



## Needs for more Effective Municipal Solid Waste Management Planning System of Local Authorities in Thailand

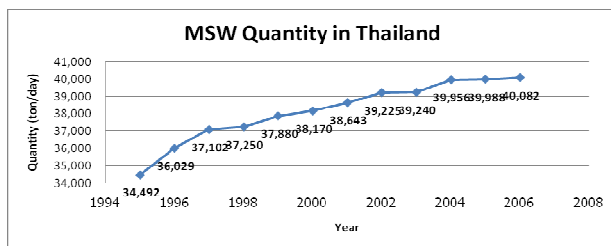
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**Abstract**— Despite the drastic changes on municipal solid waste (MSW) management in Thailand in the past decades, continue efforts are needed to increase collection efficiency, reduce open dumps, and increase recovery rate. This study founded that a key barrier for achieving effective MSW management is a low planning capability of local authorities who are responsible for managing MSW at present. The majority of local authorities in Thailand unsystematically design operational management system and prepare MSW management plan. The deficit will increase the chance of making the wrong decision or delaying corrective actions to the problem. Therefore, measures to improve MSW management planning unit of local authorities are essentially needed in order to enhance the performance of MSW operational management system. The objective of this study is therefore to identify the root causes – why local authorities in Thailand are now unable to systematically design the system for their MSW and prepare MSW management plan. This knowledge is important for designing effective measures in the future to enhance the capabilities of local authorities in Thailand for planning effective MSW management system for their regions.

**Keywords**— Municipal solid waste, Planning, Local authorities, Thailand.

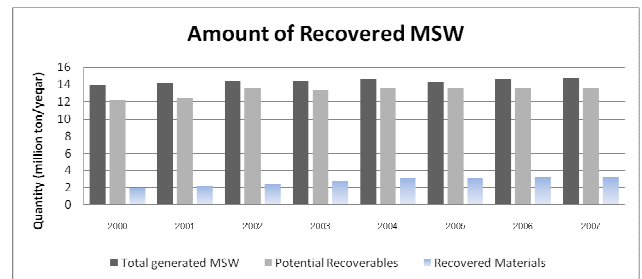
### 1. INTRODUCTION

The quantity of MSW increases each year with the continuing population growth. However, the growth rate of MSW has declined since the economic crisis in 1997 as shown in Figure 1. In 2006, total amount of MSW generated throughout Thailand was 14.63 Mton or 40,082 tons/day, 2.3% increase from last year [1]. Of that amount, 21% was generated from the capital city, Bangkok, 32% from municipal areas and 47% from outside municipal areas. The generation rate varies. It was approximately 1.5 kg/cap/day in Bangkok, with 0.7-1.0 kg/capita/day in municipal areas and about 0.4 kg/capita/day outside municipal areas [2], [3].



**Fig. 1. MSW quantity in Thailand from 1994-2006.**

With continuing improvement, the collection efficiency at present was 60% overall (compare to 30% in 1997), 100% in BKK, 70-80% in municipal areas, and 20-30% outside municipal areas [1]. The recovery rate was up from 5% to 22% via composting and recycling (Figure 2).



**Fig. 2. MSW Recovery rate.**

Open dumps are redeveloped or replaced by sanitary landfill particularly in municipal areas, provided with control systems for groundwater contamination and air pollution. As a result, sanitary disposal increases from 25% to 36% overall in 2006 [1]. All MSW collected in BKK are disposed of in sanitary landfills. Meanwhile, 33% and 4% of MSW in municipal areas were landfilled and incinerated respectively. Unfortunately, only 6% of MSW outside municipal areas were landfilled [1]. The remaining was still openly dumped.

Therefore, improvement actions need to be continuing to increase collection efficiency and to increase the recovery rate (the proportion is still low compared to the amount that has the potential for recovery) in order to reduce openly dumped and extend the lifespan of sanitary landfill. These will consequently reduce environmental harm and gain backs the public confidences and subsequently participation.

According to the management structure (Figure 3), the capability of each local authority is crucial to address this issue. Local authority must be able to develop policy and a plan that meet its local needs and consistent with national or regional policies, acquires sufficient budget and appropriate technology, operates the designed system, enforces the relevant laws, and encouraged public to participate in the system in order to achieve

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effective MSW management system.

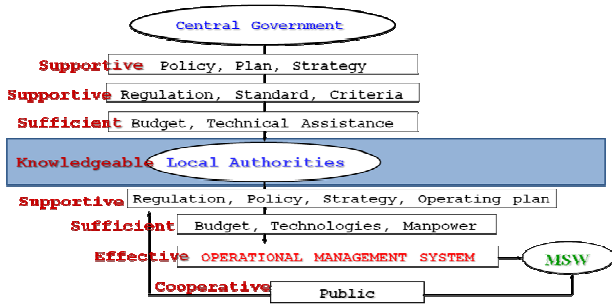


Fig. 3. Structure and conditions of MSW management.

According to its duties, local authority should efficiently perform two key functions, including planning and operating. However, operating performance relies partly on planning performance. Therefore, having an effective planning unit will also enhance the performance of MSW operational management system. The problem of inadequate budgets or low public participation could be eased by a good MSW management plan. Collection and transportation cost, accounting for a half of the entire management cost, could be reduced while the efficiency increases if properly planned.

Evidences have clearly shown that the root cause of current inefficiencies is because local authorities are unable to prepare comprehensive management plan, which result in lacking sufficient capital and operating costs, appropriate infrastructure and equipment. Public participation is low. Therefore, improvement on MSW management planning of local authorities is crucial for improving MSW management in Thailand to achieve sustainable system.

However, this study has found that little attention has been paid to this aspect, comparing to other issues such as the improvement of management technologies, budget and public participation. The improvement of MSW management planning function of local authority is not addressed in the current national management policy. No study revealing factors that actually hinder these local authorities from preparing proper management plan has been carried out.

Therefore, the aim of this study is to identify the root causes – why local authorities in Thailand are now unable to prepare comprehensive MSW management plan. This knowledge is important for designing effective measures in the future in order to enhance the capabilities of local authorities in Thailand for planning effective MSW management system in their regions.

## 2. MSW MANAGEMENT PLANNING SYSTEM

In general, key steps are similar including Problem diagnosis and definition, Goal and objective setting, Strategy development, and Implementation as summarized in Figure 4.

The planning output is MSW management plans, which should contain all necessary information for implementation to effectively regulate the operational management system. MSW management plan should be prepared in three format including Strategy,

Project/Program plan, and Day-to-day operating plan or long-, medium-, and short-term plans respectively. These MSW management plans should be systematically related to each other to ensure the success of MSW operational management system.

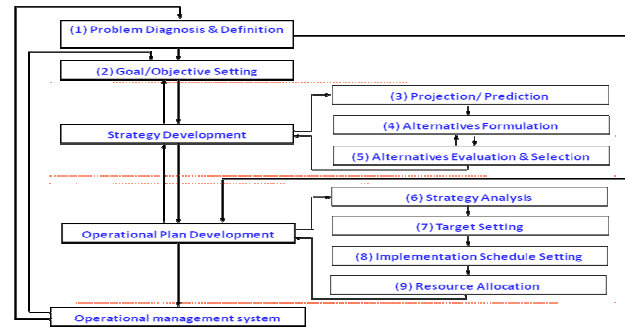


Fig. 4. MSW planning procedure.

Based experiences of various countries, each local authority needs the following components in their organization in order to carry out palnning procedure and produce proper planning output effectively. These are

- (1) information management system
- (2) decision support system
- (3) planning management system
- (4) planning staff
- (5) planning facilities and
- (6) organisation administrative structure

The relationship of these components to the performance of MSW planning is presented in Figure 5.

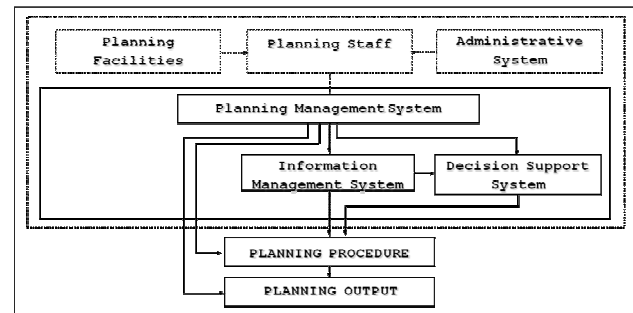


Fig. 5. The Structure of an effective MSW management planning system.

An information management system (IMS) is needed to ensure that all required information is collected on a regular basis, reliable, and properly handled and organised [4], [5]. Once information is obtained, the information management system manages and processes this information in a fashion that can be easily understood by all relevant personnel. Computer then becomes necessary when a large amount of data is collected.

The decision support system (DSS) is essential to help planning staff making all decisions based on scientific evidence, not perceptions. Intensive analysis needs to be carried out to cover all aspects of each alternative against

key criteria, including efficiency, economic, environmental impact, and social impact. Thus, the decision support system ensures that information on the performance of existing and proposed MSW operational management systems against each criterion is available before decision is made. The decision support system can include the use of computer-based analytical tools, which can handle large amounts of data and carry out complex calculations [6], [7].

The planning management system is needed to ensure the readiness of planning staff before initiating the process. In other words, the planning process must itself be planned and properly managed. The role of the planning management system includes identifying and inviting participants, scheduling meetings and establishing deadlines, and ensuring that necessary follow-up steps are taken [8].

This component ensures that all necessary activities are carried out in an orderly manner to achieve a comprehensive planning outcome. Preparation of the planning work plan is one of the means to control the planning process. The processes that will be performed over the planning period to develop the MSW management plan are documented and described in sufficient detail so that it is well understood by the planning staff and line personnel can cooperate with it readily.

Human resources are always the prime suspects of any problem in the MSW management planning system. Appropriately trained and experienced people are essential requirements, as MSW management planning process is complex [9], [10], [11]. These staff must be well capable of performing the given task. Despite the individual academic background, there is a need of system to ensure that planning staff is given clear instructions on the nature of their jobs and responsibilities to maximize their performance [9].

Planning supporting facilities should then be provided to planning staff particularly computer facility to store and analyse intensive information and to enhance their capability to handle the complexity. At present, various analytical tools have been developed to assist the local authority in evaluating the performance of alternative MSW operational management systems regarding financial and environmental aspects or selecting an optimal choice.

Another factor that affects the performance of planning staff is the administrative structure of the organisation. It reflects the working conditions required to maintain a stable and competent work force [12]. The administrative structure relates to the distribution of units, responsibilities and authority; management and organisational structures; interactions between departments; institutional capacities; and personnel administration [13].

### 3. STUDY METHODOLOGY

At present, local authorities in Thailand are mainly classified into four forms, based on the development of their responsible areas. In municipal areas, local authorities can be classed as Nakhon Municipality (NM)

– most developed area, Muang Municipality (MM), and Tambon Municipality (TM) while local authorities outside municipal areas are classed as Tambon Administrative Organisation (TAO).

Accordingly, management capability of each form is different. Local authorities in urban area or major cities tend to be higher capability than the ones on rural areas. Therefore, each form of local authorities should have different problem and then require different improvement methods for their planning function.

It is essential to know the root causes or problem characteristic of MSW planning function of each form. Proposed improvement can then provide ultimate impact. In doing so, the following steps are conducted in this case study.

1. develop an evaluation framework - Questionnaire is a method used to obtain answers
2. select local authorities to be studied
3. develop a questionnaire
4. send and collect the questionnaires
5. conduct a deep interview with selected local authorities based on the returned questionnaires
6. identify the root causes – why local authorities in Thailand are now unable to prepare MSW management plan

#### 3.1. Studied Local Authorities

At present, there are 36 local authorities in the form of Nakhon Municipalities, 137 in the form of Muang Municipalities, 1,042 in the form of Tambon Municipalities, and 6,505 in the form of TAOs (DOLA 2003). However, of these 7,720 local authorities, this study focuses on local authorities in which MSW is a crucial problem for their areas are firstly targeted due to limited study timeframe. As the national goal is aiming at a generation rate of less than 1 kg/cap/day, any local authorities, which have a MSW generation rate higher than 1 kg/cap/day, are then considered to be in the critical stage and are the target of this study.

#### 3.2. Evaluation Framework

According to the key for effective MSW planning presented in the last section, root causes of ineffective MSW planning are then assumed to relate to the weaknesses of these components. The questions used to obtain information on the performances of these components are summarized in Table 1.

Questionnaire is a method used to answer these questions. The first part collects the background information of the studied local authorities. The second part collects data on the performance of their MSW operational management system. The third part then asks for information on the performance of those key components.

**Table 1. Assessment questions for the planning system**

Component	Question
Information Management System	<ul style="list-style-type: none"> <li>• What data/ information are available for planning activities?</li> <li>• Is the available data/ information conveniently retrieved and accessed by relevant staff?</li> <li>• Is the available information in the format that is ready to be used by relevant staff?</li> </ul>
Decision Support Subsystem	<ul style="list-style-type: none"> <li>• Is the detail of the performance of existing operational management system and the possible alternatives available?</li> <li>• What criteria are used to evaluate the possible alternatives?</li> <li>• What computer-based analytical tool is used in the process?</li> <li>• Is there any formal meeting in the division before making the decision?</li> <li>• Is there any public hearing before the final decision on strategy?</li> </ul>
Planning Management System	<ul style="list-style-type: none"> <li>• Is the detail of planning procedure, information management manner, decision making manner, and plan management manner documented?</li> <li>• Is the work plan addressing planning activities with corresponding staff available?</li> <li>• Is the available work plan conveniently retrieved and accessed?</li> </ul>
Planning Staff	<ul style="list-style-type: none"> <li>• How many staff are involved in the planning activities?</li> <li>• What are their professional backgrounds (e.g. engineering, science)?</li> <li>• Is there any training program for improving knowledge of corresponding staff?</li> <li>• Are they given a clear instruction for performing their task?</li> </ul>
Planning Facilities	<ul style="list-style-type: none"> <li>• Is there any budget available for running the planning activities, training corresponding staff, and acquiring planning facilities?</li> <li>• What facilities/materials are available for assisting corresponding staff using less time and improving their knowledge?</li> </ul>
Administrative System	<ul style="list-style-type: none"> <li>• What are other tasks they need to do besides regulating the operational management system?</li> <li>• Does the system allow carrying on the process until the completion?</li> </ul>

**4. RESULT**

For the first phase, the questionnaire was sent to 337 local authorities, in which 137 of them returned the questionnaire, giving about 40% response rate. These

include 11 Nakhon Municipalities (73%), 12 Muang Municipalities (37%), 79 Tambon Municipalities (45%), and 35 Tambon Administrative Organisations (32%).

**4.1. Performance of Local Authorities**

Planning output of all local authorities that returned the questionnaire are summarised in Table 2. Of these local authorities, 19 local authorities do not have any types of MSW management plans. That means 85% of studied local authorities have at least one type of MSW management plan although only 16% of them have all three types or only 4% have all types of management plans containing all necessary information for managing their MSW.

**Table 2. Planning output of each form of local authorities**

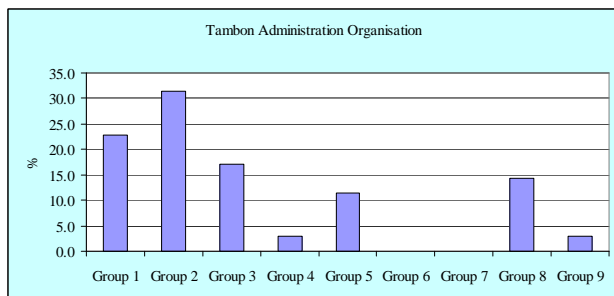
Planning Output	Form of Local Authority				
	Total (137)	NM (11)	MM (12)	TM (79)	TAO (35)
Group 1: None	19	0	0	11	8
Group 2: Only Day to day operating plan	36	1	3	21	11
Group 3: Only Project/program	28	2	1	19	6
Group 4: Only Strategy	6	1	1	3	1
Group 5: Day to day operating plan and Project/program,	23	3	2	14	4
Group 6: Project/program and Strategy	1	1	0	0	0
Group 7: Day to day operating plan and Strategy	3	0	1	2	0
Group 8: Day to day operating plan, Project/program, and Strategy	21	3	4	9	5
Group 9: Day to day operating plan, Project/program, and Strategy with all necessary information	5	0	2	2	1

The performance of each form of local authorities is further evaluated.

**4.1.1. Tambon Administrative Organisation (TAO)**

Planning output of studied TAOs is given in Figure 6.

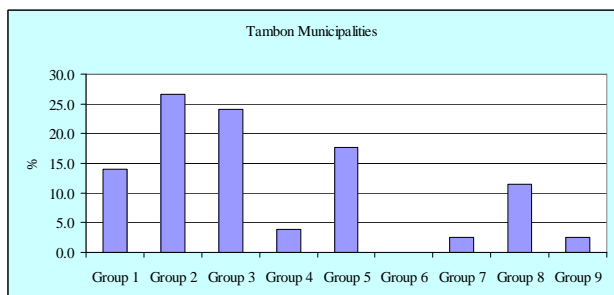
Fig. 6 shows that MSW strategy or long term plan is not prepared in the majority of them (Group 1, 2, 3, 5,6,7). Moreover, about 25% does not any MSW management plan while the remaining have only operating plan or only program plan.



**Fig. 6. Planning performance of Tambon Administration Organisations.**

4.1.2. Tambon Municipality (TM)

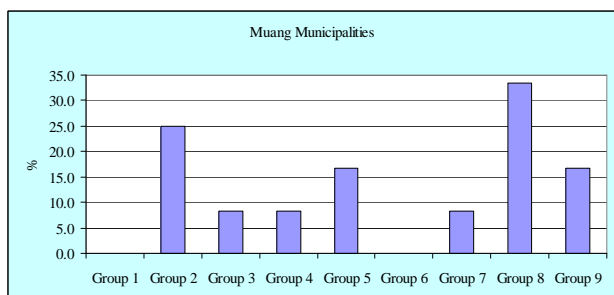
Planning outputs of studied TMs is summarised in Figure 7. As can be seen, despite the similar distribution with TAOs, TMs has a slightly better performance. More has MSW management plans although these are only operating plan or only program plan.



**Fig. 7. Planning performance of Tambon Municipalities.**

4.1.3. Muang Municipality (MM)

Planning output of studied MMs are given in Figure 8. It shows the different distribution of planning output from those TAOs and TMs. All MMs has at least one type of MSW management plan and more have two types. Half of them has prepared long term plan.

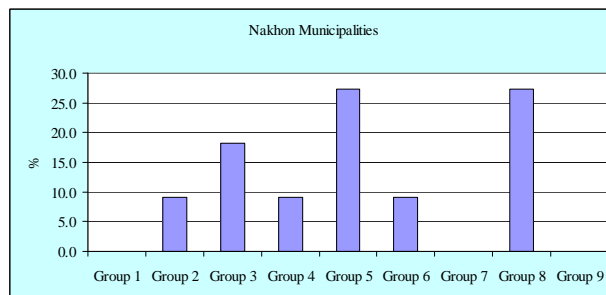


**Fig. 8. Planning performance of Muang Municipalities.**

4.1.4. Nakhon Municipality (NM)

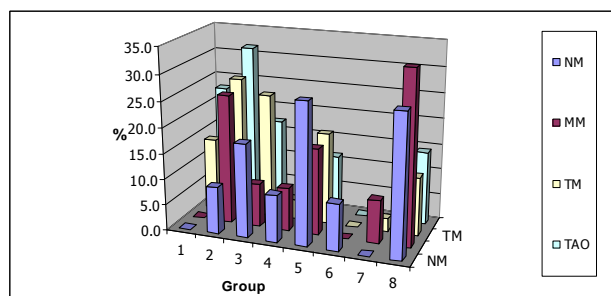
Planning output of studied MMs are given in Figure 9. It illustrates that NMs have similar performance with MMs. All NMs has at least one type of MSW management plan and 50% has strategy. However, it is interesting that none of NMs have all three types of MSW management plans with all necessary information

(Group 9) when about 15% of MMs is in this group.



**Fig. 9. Planning performance of Nakhon Municipalities.**

In summary (Figure 10), Nakhon municipalities and Muang municipalities have a better performance than Tambon municipalities and Tambon Administration Organisations. As can be seen, none of studied NMs and MMs are in Group 1 or it means all NMs and MMs have at least one type of MSW management plan. Accordingly, more NMs and MMs have all three types of MSW management plans (Group 8).



**Fig. 10. Proportions of studied local authorities in each group of MSW management planning output.**

However, regarding their status, local authorities in forms of Nakhon and Muang municipalities should have a better performance than at present. All should have strategy for managing their large amount of waste and handling complex problem.

4.2. Root Causes Analysis

This section aims to identify the causes of the drawbacks of MSW management planning systems of studied local authorities. Based on the objective of MSW management planning to prepare MSW management plan, the problem pattern can be divided into eight groups as follows.

- Group 1: none of the MSW management plans are prepared
- Group 2: only the day-to-day operating plan is prepared
- Group 3: only a project/program is prepared
- Group 4: only a strategy is prepared
- Group 5: only the day-to-day operating and a project/program plan are prepared
- Group 6: only a project/program plan and strategy are prepared

- Group 7: only Day to day operating plan and strategy are prepared, and
- Group 8: Day-to-day operating plan, project/program plan, and strategy are prepared but do not contain all the necessary information.

Planning systems in each group are analysed to identify its common characteristics. Reasons for different planning output are thus revealed. In doing so, six key components (Table 1) of each planning system are evaluated to define the performance level subject to the criteria given in Table 3, including Good (G), Fair (F), and Poor (P) performance. These criteria are developed according to the preferred conditions of each component presented in section 2.

**Table 3. Criteria for performance level of each planning system components**

Component	Performance Level		
	Good (G)	Fair (F)	Poor (P)
<b>Information Management System</b>	Necessary data are available, and properly stored	Some necessary data are available or available data are not properly stored	Few necessary data are available or available data are not properly stored
<b>Decision Support System</b>	Decision-making data is available, all criteria are used, and brainstorming and public hearings take place.	Either decision-making data is available or all criteria are used or brainstorming and public hearings take place.	Decision-making data is not available, all criteria are not used and brainstorming and public hearings do not take place.
<b>Planning Management System</b>	Workplan with all information for planning process are available and conveniently accessed	Workplan with some information for planning process are available or not conveniently accessed	Workplan with few information for planning process are available or not conveniently accessed
<b>Planning Staff</b>	More than one person are available	Only one person is available	Planning staff is not available
<b>Planning Facilities</b>	Planning budget, facilities, and training programs are available	Either planning budgets or facilities or training program are available	Planning budget, facilities, and training program are not available
<b>Administrative system</b>	Administrative system is considered supportive		Administrative system is considered unsupportive

*4.2.1 MSW management planning systems that cannot produce any MSW management plans (Group 1)*

There are 19 local authorities in this group. Only local authorities in the form of Tambon Municipalities and Tambon Administration Organisations, the lower level, are in this group. The collected data illustrates that planning staff are not available in these local authorities as well as planning facilities or planning workplan.

*4.2.2. MSW management planning systems that produce one type of MSW management plan (Group 2, 3, 4)*

Majority of studied local authorities is in this group (70 of 137 or 51%). These local authorities have planning staff and either planning facilities or planning management system in fair or good performance. However, other 2 or 3 components are still in poor performance.

*4.2.3. MSW management planning systems that produce two types of MSW management plans (Group 5, 6, 7)*

There are 27 local authorities in this group. Basically, the performance of planning staff, planning facilities, and planning management system is similar to those in Group 2,3,4 but their information management system and decision support system are slightly better.

*4.2.4. MSW management planning systems that produce all types of MSW management plans (Group 8)*

There are 21 local authorities in this group. Most components of their planning systems are in fair or good performance. Planning staff is available with planning facilities and workplan. Administrative structure supports planning process. However, for those that have strategy with all necessary information, consultant company is hired to develop such plan otherwise all supportive components are in good performance.

**4.3. Summary**

The collected data has shown that a lack of planning staff is a first barrier for local authorities in Thailand to prepare at least one type of MSW management plan. Lacking planning facilities and guidelines are then a key barrier to enhance planning capabilities of these planning staff. To achieve good planning output, ineffective information management system and decision support system are main hurdles.

However, the results shows that the majority of studied local authorities have planning staff but not having planning supportive components particularly planning facilities and planning guidelines or workplans. This is slightly different from the assumption before starting this study in which lacking planning staff is a main problem.

Therefore, the attention should be firstly given to the provision of planning facilities such as computer or planning manual. Planning software or computer program should be developed for them to enhance their planning capabilities. Consequently, the development of proper information management system and decision support system is needed to ensure good planning output.

The results also illustrates that many local authorities have potentials to achieve better MSW management

planning systems. None of the studied local authorities have all components in poor performance. A better planning output can be achieved if the existing resources are improvised. Thus, it is worth improving their existing MSW management planning system. However, the improvement should be designed for each case in its own right, as none of studied MSW management planning systems has the same problem characteristics.

## 5. PROPOSED SOLUTION

The survey clearly shows that large number of local authorities is unable to carry out comprehensive planning process. However, giving planning supporting tool could enhance their planning capability. At present, various MSW management supporting tools are available that could be used for the case of Thailand. However, most of these supporting tools are developed in developed countries. It may not be automatically transferable to developing countries [3], [14].

Differences in waste characteristics, problem priority, locally available resources and socioeconomic structure may need different analysis. Some issues are vital in developing countries but unimportant or less important in developed countries. For instance, scavengers are not widely considered as a solution of developed countries. However, scavenger should be part of the solution in developing countries as they play a significant role in the recycling business. Planning supporting tool specifically for local authorities in Thailand should be developed.

Regarding the current planning manner at local level, MSW operational management system proposed to implement often imitates the city which is reasonably successful. Comprehensive analysis to check whether the proposed system would work in their area is rarely conducted. In doing so, various cases have failed.

The application of proposed supporting tool for future study will be addressing this current nature. The proposed tool aims to quantify an overall performance of any single MSW operational management system proposed to implement in their responsible areas. No tool having such a application is available at present.

The tool will provide a number illustrating the level of long term suitability or sustainability – showing whether MSW management system intended to implement is suitable for its community. Efficiency, economic, environmental and social performances of proposed option is evaluated. Social aspect has considered the impacts on all stakeholders related to MSW management activities including public, scavengers, manufacturer, NGOs, and academics.

## 6. CONCLUSION

Low planning capability of local authorities is a key barrier for achieving effective MSW management in Thailand. Although various factors affecting the performance of planning activities, the attention should be given to the development of planning tool such as computer software to assist local staff in more systematically planning and designing their MSW management system.

Majority of studied local authorities have planning staff. However, the number is limit. As 60% of studied local authorities have computer, there is a high possibility of using planning supporting tool in these local authorities to improve their planning performance.

Regarding the current designing manner at local level in Thailand, where MSW operational management system proposed to implement often imitates the city which is reasonably successful, the application of supporting tool should be able to illustrating the level of suitability or sustainability of intended operational MSW management system to its community.

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