# Analysis of Solid Waste Management and Strategies for Bangkok Metropolitan

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**ABSTRACT**

This study aimed to examine and analyze strategic gaps and the environment of waste management of Bangkok Metropolitan Administration (BMA) in order to suggest suitable waste management strategies for Bangkok Metropolitan. The study was conducted by interviewing BMA and districts' administrators and officers, local leaders and people, and private sectors, conducting a focus group, as well as reviewing relevant documents. The data was analyzed by applying Gap analysis and SWOT analysis. The proposed five strategies are: 1) enhancement of efficiency in solid waste and hazardous waste management; 2) discipline, participation and responsibility of citizens and all sectors related to waste management; 3) appropriate and integrated waste management; 4) capacity building for BMA's staff and improvement of solid waste management system; and 5) research and development of knowledge and technology in waste management. The study also suggested driving approaches for effective implementation of the strategies.

## 1. INTRODUCTION

Solid waste problem has been considered a prime environmental concern in Thailand. In 2013, Pollution Control Department (PCD) examined the amount of solid waste nationwide and found a significant increase of solid waste accumulation. This crisis is a major national issue which is needed to be solved urgently (PCD, 2014). The waste generation rate in Bangkok is about 1.46-1.66 kg/person/day (DEBMA, 2012). Municipal solid waste collection and disposal in Bangkok Metropolitan have exhibited noticeable improvements compared to other areas in Thailand, though more effort is required (Chiemchaisri et al., 2006). BMA's waste management is still far from successful. For example, BMA has not yet applied the Polluter Pays Principle (PPP) to waste management. Thus, Bangkok is responsible for almost the entire costs, which is quite immense, causing a shortage of budget for improving the management (DEBMA, 2012). In contrast, most developed countries, such as Japan, USA and Europe, have included the PPP into the environmental policy as incentive and to improve awareness of the residents and entrepreneurs towards the environment (Larson, 2005). Fortunately, in 2014 the National Council for Peace and Order (NCPO) has considered waste management as one of the national agendas that needs instant solutions. It then stipulated a roadmap for solid waste and hazardous waste management and asked the provincial governors, local authorities and private sector to work according to this roadmap for solving the problem of existing waste dumping sites through reducing new waste and separating waste at source, using mixed-technology in disposal, transforming waste to energy, and encouraging private sector's role in the management (PCD, 2014).

Improvement of waste management for Bangkok metropolitan requires a close examination of the problems of waste management and an analysis of the circumstances of waste management of BMA. Hence, this study aimed to analyze the strategic gaps in solid waste management and the internal and external environment of the BMA's management. In addition, this research suggested some appropriate strategies for BMA's waste management to achieve maximum effectiveness which is one of the vital conditions that helps make Bangkok a metropolis with the vision of "Livable and Sustainable City".

## 2. METHODOLOGY

### 2.1 Data collection methods

This study used both primary and secondary data collection methods as follows:

*2.1.1* Primary data was collected through structured interviews with key informants which could be classified into 3 groups based on the triangulation method of data sources-government officers, community leaders and local people, and private sector as shown in Table 1.

*2.1.2* Secondary data was taken from documents and reports related to BMA's waste management such as the BMA's waste policies and plans, the BMA administration's master plan, the state of environment reports, environmental laws and regulations, and relevant researches on BMA's waste management.

**Table 1.** Key informants of this study

| Key informants | | Number (person) | Rationale |
|---|---|---|---|
| Government officers | 1) Acting Director of the Department of Environment BMA (DEBMA) | 1 | They were responsible for BMA's waste management, including formulation and analysis of policy, strategies and plans. |
| | 2) BMA's district administrators and officers<br>- Chatuchack district office<br>- Suan Luang district office<br>- Laksi district office<br>- Ladprao district office | 8 | - Chatuchack district office had a project of waste management with good support from a private organization. The project received award as a model of waste management.<br>- Suan Luang district was selected for a pilot district in implementing the Roadmap of solid waste and hazardous waste management by DEBMA.<br>- Laksi district office also received the award as a model of waste management from the BMA.<br>- Ladprao district was awarded as a model of waste recycle bank. |
| Community leaders and local people | 1) Urban Community (Samitthichot) | 2 | There were 5 types of local communities in Bangkok. Each type had different social and physical environments which may affect the residents' behaviors about waste management operations. |
| | 2) Crowded Community (Wat Park Bor and Suan Park) | 4 | |
| | 3) Housing Community (Kea Ha Tung Song Hong 320) | 2 | |
| | 4) Gated Community (Cheun Gamon Nivage 1 Village) | 2 | |
| | 5) Suburban Communities (Ban Ma Kor Lang) | 2 | |
| Private organizations | 1) Director of Best Care International | 1 | The private organization that supported and was helpful to BMA's waste management. |
| | 2) Director of Shinawatra Tower 3 | 1 | The private organization that participated in the BMA's waste management projects. |

### 2.2 Data analysis

The data were analyzed by content analysis method. The data were initially analyzed to find the potential gaps by Gap analysis, and then by SWOT analysis which consists of the analyses of internal and external factors. The results from SWOT analysis were confirmed by a focus group discussion with around 80 participants comprising of local leaders and local people from various BMA's districts. The participants were selected from the local leaders and local people who were actively involved in BMA's waste management. Subsequently, the results from those analyses were used for the formulation of waste management strategies for Bangkok metropolitan.

*2.2.1 Gap analysis*

As explained by Hoberg et al. (2016), the Gap analysis is a technique used to understand how effectively governments respond to challenges and identify potential gaps and opportunities. This study compared BMA's existing management with the Roadmap of solid waste and hazardous waste management approved by the National Council for Peace and Order in 2014 (NCPO, 2014). This included: 1) disposal of waste accumulation in the crisis areas (old waste); 2) build up appropriate models of solid waste and hazardous waste management (new waste); 3) stipulate regulations and measures for solid waste and hazardous waste; and 4) build up people's discipline for sustainable management. However, this study focused solely on general solid waste generated from communities in Bangkok, excluding the hazardous waste.

*2.2.2 SWOT analysis*

The SWOT analysis technique is a tool for assessing the environment or context of an organization. In this study, the SWOT analysis was used for the analysis of the environment of waste management of Bangkok Metropolitan Administration (BMA) consisting of internal factors (strengths and weaknesses) which are: 1) policies and plans; 2) management; 3) budget; 4) personnel; and 5) equipment and technology; and external factors (opportunities and threats) which are: 1) area conditions; 2) society and culture; 3) political conditions; 4) technology; 5) community participation; and 6) cooperation of public and private sectors.

*2.2.3 Formulation of the strategies*

The results of Gap analysis and SWOT analysis were employed as the basis for formulation of the solid waste management policy for the BMA. In addition, the 4 perspectives of the Balanced Scorecard (BSC) were adopted as a framework of the proposed strategies. The 4 perspectives which are modified for the management of government and local authorities comprise of: 1) effectiveness; 2) target groups; 3) management process; and 4) learning and development (Poboon, 2016).

## 3. RESULTS AND DISCUSSION

### 3.1 Gap analysis

Gap analysis of waste management for Bangkok Metropolitan was conducted by a comparison of existing BMA's waste management with the roadmap of solid waste and hazardous waste management approved by the NCPO in 2014. Table 2 indicated opinions of the key informants on gaps/needs of BMA's solid waste management. The analysis subsequently indicated the gaps and needs of BMA's solid waste management as summarized in Table 3. The results were employed as a fundamental information for suggestion of the strategies.

**Table 2.** Opinions of key informants on the gaps/needs of BMA's waste management

| Key informants | Opinions on gaps/needs | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4.1 Old waste | | 4.2 New waste | | 4.3 Stipulate regulations and measures | | 4.4 Build up people's discipline | |
| | Gaps | Needs | Gaps | Needs | Gaps | Needs | Gaps | Needs |
| DEBMA | | | | | | | | |
| 1. Acting director of DEBMA | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2. A policy and plan analyst of the DEBMA | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Heads and specialists of Cleansing and Parks Divisions of district office | | | | | | | | |
| 3. Head of Suan Luang district office | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 4. Specialist of Suan Luang district office | | | ✓ | ✓ | ✓ | | ✓ | ✓ |
| 5. Head of Chatuchak district office | | | ✓ | ✓ | | ✓ | ✓ | ✓ |

**Table 2.** Opinions of key informants on the gaps/needs of BMA's waste management (cont.)

| Key informants | Opinions on gaps/needs | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4.1 Old waste | | 4.2 New waste | | 4.3 Stipulate regulations and measures | | 4.4 Build up people's discipline | |
| | Gaps | Needs | Gaps | Needs | Gaps | Needs | Gaps | Needs |
| 6. A specialist of Chatuchak district office | | | ✓ | ✓ | ✓ | | ✓ | ✓ |
| 7. Head of Ladprao district office | | | ✓ | ✓ | ✓ | | ✓ | ✓ |
| 8. A Specialist of Ladprao district office | | | ✓ | | | | ✓ | ✓ |
| 9. Head of Laksi district office | ✓ | | ✓ | | ✓ | ✓ | ✓ | ✓ |
| 10. A Specialist of Laksi district office | | | ✓ | | ✓ | | ✓ | ✓ |

**Table 3.** Summary of the results of Gap analysis of BMA's waste management

| Principles | Gaps | Needs |
|---|---|---|
| 1. Disposal of waste accumulation in the crisis areas (Old waste; the wastes were in the old landfill sites that could be closed or restored and isn't operated.) | There was no problem of waste accumulation at waste-disposal sites and no open-dumping in Bangkok. BMA did not have plan to improve the existing landfills. | - Measures to prevent waste accumulation that might occur from improper operation of the private contractors or an emergency situation e.g. flooding.<br>- Improving the existing disposal sites by applying better and more appropriate technologies. |
| 2. Build up appropriate models of solid waste and hazardous waste management (New waste; the wastes were managed at currently used landfill sites from the households every day. | Public campaigns regarding waste management have not reached local people thoroughly. | - All BMA offices encourage all sectors to practice in waste reduction and segregation and they themselves practice as good examples for the others.<br>- Scheduling time for waste collection on every route and informing public thoroughly.<br>- Apply the integrated waste management and converting solid waste into energy instead of disposing in landfill. |
| 3. Stipulate regulations and measures for solid waste and hazardous waste | The fee collection has not been effectively practiced. The collected revenues are very minimal compared to the costs. | - Issue local regulations for waste classification and littering of hazardous waste with general waste is strictly forbidden.<br>- Reforming the regulations on solid waste collection fees and disposal fees in line with the new laws and improve fee collection system as well as law enforcement. |

**Table 3.** Summary of the results of Gap analysis of BMA's waste management (cont.)

| Principles | Gaps | Needs |
|---|---|---|
| 4. Build up people's discipline for sustainable management | BMA has enhanced people's awareness on the value of sorting out the reusable and recyclable components of the solid waste through public relations and various medias, but still not comprehensive enough. | - Producing result-driven public relations through media to all parties thoroughly regarding waste separation with 3R principle such as television and social media.<br>- Educating and raising awareness of people, particularly children, on the importance of waste management and how to practice it. Establishing courses about sustainable waste management in schools.<br>- Cooperation from local people in monitoring the wrong behavior of individual or illegal practices of business in waste littering and disposal. |

### 3.2 SWOT analysis

To find the way out of these problems it is necessary to understand clearly about the environment of existing BMA's waste management. The environment of BMA's waste management can be analyzed by adopting the SWOT analysis which consists of internal and external environment analyses. The opinions of key informants towards the internal and external environment of BMA's waste management are shown in Table 4 and Table 5.

The analysis of internal environment found that the strengths of BMA's waste management were clear policy and plans as well as a concrete structure of waste management. The weaknesses consisted of budget, personnel, and equipment and technology. The past and present budget management had raised some questions about budget transparency in purchasing and making contracts that diminished the public confidence towards the BMA. For the personnel, the weakness was insufficient manpower with specialized knowledge. In addition, outdated and insufficient equipment and technology was also a significant weakness in waste management.

From Table 5, the opportunities of BMA's waste management were political conditions that support the BMA' waste management, communities' participation, and cooperation from other public agencies and private sector. However, there were some threats such as limitation of the area available for waste disposal, diversified awareness and responsibility among local residents, as well as a minimal cooperation from a majority of the communities.

### 3.3 Strategies of waste management for Bangkok metropolitan

Based on the Gap analysis which compared the BMA's existing waste management with the roadmap of solid waste and hazardous waste management approved by the NCPO on 26$^{th}$ August 2014, as well as the results of the SWOT analysis which focused on the environment of BMA's waste management, the 5 strategies for BMA's waste management for Bangkok metropolitan are proposed within the BSC framework to yield sustainable outcomes to Bangkok as discussed below:

**Table 4.** Opinions of key informants on the internal environment of BMA's waste management

| Interviewees | Policies and plans | | Management | | Budget | | Personnel | | Equipment and technology | |
|---|---|---|---|---|---|---|---|---|---|---|
| | S* | W* | S | W | S | W | S | W | S | W |
| DEBMA | | | | | | | | | | |
| 1. Acting Director of DEBMA | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2. A policy and plan analyst of the DEBMA | ✓ | | ✓ | | ✓ | ✓ | | ✓ | ✓ | |
| Heads and specialists of cleansing and parks divisions of district office | | | | | | | | | | |
| 3. Head of Suan Luang district office | ✓ | | | | | | ✓ | | ✓ | |
| 4. A Specialist of Suan Luang district office | ✓ | | | | | ✓ | ✓ | | | |
| 5. Head of Chatuchak district office | | | ✓ | | | ✓ | | ✓ | | ✓ |
| 6. A Specialist of Chatuchak district office | | ✓ | | | | ✓ | | ✓ | ✓ | ✓ |
| 7. Head of Ladprao district office | ✓ | | | | | ✓ | ✓ | ✓ | | ✓ |
| 8. A Specialist of Ladprao district office | ✓ | | | | | ✓ | | ✓ | ✓ | ✓ |
| 9. Head of Laksi district office | ✓ | | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ |
| 10. A Specialist of Laksi district office | | | | | | ✓ | | ✓ | | ✓ |
| Community leaders and people | | | | | | | | | | |
| 11. Leader of Samitthichot Community | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | |
| 12. People of Samitthichot Community | | ✓ | | ✓ | | | | ✓ | | |
| 13. Leader of Wat Park Bor Community | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | |
| 14. People of Wat Park Bor Community | ✓ | | ✓ | | | | | ✓ | | |
| 15. Leader of Suan Park Community | ✓ | | | ✓ | | | | ✓ | ✓ | |
| 16. People of Suan Park Community | ✓ | | | ✓ | | | | ✓ | ✓ | |
| 17. Leader of Kea Ha Tung Song Hong 320 | ✓ | | ✓ | | ✓ | ✓ | | | | |
| 18. People of Kea Ha Tung Song Hong 320 | | | ✓ | | ✓ | ✓ | | | | |
| 19. Leader of Cheun Gamon Nivage 1 Village | ✓ | | ✓ | | | | ✓ | ✓ | | |
| 20. People of Cheun Gamon Nivage 1 Village | ✓ | | ✓ | | | | | | | |
| 21. Leader of Ban Ma Kor Lang Community | | | | | | | | ✓ | | |
| 22. People of Ban Ma Kor Lang Community | | | | | | | ✓ | ✓ | | |
| 23. A focus group | ✓ | ✓ | ✓ | | | ✓ | | ✓ | | ✓ |
| Private organizations | | | | | | | | | | |
| 24. Director of Best Care International | ✓ | | | | | ✓ | | ✓ | | |
| 25. Director of Shinawatra Tower 3 | ✓ | | | | | | | ✓ | | |

* S=Strengths, W=Weaknesses

**Table 5.** Opinions of key informants on external environment of BMA's waste management

| Interviewees | Area conditions | | Society and culture | | Political conditions | | Technology | | Communities' cooperation | | Cooperation from other public agencies | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | O* | T* | O | T | O | T | O | T | O | T | O | T |
| DEBMA | | | | | | | | | | | | |
| 1. Deputy Director of DEBMA | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2. A policy and plan analyst of the DEBMA | ✓ | | ✓ | | | | ✓ | | ✓ | | ✓ | |
| Heads and specialists of cleansing and parks divisions of district office | | | | | | | | | | | | |
| 3. Head of Suan Luang district office | ✓ | | | ✓ | | | | ✓ | | ✓ | ✓ | |
| 4. A Specialist of Suan Luang district office | ✓ | | | | | | | ✓ | | ✓ | | |
| 5. Head of Chatuchak district office | | | | ✓ | ✓ | | | ✓ | | ✓ | ✓ | ✓ |
| 6. A Specialist of Chatuchak district office | | | | | ✓ | | ✓ | | ✓ | ✓ | | |
| 7. Head of Ladprao district office | ✓ | | | | | | | ✓ | ✓ | ✓ | | |
| 8. A Specialist of Ladprao district office | ✓ | | | | | | | | ✓ | ✓ | | |
| 9. Head of Laksi district office | ✓ | | | | ✓ | | ✓ | ✓ | | ✓ | | |
| 10. A Specialist of Laksi district office | | | | | | | | ✓ | ✓ | ✓ | | |
| Community leaders and people | | | | | | | | | | | | |
| 11. Leader of Samitthichot Community | | ✓ | ✓ | ✓ | | | | | ✓ | ✓ | ✓ | |
| 12. People of Samitthichot Community | | ✓ | ✓ | ✓ | | | | | ✓ | | | |
| 13. Leader of Wat Park Bor Community | | | | ✓ | ✓ | | | | ✓ | ✓ | | |
| 14. People of Wat Park Bor Community | | | | ✓ | ✓ | | | | ✓ | | | |
| 15. Leader of Suan Park Community | | | | | | | | | ✓ | ✓ | ✓ | |
| 16. People of Suan Park Community | | | | | | | | | ✓ | | ✓ | |
| 17. Leader of Kea Ha Tung Song Hong 320 | ✓ | ✓ | ✓ | | | | | | ✓ | | | |
| 18. People of Kea Ha Tung Song Hong 320 | ✓ | | | | | | | | | ✓ | | |
| 19. Leader of Cheun Gamon Nivage 1 Village | | ✓ | | ✓ | | | | | ✓ | ✓ | | |
| 20. People of Cheun Gamon Nivage 1 Village | | ✓ | | | | | | | ✓ | | | |
| 21. Leader of Ban Ma Kor Lang Community | | | | ✓ | | | | ✓ | ✓ | | | |
| 22. People of Ban Ma Kor Lang Community | | | | ✓ | | | ✓ | ✓ | ✓ | | | |
| 23. A focus group | | | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Private organizations | | | | | | | | | | | | |
| 24. Director of Best Care International | | | | | ✓ | ✓ | | | | ✓ | ✓ | ✓ |
| 25. Director of Shinawatra Tower 3 | | | | | | | | | | ✓ | ✓ | |

* O=Opportunities, T=Threats

*3.3.1 Strategy 1: enhancement of efficiency in solid waste and hazardous waste management*

This strategy focuses on enhancing the efficiency of waste separation, collection, transportation and disposal. Waste separation is one of the key factors affecting the reduction of waste quantity that needed to be collected, transported and disposed. Awareness raising, behavior improving and consumption value should be promoted for the reduction and segregation of general waste, hazardous waste and electronic waste at sources as Buttol et al. ( 2007) observed "the promotion of recycling and recovery due to increasing environmental pressure and decreasing landfill capacity, prevention of municipal solid waste and promoting reuse, recycle and recovery are becoming more popular". In Singapore, the goal of waste management is to establish a sound material recycling society through the "3Rs" (reduce, reuse, and recycle) (Dongqing et al., 2010). The improvement of waste collection and appropriate methods of transportation for each type of waste, and improvement of the performance of integrated waste management with technologies can help manage waste more effectively. In addition, the study of Mesjasz-Lech (2014) suggested that "in order to build an effective waste management system, it is necessary to understand the scale of the municipal waste problem".

Furthermore, there is a strategy for promoting the use of new technologies in municipal waste collection, disposal and value-added utilization of waste, including adopting waste-to-energy technologies from the countries that have successfully used these technologies. The enhancement of municipal solid waste management will additionally bring clients and all stakeholders' satisfaction. As Matsuto (2014) noted "the world has adopted common goals in the area of waste management: reduction of the duration of landfill aftercare, and the recovery of energy and resources, all with the aim of achieving a universal concept of waste management". This strategy is also in accordance with the road map of solid waste and hazardous waste management approved by the NCPO with the first objective to get rid of accumulated waste in disposal sites in the crisis areas (PCD, 2014).

*3.3.2 Strategy 2: discipline, participation and responsibility of citizens and all sectors related to waste management*

This strategy emphasizes the importance of the discipline, participation and responsibilities of all sectors-government sector, private sector and the people. This strategy is in line with the NCPO's road map on building the citizen's discipline towards sustainable management because all relevant sectors have to take responsibilities for the solid waste management (PCD, 2014). Akintoye et al. (1998) stated that waste issues are not a wholly government-owned and operated responsibility, but the entire society referring to Public-Private Partnership principle which necessitates the responsibilities between public and private sectors. This mentioned theory should be followed with the use of basic form of pay-as-you-throw charging arrangements so that business sector can become a significant player in the waste management system.

The strategy is also consistent with the study of Luan Ong and Sovacool (2012) which found that in Singapore, the campaign sought to educate men and women, children and teachers, employers and employees on the importance of not littering the streets, drains and public places. There was a sustained and extensive coverage of campaign activities throughout the month through cooperation of the mass media. In order to get the public onboard, training and educational programs need to be undertaken to educate the public about their role in the process. In Japan, schools take active role in educating school children on the proper separation and disposal of waste. Beside the comprehendsiveness of environment education, all the schools (from elementary to junior-high schools) incurporate cleaning as part of daily school activities, plus separation of waste.

Sustainable management of household solid waste is a challenging task. The central purpose is a shift in the public's behavior in order to minimize the volume of their waste combined with an increase in recycling. For this purpose, several policy instruments have been proposed based on different incentives (Dowie et al., 1998; Seadon, 2006). In terms of public role, community networks can be built to raise awareness and contribute knowledge of preventing the generation of waste in the first place.

It was recognized very early in the regional solid waste management project cycle that the involvement of the people was necessary for project success. People can join a committee to monitor and oversee the work of the government and relevant private sectors and report waste crime accordingly. In addition, Luan Ong and Sovacool (2012) noted "in Japan, Yokohama has fines for individuals caught throwing rubbish away improperly, interview respondents indicated that there was 'hardly any need for enforcement action from the government' because the city has 'very strong community monitoring' that deters people from doing inconsiderate acts". This is one of the key elements to ensure the operations pulling in the same direction and providing net benefits as well as showing fairness to all different tiers in the community.

*3.3.3 Strategy 3: appropriate methods for integrated waste management*

Integration of waste management is discussed in this strategy through designing and implementing an inclusive public education and information management. Waste management planning is drawn by relevant stakeholders-followed by supervision missions and monitoring to make adjustments and achieve goals. It was found that the factors affecting the success of waste management project consists of knowledge factor, the understanding of solid waste such as policies and objectives towards waste management (Dos Muchangos et al., 2015), knowledge about segregated or specialized collection, public participation (Li and Yang, 2014), the ability of the organizations, collaboration from other departments, as well as the monitoring and the evaluation. More broadly, when defects are discovered in implementation process, it should always be diagnosed and developed until the final plan. It should be the case that the entire process is impartial, transparent and can be inspected both internally and externally in order to create high-reliability and be accepted by the society.

To obtain a practical achievement, laws and legislations should be revised associated with the road map of solid waste and hazardous waste management approved by the National Council for Peace and Order on regulating measures of solid waste and hazardous waste management and be imposed by giving more serious sentence to offenders. The incentives provided in order for citizens to comply and cooperate with these environmental policies may differ significantly. Command and control instruments are mainly based on the level of control that exists in a community along with environmental awareness. Examples of such tools are waste regulations, including legislation for the public and industry (Bai and Sutanto, 2002; Stafford, 2002; Slack et al., 2009).

The Polluters Pay Principle: PPP should be taken into consideration to allow for all stakeholders' involvement in waste management. The feasibility study of suppliers shall be obligated to costs accounting for waste management. Additionally, the feasibility study of collecting revenues should be suitable to costs of municipal waste management. Consistent with studies of Luppi et al. (2012), the polluter-pays principle stipulates that the person who damages the environment must bear the cost of such damage. A number of developing countries have recently extended this principle to create an obligation on the state to compensate the victims of environmental harm. This variation of the polluter-pays principle is aimed at ensuring victims' compensation when polluters cannot be identified or are insolvent and at providing stronger incentives for local governments' monitoring of environmentally risky activities. These underlying methods are tools that contribute to the success.

*3.3.4 Strategy 4: the potential development of Bangkok metropolitan in solid waste management*

This strategy aims at the capacity development of Bangkok officials by means of knowledge and skills distribution as well as building positive behaviors and attitudes. In order to manage municipal solid waste effectively it is essential to provide training, activities, and study trips both domestically and internationally to adopt new concepts in a certain social context of Bangkok. The human capital theory provides a theoretical basis for understanding the individual approach to career success. As Hassan (2007) indicated "the individuals who invest the most in human capital attributes such as education, training, and experience are expected to show higher level of work performance and subsequently obtain higher organizational rewards". Human capital, therefore, is a significant factor that helps improve waste

management of Bangkok to be more productive and help drive sustainable development. For reasons of the convenience and cost saving, new alternative technologies such as information technology have been attuned to improve the performance of personnel. This is also in accordance with the study of Wang et al. (2015) that found information technology (IT) can be the problem and solution for environmental sustainability. While IT is a source of environmental contamination during manufacturing and disposal, IT also presents opportunities for firms to greening IT and/or increasing their efficiency of resource use. IT influences environmental performance by enabling the integration of IT in environmental management processes. Firstly, firm's proficiency in leveraging IT technical infrastructure flexibility, IT personnel skills and IT-business alignment enables the integration of IT in the environmental management processes to improve environmental performance, and secondly, this IT integration is stronger when the firm is more oriented to environmental sustainability.

*3.3.5 Strategy 5: researching and developing knowledge and technology in waste management*

Good research and innovation brings added value to existing processes, products and services while generating prosperity and improving overall quality of life (NSTDA, 2011). Thus, it is consistent with the strategic planning in strategy 5 by highlighting the significance of relevant research related to waste management either inbounds or outbound stream. It will lead to a series of a wide range of information and new innovative technologies that can be adopted where current practices are acceptable and ameliorating problems encountered in a safe and efficient manner. The proposed strategies were prioritized by considering their urgency and importance as shown in Table 6. In addition, the overall linkages among the Gap analysis, the SWOT analysis and the strategies are shown in Figure 1.

**Table 6.** Prioritization of the strategies

| Prioritization | Strategies | Rationale |
|---|---|---|
| Urgent & very Important (Do it now with sufficient allocation of resources) | - Strategy 1 Enhancement of efficiency in solid waste and hazardous waste management | - The enhancement of efficiency in BMA's waste management is important and urgent because of the current BMA's waste management has a lot of problems. If the problems are not solved immediately, there will be serious impact on the society and the environment as well as the BMA's financial system. |
| | - Strategy 2 Discipline, participation and responsibility of citizens and all sectors related to waste management | - The root causes of BMA's waste management problems are the lack of discipline, participation and responsibility from the residents. Hence, to resolve the problems, BMA need to implement this strategy seriously and thoroughly. |
| Important but not urgent (Do it at appropriate time and with appropriate resources) | - Strategy 4 The potential development of Bangkok Metropolitan in solid waste management<br>- Strategy 5 Researching and developing knowledge and technology in waste management<br>- Strategy 3 Appropriate methods for integrated waste management | - These 3 strategies are also important but they need time to implement to yield sustainable results for the management of waste in Bangkok. |

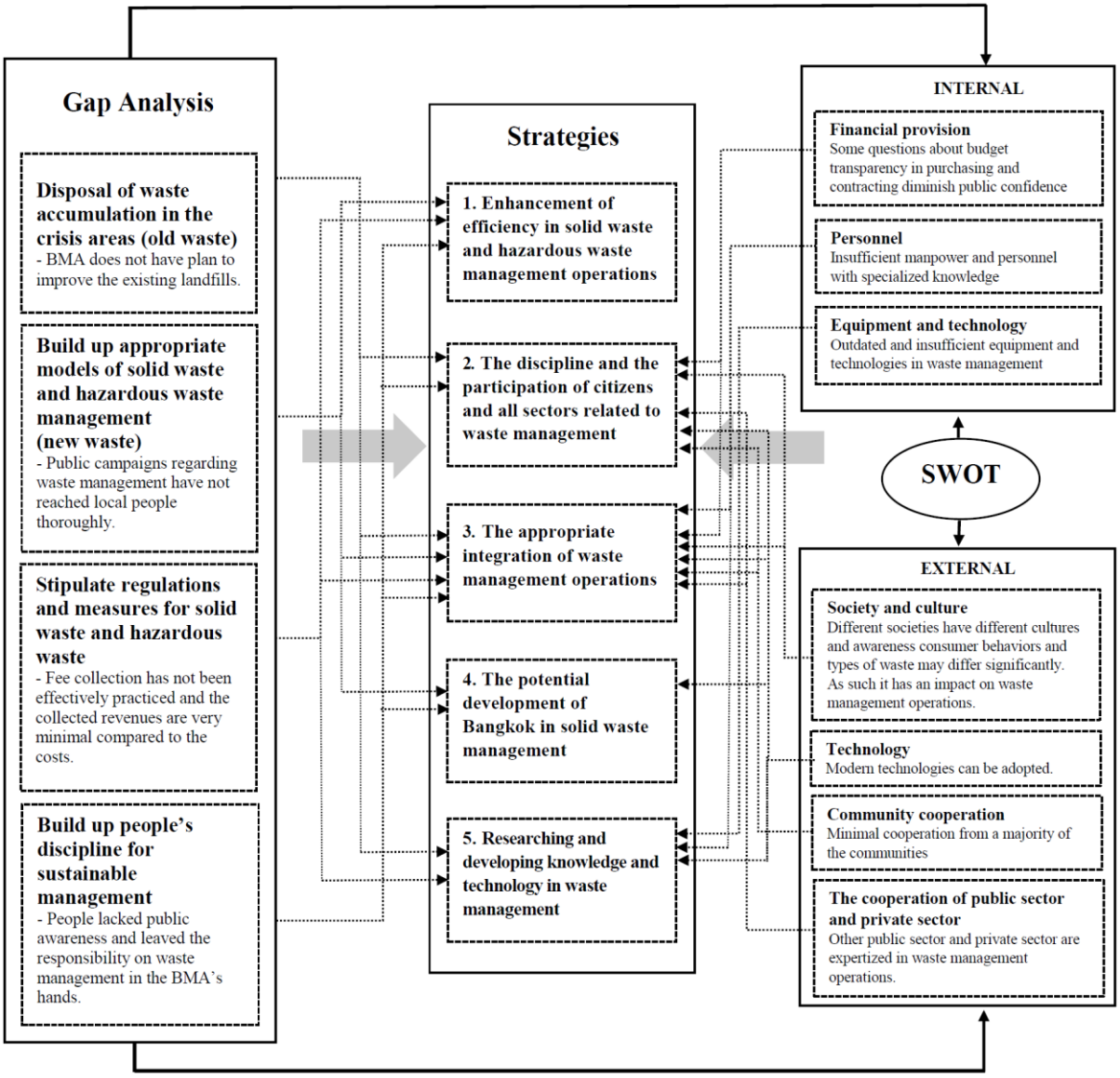


**Figure 1.** Linkages among the Gap analysis, the SWOT analysis and the strategies of waste management for BMA

## 4. CONCLUSIONS

Based on Gap analysis and SWOT analysis, this study proposed 5 strategies for strengthening BMA's waste management performance. The study believes that if all of these strategies are adopted by BMA's and the stakeholders, the BMA's performance on waste management would be very much improved and could lead to a much more sustainable development of Bangkok. In addition, to drive the execution of strategic initiatives into successful implementation, the BMA's administrators and staff should pay high attention to: 1) the significance of solid waste management issues; 2) the effective structure and function of responsible units and personnel at city, district and community level; 3) sufficient allocation of budget and resources for waste management; and 4) the inclusiveness of the locals and all stakeholders in all steps of the management.

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