measured the significance level of each element. This survey underpinned the BSC perspectives, being stakeholder, financial, internal process, and learning and growth perspectives. Each perspective incorporates the key elements as the KPIs. These are transformed into four of the BSC perspectives and are used to measure the level of significance of each element. To perform an analysis based on the AHP, there are 18 scales for the AHP question. The type of data from the survey is ordinal. Therefore, the questions were developed from the measurement of the variables (listed in Table 1) from each key element (level 1) and each key performance indicator (level 2). Each is organized as a pairwise comparison between an ordinal data scale from 1 to 9. The scale and degree of preference are stated as 1 (equal), 3 (moderate), 5 (strong), 7 (very strong), and 9 (extremely strong).

<< insert Fig. 2 here >>

This was designed in both web-based and paper-based forms. The web-based survey utilized a specific link to *Key Survey* − consisting of a dashboard and customized content. The type, theme, and number of questions in the paper-based questionnaire are identical to those of the web-based survey. The language of the questionnaire was translated from English to Bahasa Indonesia. We conducted the web-based survey after adjustments made to the questions from feedback from the pilot survey. The questionnaire accommodates the perceptions of people involved in both large metropolitan and medium city situations. We selected Jakarta to represent a large city, more complex in expectations in terms of the quality of buildings where the participants are working and living. Surabaya and Semarang represent the regional situation, where the volume of work is relatively stable compared to Jakarta and distributed among weekdays − which may affect the viewpoints of the key element of optimal land and buildings.

We used purposive sampling, where respondents were selected based on their (1) being in Jakarta, Surabaya, or Semarang; and (2) having a current job position in the organization and role in asset management[1]. These comprise:

*External stakeholders* (ES) including customers or clients − users or people who received benefits and functions of public buildings and have perceptions relating to the performance of the buildings over at least six months, practitioners from the real estate field, with a property view of the market as well as value sense, the highest and best-used assets in their perception, and contribute to deciding the best alternatives in optimizing land and building;

*Internal stakeholders* (IS), referring to employees who are living in the building and have worked inside the building for more than six months;

*Asset or facility managers* (AM) responsible for the maintenance and operation of the building, selected from various levels of DGSAM leaders − the highest represented by *Echelon 2,* middle from

[1] Position level consists of a top, middle, and lower manager, and staff or operators in the government or private sectors. The role in asset management consists of asset authorization, asset optimization advisor, asset operator, and staff. Additionally, role of asset management includes the users of public land and/or buildings. The private sector is composed of property market players as buyers or sellers of land and buildings.

*Echelon 3* (or the head of the operational office or head of sub-directorate), and the lower leaders represented by the head of the section in central, regional, or operational offices; and

*Asset authority* (AA), being responsible for the allocation, procurement, and disposing of government assets for a minimum of six months, and have at least a bachelor's degree.

The profile of the respondent's position corresponds to the optimization strategy and can be defined as follows:

1. The DGSAM is the manager of public assets owned by the central government.
2. Asset managers have responsibility and experience in the key elements of asset optimization because they are involved in the life cycle process of asset management.
3. The DGSAM staff not only have practical knowledge in implementing asset optimization, but also have a role as internal stakeholders − one of the key elements of AOS.
4. Lembaga Management Asset Negara (LMAN) is one of the arms of the DGSAM that has a special duty to implement the public asset optimization program for public lands and buildings (MoF, 2015). Therefore, issues related to asset optimization are highly relevant, either in concept or implementation.
5. The municipal government of Semarang and Surabaya represent the users of public buildings and asset information systems provided by the DGSAM. Semarang is the capital city of Central Java (Indonesia's fifth-largest city after Jakarta, Surabaya, Bandung, and Medan).
6. The *auction* participants are customers of DGSAM's operational offices in the regional area of Kantor Pelayanan Kekayaan Negara dan Lelang (KPKNL). They are real estate agencies, and potential and

previous buyers of state assets placed on auction in KPKNL and provide an opinion as a property market player and as an end-user of public land and buildings.

7. All the participants of the study are familiar with BSC.

We conducted the paper-based survey with such respondents from outside the DGSAM office as the municipal government – as representatives of the government sector (Echelon IV or staff) – and auction participants – as representatives of the private sector (mainly staff). The researcher targeted 131 respondents for the survey; we received 117 online responses and 12 paper based responses. The study included all stakeholders (both internal and external stakeholders) in the survey.

*Analysis*

We processed the AHP using Microsoft Excel, first introduced by Perzina and Ramík (2014) for a single respondent. Although Microsoft Excel subsequently provided a free feature named Decision Analysis Module for Excel (DAME) that allows the users to solve multi-criteria decision problems instantly, DAME requires extra steps for multiple respondents to process each decision maker's opinion. As these are proportional to the number of respondents, we used Microsoft Excel manually. This involves four main steps: (1) calculation of weighted criterion, (2) calculation of weighted alternatives or variants based on the criterion, (3) ranking of alternatives or variants, and (4) improvement of an inconsistent matrix where necessary using the Orcon tool system (Microsoft Excel-based program) to ensure the final CR before further analysis. The value option for pairwise criterion or variants is provided in columns (in scales two to nine) to indicate the higher value is more important, or ½ to 1/9 indicates the criteria in the column is less important than in the row. Here, we use the geometric mean (GEOMEAN) to obtain a single input of the 129 respondents' opinions from the pairwise process.

Upon transformation of the key elements into the BSC perspectives, we used the weighted criterion (key elements) to obtain the level of significance of each key element in contributing to the SOs. This means that each key element has a specific percentage (based on ranking) towards the SOs, which helps in identifying the priority of key elements. Accordingly, the performance measurement of the key elements can be revealed after the key elements are broken down into the KPIs, leading to the calculation of the scorecard. The overall priority of alternatives is obtained by summing the weight of the key elements contributing to the alternatives with respect to the criterion.

Regarding the development of the asset optimization strategy framework, the level of contribution means the level of significance for decision makers to select the highest contribution as the first priority. On the alternative level, the highest-ranking of contribution is the most favorable decision to be chosen, which is to maintain assets efficiently.

## Structuring the hierarchy

As a system, the hierarchy of asset optimization is developed from the subsystem (the key elements of the optimization program). Fig. 3 illustrates the structure of AHP, in which the main goal of asset optimization is optimal asset management (Level 01). Each level of optimal asset management depends on the key elements (Level 02) as the criteria of the optimization program. The adaptation of key elements into the BSC perspectives is grouped into four criteria, including its corresponding sub criteria as shown in Fig. 3.

<< insert Fig. 3 here >>

These criteria (SER, OB, AAA, and CHR) were asked of the respondents, using the 9 scales of the AHP questionnaire. Level 03 consists of several alternatives for asset optimization: namely, to maintain assets efficiently, improve asset performance and value, and utilize assets.

Assigning the weight of the criteria level

This process assigns the weight of the level of criteria (Level 02). The valuation of each criterion is based on the pairwise data. The output of the weighted criteria is in the matrix:

$$K = \begin{bmatrix} k\,(AAA, AAA) & k\,(AAA, OB) & k\,(AAA, CHR) & k\,(AAA, SER) \\ k\,(OB, AAA) & k\,(OB, OB) & k\,(OB, CHR) & k\,(OB, SER) \\ k\,(CHR, AAA) & k\,(CHR, OB) & k\,(CHR, CHR) & k\,(CHR, SER) \\ k\,(SER, AAA) & k\,(SER, OB) & k\,(SER, CHR) & k\,(SER, SER) \end{bmatrix}$$

where, K (AAA,AAA), K (OB, OB)… in yellow = score of comparison between criteria AAA with criteria AAA = 1, OB with OB = 1, and K (OB, AAA) = score of comparison between criteria OB with criteria AAA.

Calculation of the priority weight

There are three calculations involved in weighing the priority as follows.

1. Pairwise comparison in decimals − where there are 4 criteria that means ¼ or 0.25.
2. Calculate the Eigenvalue (EV) by squaring the matrix of criteria, or $\boldsymbol{K}^2$
3. Calculate the weighted priority of criteria (EV=total of EV), which become the weights of the asset optimization alternatives.

Checking for consistency

There are six steps involved in checking if the consistency of the pairwise values was sufficient (Consistency Index (CI) < 10 %) as follows:

1. Calculate the weighted synthesis

   We undertook this by dividing the value of OB, CHR, SER, and EV by the sum of each. The calculation of the Eigen Maximum (X) is undertaken by dividing each value of the weighted synthesis of these with the corresponding value of the weighted priority resulting value of Eigen Maximum (X).

2. Calculate the Consistency Index (CI) and Consistency Ratio (CR)

   $\lambda$ Max is the summation of Eigen Max (X) divided by the number of criteria. CI is the result of $\lambda$ Max deducted by several criteria.

3. Calculate the Consistency Ratio (CR)

   CR is the Consistency Index (CI) divided by the Random Index (RI).

Selecting the best alternative

We gave three alternatives to the respondents:

a. To improve the performance and value of assets
b. To maintain assets efficiently
c. To utilize assets

Based on the structural hierarchy of the asset optimization strategy as shown in Fig. 3, an alternative of asset optimization is placed in Level 03. The pairwise values among the alternatives are set in accordance with each criterion. Therefore, there are three priority weights of alternatives. The calculation of priority of weight of alternative is as follows:

1. Pairwise comparison in decimals − whereby there are 3 alternatives, which means 1/3 or 0.3333.
2. Calculate the Eigenvalue (EV). The EV is the square of matrix or $\boldsymbol{K}^2$. The matrix of alternatives depends on the criteria to which the alternative refers.
3. Calculate the weighted alternative, whereby the formula of the weighted alternative is EV divided by a total of EV.

The last step in selecting the best alternative is the Weighted Alternative of each criterion.

Organization view-based and role view-based implications

There are five main groups of respondent organizations and five roles or positions in their organizations. When we classified the respondents into the organization or group and the role, the order of the key element preferences changed, and they became scattered among the group and role.

**Results**

*Assigning the weight of the criteria level*

Table 2 (columns 2 to 5) provides the result of assigning the criteria level (as a comparison in the matrix).

<< insert Table 2 here >>

*Priority weight*

Table 2 shows the priority weights, with $\boldsymbol{K}^2$ in column (5) and the weighted priority of criteria in column (6). Also shown is the ranking (column 7) and the highest scored criteria (column 6) as Stakeholder Requirement and Natural Environment Fulfilment (SER) with a score of 0.3624. The complete results of the priorities and scores are the following order:

- Ranking 1 SER 0.3624 or 36%
- Ranking 2 CHR 0.2790 or 28%
- Ranking 3 AAA 0.2464 or 26%
- Ranking 4 OB 0.1121 or 11%.

The respondents chose Stakeholder Requirements and Environmental Fulfilment (SER) as the highest factor in asset optimization, with the best alternative for asset optimization being to Maintain Assets Efficiently. The AHP process that applied the data conveyed the research findings as further resources of asset optimization strategy development. The consistency matrix has been resolved through Orcon tool calculation. There are three analyses of data from different deliberations of purposive respondents, organizations of respondents, and roles or positions of respondents. These three analyses suggest the key findings as follows.

- Concerning the number of respondents, there is no significant disparity pertaining to the level of significance of key elements as criteria in developing an asset optimization strategy. This also occurs when weighing the alternative of asset optimization. The number of respondents does not contribute substantially to the final selection of alternatives.
- The respondents' roles or positions and organizations' perspectives contributed **insignificantly** to defining the level of significance of key elements in contributing to the development of asset optimization strategy, as well as in selecting the alternative for asset optimization.
- Each of the key elements has a level of importance in contributing to the strategy development as proposed by respondents. Nonetheless, the disparities of ranking among the categorical respondents explicitly appeared, and most respondents agreed the significant level of key elements and alternatives of asset optimization was in the following order:
  - Ranking 1 (36%): Stakeholder perspective – SER (Stakeholder Requirements and Natural Environment Fulfilment)
  - Ranking 2 (34%): Learning and Growth perspective – CHR (Competitive Human Resources)
  - Ranking 3 (19%): Internal process perspective – AAA (Accountable Asset Administration)
  - Ranking 4 (11%): Financial perspective – OB (Optimal Budget)

The percentage of weighted priority indicates the contribution of key elements to achieve the strategic goal when it turns into the implementation of BSC. None of the respondents selected AAA as the first or fourth important key element in the development of an asset optimization strategy. This emphasizes the importance of AAA compared to OB.

- The priority level has been generated across respondents, with a small dispersion and the proposed best alternative in the following order:
  - Ranking 1 (40%): Maintain asset efficiently
  - Ranking 2 (32%): Improve asset performance and value

- Ranking 3 (28%): Utilize asset

*Checking for consistency*

1. Weighted synthesis:

Each row in Table 2 (column 2 to 5) is divided by the total value of all rows in the same column as shown in Table 3 (column 8 to 11). The weighted synthesis is shown in Table 3 (column 12). The Eigen Maximum (X) in Table 3 column (13) is given by dividing each value of weighted synthesis in column (12) with the corresponding value of weighted priority in column (7).

2. Consistency Index (CI) and Consistency Ratio (CR)

The $\lambda$ Max results are from: 4.7564 + 4.7874 + 4.7822 + 2.6399): 4 = 4.2415; while the CI is 4 divided by the number of criteria minus 1, i.e., ($\lambda$ max - 4): 3 = 0.0805.

3. Consistency Ratio (CR)

The CR is 0, 0, 0.58, and 0.90 for 1, 2, 3, and 4 criteria, respectively. Therefore, CR = 0.0805: 0.9 = 0.0894 or 9%, which means accepted, as the minimum requirement for this is CR<10%.

<< insert Table 3 here >>

*The best alternative*

The EV of the alternatives corresponds to the criteria as shown in column (5) of Table 3, the weighted alternative is shown in column (6) of Table 3, and the Weighted Alternative of each criterion is shown in Table 3. Their matrix values indicate that ‘Improve performance and value’, ‘Maintain asset efficiently’, and ‘Utilize asset’ rank 2, 1, and 3, respectively.

*Organization view-based and role view-based implications*

Table 4 provides the corresponding AHP results by respondent organization, showing Stakeholder Requirement and Environmental Fulfilment (SER) to be the most important key element in asset optimization, with the auction respondents expressed prioritizing Competitive Human Resources (CHR).

<< insert Table 4 here >>

Although the Consistency Ratios are not acceptable except for the DGSAM and auction respondents, our further analysis using Moshkovich and Mechitov’s (2017) ORCON spreadsheet system – designed for such a situation − produced the same prioritization, with Stakeholder Requirement and Environmental Fulfilment (SER) as the most important key element, followed by Competitive Human Resources (CHR), Accountable Administration of Asset (AAA), and finally Optimal Budget (OB). This priority order is different for the 13% of respondents from auction participants, where CHR is the most important element followed by SER.

Table 5 shows the ranking according to the respondents’ role, indicating Stakeholder Requirement and Environmental Fulfilment (SER) is ranked irrespective of role, followed by Competitive Human Resources (CHR), for a large majority of respondents.

<< insert Table 5 here >>

At the global alternative level, the ranking of alternatives was different only when the respondents were grouped based on the role. As Table 6 indicates, there is no convergence perceptions from the alternatives. The roles of respondents contributed to the weighted priority of alternatives. Most respondents from *Echelon 4* (43%) and staff (50%) have dominated the alternatives. Interestingly, these two roles are convergent in the selection of alternatives; consequently, their preferences became the majority’s votes. The first ranking alternative was scattered whereby 94% of respondents selected the option of Maintain Asset Efficiently, while 6% of respondents selected this option as the second ranking. It also occurred in the second ranking when 93% of respondents chose the option of Improve the Performance of Asset and Value, while 6% of respondents chose this option as the first, and the remainder of 1% considered it as the third ranking. The third ranking has been slightly divergent whereby 99% of respondents decided on the option of Utilize Asset but 1% of them favored it as the second-best alternative.

<< insert Table 6 here >>

**Discussion**

The contribution of our result to strategy development is in determining the level of significance of each key element as criteria for a strategy, and priority for an alternative strategy.. When the result is put into the BSC as a strategic tool, the key elements are then transformed into their BSC perspectives:

- Stakeholder or customer perspective element is represented by stakeholder requirements and natural environment fulfilment element (SER)
- Financial perspective was featured in the optimal budget (OB)
- Internal process perspective was described by accountable asset administration (AAA)
- Learning and growth were indicated by competitive human resources elements (CHR)

These key elements in their levels of priority become the weight of the BSC perspectives driven by calculating the KPIs. The alternatives of asset optimization when transformed into BSC become the strategic initiative. Strategic initiatives are the action of the projects to help achieve the goal of the strategy, so the strategy becomes actionable.

SER was composed of the quality and standard of service, rule, and regulation compliance; the public or community interest fulfilment; and natural environment obedience. This means, in optimizing public land and buildings, the awareness of stakeholder interests in most circumstances is important. Stakeholders of organization can be the supplier, governments and agencies, and union employees from which the organizations can draw resources. This also means planning, procurement, improvement, and operation of public land and buildings must be able to fulfil their needs precisely. To do so, the strategy required analysis of stakeholders to manage and identify opportunities to mobilize their support for the achievement of strategic goals (Bryson et al., 2011; Shirey, 2012). It also includes how the organization complies with the current rule and regulation and environmental factors, as some stakeholders create regulations and rules or regulators (Kaufman & Englander, 2011). Nonetheless, some of the regulations might have a certain impact on the assets. For example, prioritizing the SER in strategy in land and building organization may take the alternative strategy to improve the land or buildings in terms of performance and value. Choosing this option tends to raise costs such as cost to obtain permission or codes by using certain materials or building facilities as requested by law (Bocarejo et al., 2013; Kok et al., 2014; Monkkonen & Ronconi, 2013).

Considering this, the improvement of asset performance as part of the improvement in public service is one of the second-highest alternatives of strategy to optimize assets. This linkage contributes to the strategy more effectively due to the strong and direct connection between key elements of strategy and the alternatives.

Maintaining assets of land and buildings efficiently as the highest score of alternative strategy corresponds to the operational and maintenance cost of land and buildings. This strategy connects to financial elements, one of the last priorities based on the AHP process and comply with the stakeholder’s obligations as the first priority of the key element.

**Conclusion**

The Indonesian government uses the BSC for their organization's performance measurement. Therefore, this study highlights the revised BSC key elements which includes the optimization strategy and how to prioritize them to achieve the goal set. In addition, it demonstrates the use of AHP using the BSC elements as the criteria in the AHP hierarchy. In addition, the study shows that the prioritization can include stakeholder views through a pairwise survey using AHP techniques. It also shows that using AHP for prioritization and linking existing BSC elements can be carried out in practice not just in the research domain.

Our analysis concludes the interpretation of significant levels of key elements and alternatives of asset optimization to develop the strategy. This priority was generated from the pairwise amongst the key elements through the implementation of AHP. The analysis of respondents' views in respect to the number of respondents, organizations, and roles or positions of respondents have been employed during this process. The results showed the **convergence of respondents** either in organizations or roles of respondents' angles. This means that the position of the respondent has no significant contribution to perceiving the importance of key elements and alternatives. It confirms that more than 90% of them agreed, and therefore conclusions can be drawn. The most important key element of asset optimization was a Stakeholder Requirement and Natural Environment Fulfilment (SER). Additionally, the best alternative to the strategy of optimization was to Maintain Asset Efficiently.

Our study is limited to using the Balance Scorecard as an existing strategic tool in the Indonesian Ministry of Finance. This paper is part of the larger study that covers the review of the key elements of developing asset optimization strategy. Not included are the detailed sub-elements, which are crucial as components of each key element prioritization process. Finally, the dynamic strategic policies and priorities of the action need to be re-evaluated annually to ensure the main objectives are achieved.

The implications for research are that this study demonstrates the integration of strategic asset management into the general strategic management tools for the organization. It offers a minor adjustment of the existing tools to increase the adoption of government performance management strategies, so it can be used in practice. In terms of the implications for society, the study will improve the strategic management tools in use, which will help government decision making in asset investment to optimize the use of tax or other public money. There is also an indirect impact on society when the government can deliver an optimized service and well-maintained assets. Moreover, the research can be used to influence public policy concerning how to include the stakeholder (including from the bottom-up) to contribute to the prioritization of the organization's performance. The same methodology can be used to integrate asset optimization in organization strategy management in other countries, with minor adjustments related to specific jurisdictions. The criteria can be changed and modified based on the needs or requirements of each organization.

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## Figures and Tables

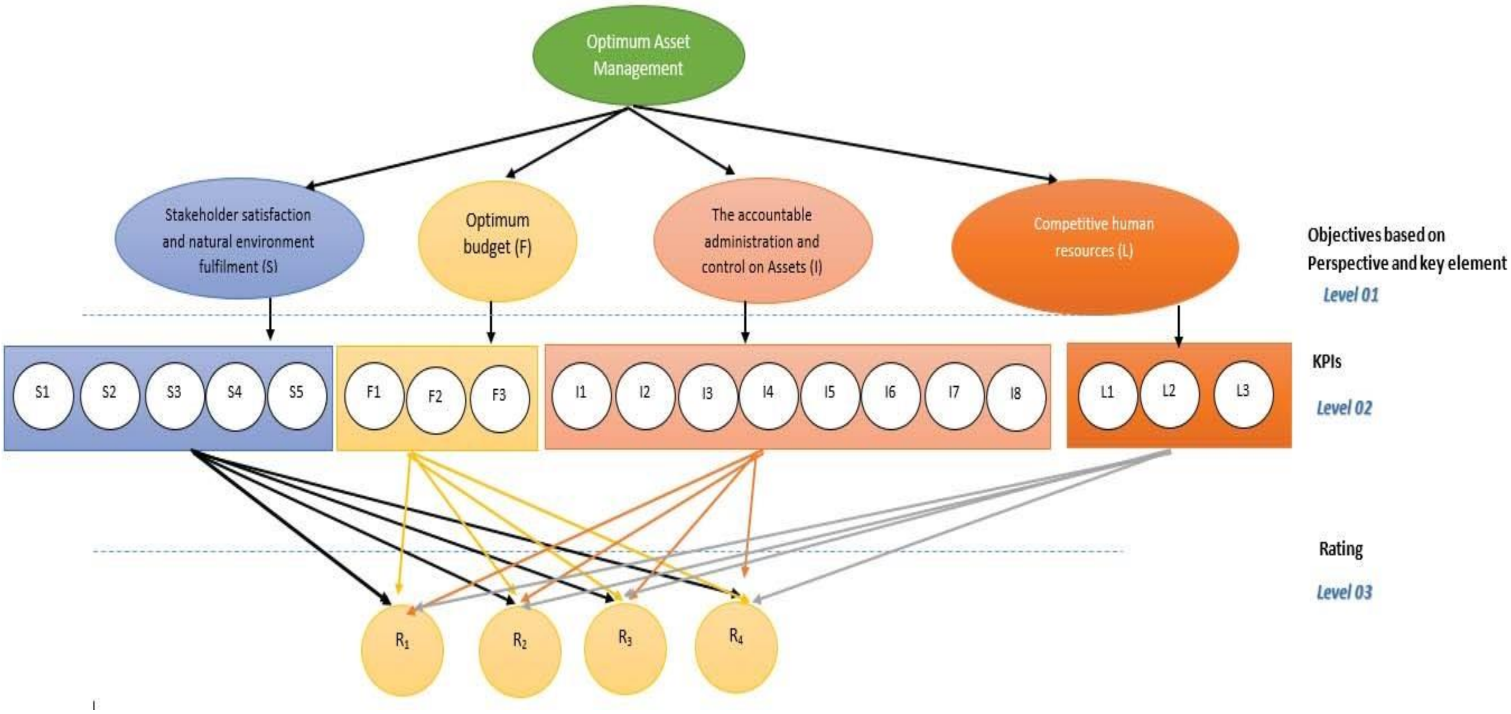


**Fig. 1.** Hierarchy of asset optimization strategy

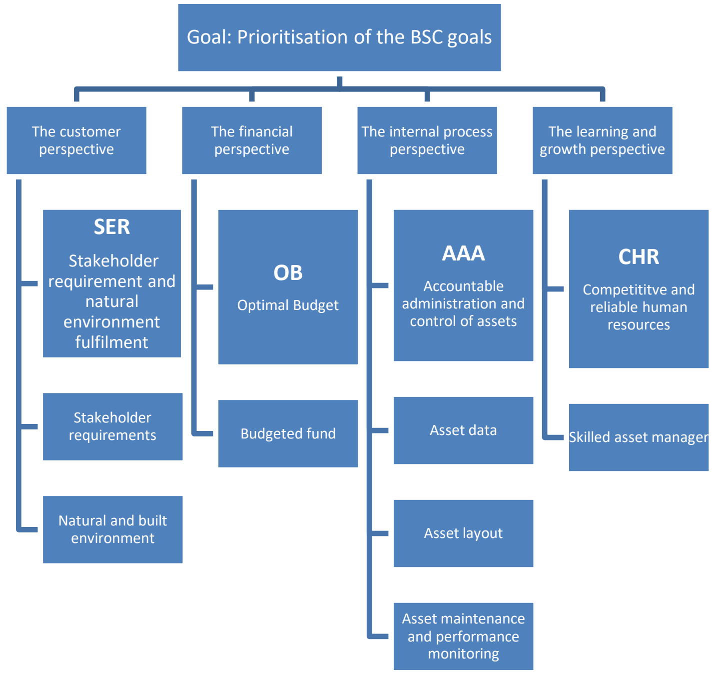


**Fig. 2.** The AHP-BSC model

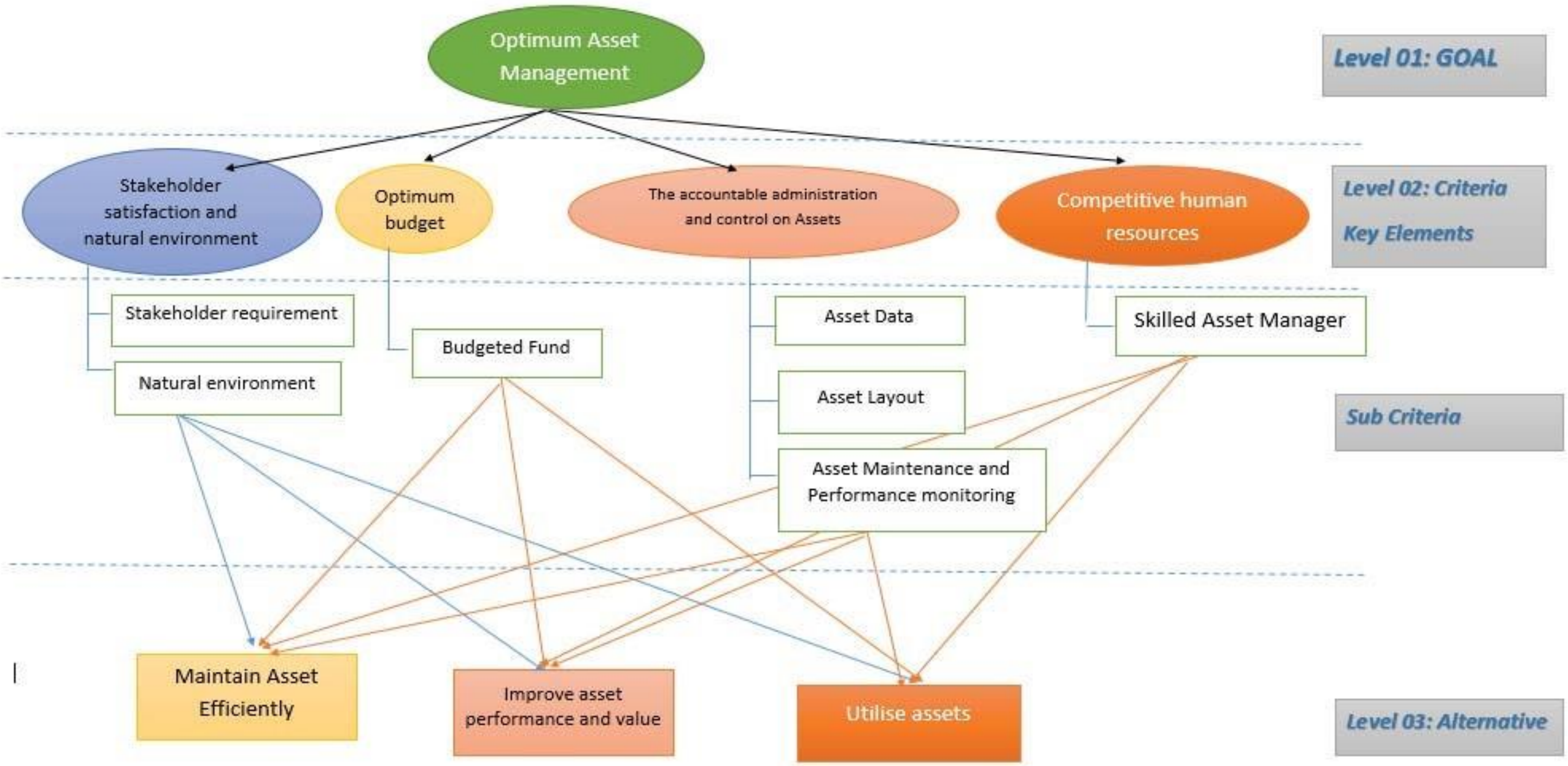


**Fig. 3.** Hierarchical structure of the asset optimization strategy

**Table 1.** Hierarchy in implementing BSC using AHP

| Perspective | SO (level 1) | Key element | Measurement (KPI) (level 2) |
|---|---|---|---|
| Stakeholder | Stakeholder requirement and natural environment fulfilment | Stakeholder requirements | (s1) number of complaints |
| | | | (s2) customer satisfaction index |
| | | Natural and built environment | (s3) compliance indicator |
| | | | (s4) pollution prevention indicator |
| | | | (s5) eco-efficiency indicator |
| Financial | Optimal budget | Budgeted fund | (f1) sum of deviation of the planned budget |
| | | | (f2) percentage of operation and maintenance costs of the total cost |
| | | | (f3) cost-effectiveness ratio |
| Internal process | Accountable administration and control of assets | Asset data | (i1) the availability of basic data |
| | | | (i2) asset classification and function |
| | | | (i3) the up-to-date asset value |
| | | | (i4) legal aspect clearness |
| | | Asset layout | (i5) optimal space of land |
| | | | (i6) optimal space of the building |
| | | Asset maintenance and performance monitoring | (i7) reliable maintenance system |
| | | | (i8) reliable performance monitoring |
| Learning and growth | Competitive and reliable human resources | Skilled asset manager | (l1) improvement of understanding |
| | | | (l2) number of training and certification opportunities |
| | | | (l3) employee satisfaction level |

**Table 2.** Weighted criteria priorities, synthesis, and eigen maximum (X)

| Criterion | AAA | OB | CHR | SER | Eigen value (EV) | Weighted priority | Ranking | AAA | OB | CHR | SER | Weighted synthesis | Eigen max (X) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) = $\boldsymbol{K}^2$ | (6) = EV: Total EV | (7) | (8) = col 2: ∑ col 2 | (9) = col 3: ∑ col 3 | (10) = col 4: ∑ col 4 | (11) = col 5: ∑ col 5 | (12) = (8+9+10+11) | (13) =12: ∑12 |
| AAA | 1.0000 | 1.9822 | 0.8520 | 2.2251 | 1.3923 | 0.2464 | 3 | 0.2111 | 0.2724 | 0.2954 | 0.3931 | 1.1721 | 4.7564 |
| OB | 0.5045 | 1.0000 | 0.2973 | 1.0742 | 0.6336 | 0.1121 | 4 | 0.1065 | 0.1374 | 0.1031 | 0.1898 | 0.5368 | 4.7874 |
| CHR | 1.3493 | 3.3635 | 1.0000 | 1.3613 | 1.5766 | 0.2790 | 2 | 0.2849 | 0.4622 | 0.3468 | 0.2405 | 1.3344 | 4.7822 |
| SER | 1.8823 | 0.9309 | 0.7346 | 1.0000 | 2.0478 | 0.3624 | 1 | 0.3974 | 0.1279 | 0.2547 | 0.1767 | 0.9567 | 2.6399 |
| *Total* | *4.7361* | *7.2766* | *2.8839* | *5.6607* | *5.6502* | *1.0000* | | | | | | | |

**Table 3.** Priority of weight of alternatives

| Criteria | (1) | Improve performance (2) | Maintain asset efficiency (3) | Utilize asset (4) | Eigenvalue (5) | Weighted alternative (6) |
|---|---|---|---|---|---|---|
| AAA | Improve performance and value | 1.0000 | 0.8115 | 1.9129 | 1.1579 | 0.3613 |
| AAA | Maintain asset efficiently | 1.2323 | 1.0000 | 2.4871 | 1.4525 | 0.4532 |
| AAA | Utilize asset | 0.5228 | 0.4021 | 1.0000 | 0.5946 | 0.1855 |
| | *Total* | | | | *3.2050* | |
| OB | Improve performance and value | 1.0000 | 1.0657 | 0.5817 | 0.8527 | 0.2732 |
| OB | Maintain asset efficiently | 0.9383 | 1.0000 | 2.0153 | 1.2366 | 0.3962 |
| OB | Utilize asset | 1.7191 | 0.6393 | 1.0000 | 1.0320 | 0.3306 |
| | *Total* | | | | *3.1212* | |
| CHR | Improve performance and value | 1.0000 | 0.9828 | 0.4903 | 0.7840 | 0.2576 |
| CHR | Maintain asset efficiently | 1.0175 | 1.0000 | 1.5505 | 1.1641 | 0.3825 |
| CHR | Utilize asset | 2.0395 | 0.6449 | 1.0000 | 1.0957 | 0.3600 |
| | *Total* | | | | *3.0438* | |
| SER | Improve performance and value | 1.0000 | 0.9821 | 1.7070 | 1.1879 | 0.3859 |
| SER | Maintain asset efficiently | 1.0182 | 1.0000 | 1.5829 | 1.1725 | 0.3809 |
| SER | Utilize asset | 0.5858 | 0.6317 | 1.0000 | 0.7180 | 0.2332 |
| | *Total* | | | | *3.0784* | |
| | *Alternative* | AAA | OB | CHR | SER | *Matrix value* |
| | Improve performance and value | 0.3613 | 0.2732 | 0.2576 | 0.3859 | 0.3314 |
| | Maintain asset efficiently | 0.4532 | 0.3962 | 0.3825 | 0.3809 | 0.4009 |
| | Utilize asset | 0.1855 | 0.3306 | 0.3600 | 0.2332 | 0.2678 |

**Table 4.** Result of AHP based on organization or respondent group

| Description | Organization/group DGSAM | LMAN | Municipal government | Auction |
|---|---|---|---|---|
| Percentage of respondents (total 229) | 74% | 5% | 8% | 13% |
| 1. Weighted priority of criteria | | | | |
| a. Accountable administration of asset (AAA) | 0.1915 | 0.2542 | 0.1902 | 0.1472 |
| b. Optimal budget (OB) | 0.1119 | 0.0804 | 0.1763 | 0.0715 |
| c. Competitive human resources (CHR) | 0.3415 | 0.2583 | 0.2557 | 0.4320 |
| d. Stakeholder requirements and environmental fulfilment (SER) | 0.3550 | 0.4071 | 0.3779 | 0.3492 |
| 2. Λ max | 4.2816 | 4.3770 | 4.4364 | 4.2617 |
| 3. CI (consistency index) | 0.0939 | 0.1257 | 0.1455 | 0.0872 |
| 4. CR (consistency ratio) | 10% | 14% | 16% | 10% |
| 5. Alternative | | | | |
| a. Improve performance of asset and value | 0.3148 | 0.3126 | 0.3150 | 0.3152 |
| b. Maintain asset efficiently | 0.4100 | 0.3878 | 0.3950 | 0.3832 |

| | | | | |
|---|---|---|---|---|
| c. Utilize assets | 0.2752 | 0.2996 | 0.2900 | 0.3016 |

**Table 5.** Rank of key elements according to the respondents' roles/positions in their respective organizations

| | | Ranking | | | |
|---|---|---|---|---|---|
| A. Accountable administration of asset (AAA) | Weighted priority | 1 | 2 | 3 | 4 |
| Echelon 2 | 0.3121 | | 1% | | |
| Echelon 3 | 0.2746 | | 6% | | |
| Echelon 4 | 0.1804 | | | 43% | |
| Staff/other | 0.1880 | | | 50% | |
| *Total* | *0.9551* | *0%* | *7%* | *93%* | *0%* |
| *Average* | *0.2388* | | | | |
| *Standard deviation* | *0.0649* | | | | |
| | | Ranking | | | |
| B. Optimal budget (OB) | Weighted priority | 1 | 2 | 3 | 4 |
| Echelon 2 | 0.0660 | | | | 1% |
| Echelon 3 | 0.2293 | | | 6% | |
| Echelon 4 | 0.0966 | | | | 43% |
| Staff/other | 0.1098 | | | | 50% |
| *Total* | *0.5017* | *0%* | *0%* | *6%* | *94%* |
| *Average* | *0.1117* | | | | |
| *Standard deviation* | *0.0716* | | | | |
| | | Ranking | | | |
| C. Competitive human resources (CHR) | Weighted priority | 1 | 2 | 3 | 4 |
| Echelon 2 | 0.2625 | | | 1% | |
| Echelon 3 | 0.1615 | | | | 6% |
| Echelon 4 | 0.3609 | | 43% | | |
| Staff/other | 0.3408 | | 50% | | |
| *Total* | *1.1257* | *0%* | *93%* | *1%* | *6%* |
| *Average* | *0.2814* | | | | |
| *Standard deviation* | *0.0905* | | | | |
| | | Ranking | | | |
| D. Stakeholder requirements and environmental fulfilment (SER) | Weighted priority | 1 | 2 | 3 | 4 |
| Echelon 2 | 0.3594 | 1% | | | |
| Echelon 3 | 0.3346 | 6% | | | |
| Echelon 4 | 0.3621 | 43% | | | |
| Staff/other | 0.3614 | 50% | | | |
| *Total* | *1.4175* | *100%* | *0%* | *0%* | *0%* |
| *Average* | *0.3544* | | | | |
| *Standard deviation* | *0.0132* | | | | |

**Table 6.** Distribution of ranking of alternative based on the role/position in organization

| | | Ranking | | |
|---|---|---|---|---|
| A. Improve performance of asset and value | Weighted priority | 1 | 2 | 3 |

| | Weighted priority | 1 | 2 | 3 |
|---|---|---|---|---|
| Echelon 2 | 0.2515 | | | 1% |
| Echelon 3 | 0.4551 | 6% | | |
| Echelon 4 | 0.3150 | | 43% | |
| Staff/other | 0.2985 | | 50% | |
| *Total* | *1.3200* | *6%* | *93%* | *1%* |
| *Average* | *0.3300* | | | |
| *Standard deviation* | *0.0876* | | | |

| B. Maintain asset efficiently | Weighted priority | Ranking | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| Echelon 2 | 0.4201 | 1% | | |
| Echelon 3 | 0.3348 | | 6% | |
| Echelon 4 | 0.3950 | 43% | | |
| Staff/other | 0.4392 | 50% | | |
| *Total* | *1.5891* | *94%* | *6%* | *0%* |
| *Average* | *0.3973* | | | |
| *Standard deviation* | *0.0454* | | | |

| C. Utilize assets | Weighted priority | Ranking | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| Echelon 2 | 0.3284 | | 1% | |
| Echelon 3 | 0.2101 | | | 6% |
| Echelon 4 | 0.2900 | | | 43% |
| Staff/other | 0.2624 | | | 50% |
| *Total* | *1.0909* | *0%* | *1%* | *99%* |
| *Average* | *0.2727* | | | |
| *Standard deviation* | *0.0498* | | | |