

**COMPARATIVE ANALYSIS OF
LOCAL ROAD MAINTENANCE PRIORITIZATION
(CASE STUDY: WEST LOMBOK REGENCY – INDONESIA, THE CITY OF HAMILTON -
CANADA, AND EKURHULENI METROPOLITAN MUNICIPALITY - SOUTH AFRICA)**

THESIS

A thesis submitted in partial fulfillment of the requirements for
the Master Degree from Institut Teknologi Bandung and
the Master Degree from the University of Groningen

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DOUBLE DEGREE MASTER PROGRAMME

**DEVELOPMENT PLANNING AND
INFRASTRUCTURE MANAGEMENT
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AND POLICY DEVELOPMENT
INSTITUT TEKNOLOGI BANDUNG**



AND

**ENVIRONMENTAL AND INFRASTRUCTURE PLANNING
FACULTY OF SPATIAL SCIENCES
UNIVERSITY OF GRONINGEN**



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Double Degree Master Programme

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PREFACE

Roads infrastructure has many economical and social benefits. Therefore, the quality of roads should be maintained and improved in order to ensure the public services are delivered well. The main problem faced in maintaining road quality is the available funds will be always not sufficient to maintain all roads. The solution is to maintain the most importance roads first. Selecting roads to be maintained is not an easy work since there are many parameters should be considered in order to optimize the results. In this case, the importance of roads can be identified and ranked through conducting the right prioritization. It will help the decision makers in allocating the limited resources efficiently and effectively.

Local road maintenance prioritization issue is very interesting for me since I worked in road planning section for four years in West Lombok Regency-Indonesia. During my work time, I was involved actively in prioritizing local roads in the regency. Based on my experience, I did not see many improvements in road quality even though road maintenance sector always receives a big amount of road maintenance funds. For that reasons, I am wondering how to conduct the right local road maintenance prioritization in West Lombok Regency through observing the prioritization practices in other places. Therefore, I choose to explore the practices of local road maintenance prioritization in the City of Hamilton-Canada and Ekurhuleni Metropolitan Municipality-South Africa that have better road quality than West Lombok Regency.

In finishing this thesis, I receive many supports. Therefore, in this time I want to express my gratitude. First of all, I want to thank to God for all He gives to me. Secondly, I would like to convey my great appreciation to Dr. Eva Heinen, and Mr. Ir. Heru Purboyo H.P, DEA, Ph.D. who always encourage me, and guide me in order to keep my thesis on the right track. Thirdly, I want to say my gratitude to Ir. S. Fajri as the head of Planning Section in Roads and Bridge Department, Public Works Agency – the local government of West Lombok Regency, Mr. John Murray as the manager of Asset Management, City of

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ABSTRACT**COMPARATIVE ANALYSIS OF
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The quality of roads as public goods should be maintained and improved time to time. However, the available funds cannot match with the requirements of roads to be maintained. In order to put the available funds on the right roads for the optimal results, roads should be prioritized. In this case, local road maintenance prioritization practiced in West Lombok Regency (WLR) needs to be improved. It is because the poor quality of roads. In generating the improvement, it needs lessons learned from other places. In this case, this research takes lessons from the City of Hamilton-Canada, and Ekurhuleni Metropolitan Municipality-South Africa (EMM). After that, recommendations for improving the practice of local road maintenance prioritization in West Lombok Regency–Indonesia can be generated based on those lessons. Finally, the recommendations can contribute in maintaining and improving the local road quality in the regency.

In order to explore local road maintenance prioritization practiced in those three case studies and to gain lessons from those practices, this research uses the case study research and the comparative analysis respectively. It was found that those three case studies use different prioritization method. In this case, WLR uses simple subjective ranking, Hamilton city combines ranking considering parameters with scoring and/or weighting with subjective ranking, and EMM uses ranking considering parameters with scoring and/or weighting. Furthermore, the prioritization criteria considered in those three countries are multi criteria covers technical criteria, regional goals and objectives, political criteria, financial criteria, and social criteria. The actors who always involved in the prioritization conducted in all countries are authorities (Regent), technical agency of local government, politician (council), and communities. Through comparing the similarities and differences of those practices, it can be said that the prioritization methods used by Hamilton and EMM are much better than the method used by WLR. This is because Hamilton and EMM use the analytic tools that ensure the objectivity. In addition, Hamilton city uses more diverse criteria and actors so that the

prioritization practiced in this city is better than the prioritization practiced in WLR and EMM. The additional criteria considered by the city are environmental criteria, economical criteria, and risk analyses. Furthermore, this city also involves more actors than two other places which are road users. It shows that Hamilton city wants to consider as many as the relevant interests in addressing the road maintenance issues.

However, the strength of prioritization practiced in Hamilton city and EMM cannot be transferred directly to WLR. The transfer will need some adjustments such as strong willingness and efforts from technical agency to operate analytical tools for improving the objectivity, the legal regulations that force the implementation of prioritization guidelines, the rules setting the main prioritization criteria, and coordination among all local agencies discussing projects affected local roads. Besides that, the local government should provide the current LOS data and the clear LOS standards, conduct the suitable prioritization program involving road users, give communities education related to their rights in the prioritization, and manage the proportional intervention from politicians.

In the beginning of transfer process, the government of WLR can implement a prioritization method stated in the Local Roads Maintenance Guideline year 2005, and encourage the active involvement of the road observers and their staff in every district for collecting traffic volume and road condition data. Besides that, the local government can require environmental criteria, economical criteria, and risk analyses only for every proposed road maintenance project to the council for approval. Furthermore, the mandatory meeting among the local government, the provincial government, and the national government discussing all projects affected local roads located in WLR can be scheduled regularly. In addition, the local government could conduct an LOS evaluation for minimum once in five years, involve road users and other relevant agencies in development planning consensus, increase the knowledge of road maintenance prioritization in local council, educate the communities related to their rights in local road maintenance prioritization, and formulate a legal document namely Integrated Development Plan as practiced in EMM. Therefore, the prioritization in WLR can be conducted in more appropriate manner. Finally, the objective and transparent prioritization practices will contribute in maintaining and improving local road quality in WLR.

.Key words: *actors, criteria, methods, local road maintenance, prioritization*

CHAPTER I

INTRODUCTION

I.1. Research Background

Infrastructure are facilities delivering public services in the area of public utilities (telecommunication, piped water supply, etc.), public works (roads, major dam, and canal works), and other transport sectors such as railways and port (World Bank, 1994 in Parkin and Sharma, 1999, p. 2). Roads as one of transportation infrastructure are classified as public goods. It means that everyone has the same access to roads and should get the minimum level of accessibility. Roads have many benefits as stated by Schroeder (http://pdf.usaid.gov/pdf_docs/PNACB393.pdf) in his paper, such as to create efficiency through reducing the costs of transporting goods and persons, facilitating social exchange and mobility. As an illustration, according to O'Sullivan (2003), demand of labor and equilibrium of employment can be enhanced through public policies that decrease the production costs. One way to decrease the production cost is through reducing transportation costs by improving road condition. Since transportation cost is an important factor in deciding business location, road condition influences economic activities. Besides that, the revenues spent by local government on public services such as infrastructure will increase the relative attractiveness of a region. In this case, infrastructure development not only can create employment but also can reduce the disparities among regions.

According to EC External Services Evaluation Unit (2009), there are other positive impacts of investments in road infrastructure such as reducing road transport time, and increasing trade activities. In general, the road investment can improve the quality of public services delivered by the roads that eventually will generate economic and social benefits. In the case of Indonesia, the significant roles of roads were already stated in several legal regulations. For example, according to article 5 verse 2 Republic of Indonesia Act number 38 year 2004 of road, road has an important role in economic, socio culture, environment, politic, defense and security, and should be used for the prosperity of people.

Schroeder (http://pdf.usaid.gov/pdf_docs/PNACB393.pdf) stated that maintenance is requested in order to ensure the roads serviceable. Furthermore, Donnges et al. (2007) stated that road maintenance which is activities aimed to maintain the service level of roads within its design life will both prevent and reduce road deterioration that eventually will prolong the life service of roads, sustain the road investment, reduce the vehicle operational cost, maintain the roads for traffic and transport services, and sustain social and economic benefits. Road maintenance will not only maintain road quality, but also improve road quality into the original quality. For this reason, the continuous jobs of road maintenance are a must in order to ensure roads sustainability in delivering public services.

Since the proper infrastructure planning conducted by the government is very crucial especially in developing countries (Parkin and Sharma, 1999), the government intervention is urgent in organizing the roads maintenance. In this case, the central government and provincial government allocate much fund to build, maintain, and reconstruct country roads and provincial roads in order to provide public services. This effort should be supported by the local government through providing the optimal condition of local roads since local roads are an important part of the entire road system. Local roads can include rural roads, urban roads, and highway. It depends on the road regulation management issued by the authorities in every country. These roads have a significant role for local communities since it link them with major public assets such as education and health services. Therefore, this thesis emphasizes the research in the scope of local roads which is defined as roads that manage by the local government.

However, the funds required to maintain all roads cannot match with the available funds. This situation causes not all proposed local road maintenance can be realized. In this case, the local government can intervene the allocation of funds through public policies related to their main functions. Musgrave (1959) stated that there are three traditional functions of government in federal system: stabilization, redistribution, and allocation. The central government usually takes the first two functions, while the local government responsible in allocating the local resources. Therefore, the local government should ensure that the available resources are used efficiently for the optimal results. For these reasons, the local government should

have strategic plans in allocating the development funds for maintaining roads in order to achieve the high positive impacts as well as sustain the development. The example of strategic plan is the rank of selected roads to be maintained. Process required to rank the alternatives is well-known as prioritization. Road maintenance prioritization can be defined as an activity to rank roads that need to be maintained based on the level of importance. However, choosing which roads to be maintained first in order to get the optimal result is not an easy work, whether the one with the worst condition or the one that important for communities. Therefore, it is important to implement the right prioritization so that the road maintenance funds will be allocated to the appropriate roads. Finally, the overall road quality can be maintained which eventually will sustain the social and economic benefits of roads. For those reasons, the methods used, criteria considered, and actors involved in the prioritization need to be explored in order to optimize prioritization process.

The prioritization process will be guided by certain methods which should be as objective as possible. Prioritization method consists of sequence steps conducted in determining priorities called procedures (Botta and Bahill, 2007; http://ec.europa.eu/environment/enlarg/pdf/proj_priorit_criteria.pdf). Thus, through examining the procedures this thesis can simultaneously determine both the prioritization methods used and the basis of analysis that can show the level of objectivity. The level of objectivity can also be detected through examining the criteria considered in assessing the alternatives since criteria show the important attributes considered and the existing constraints in achieving the goals (Shen, 1997 and http://ec.europa.eu/environment/enlarg/pdf/proj_priorit_criteria.pdf). Furthermore, criteria can be different for every case, depend on the circumstances faced (http://ec.europa.eu/environment/enlarg/pdf/proj_priorit_criteria.pdf). For example, Hoban et al. (1994) claims that for rural roads, the priority is focused to maintain the roads that are functionally important and in good condition in order to improve the accessibility. Besides that, the routine and periodic road maintenance are the prioritized treatments. Meanwhile, for urban roads the criteria can be more diverse including road function, road condition, traffic flow and composition, critical bottlenecks, and constraints on mobility for personal, social, economic, health, and education.

The exploration of actors involved in local road maintenance prioritization is considered important in this thesis since actor is an important element in decision making process. As an executor, actors are greatly having influence on the success of decision making process. In this case, actors' involvement can diminish the veto power, and improve the quality of decision making. Besides that, the interaction between the citizens and politicians can strengthen their relationship (Edelenbos and Klijn, 2004). Furthermore, actors' involvement can generate understanding, commitment, and support (Kessler, 2004). These outcomes will lead to the acceptance and legitimacy of policy plans. By involving actors who have skill, knowledge, experience, and significant roles in the project process, issues can be addressed as soon as possible in appropriate manners, and preventing the potential problems in the future can be prevented. Therefore, there will be some drawbacks if there some key actors are not involved in decision making. For example, it can make the issue/alternative be seen overlooked or under-prioritized (Taschner and Fiedler, 2009). However, the diversity of actors involved is depended on the complexity of issues and condition faced, and the arrangement by regulation. Therefore, it is important to identify actors involved, their roles, types, and the level of importance which can be used to improve the practices of local road maintenance prioritization in West Lombok Regency.

Given the importance of prioritization, there are some publications discussing the prioritization process of transportation asset. However, very few can be found in the field of road maintenance and in the scope of local roads in developing countries. For example, research conducted by Muniandy and Moazami (2010) examined the use of analytical hierarchy process and fuzzy logic modeling in prioritizing pavement rehabilitation, and research by Kaysi et al. (2010) presented a prioritization framework for prioritizing the proposed nationwide primary and secondary road projects in the Kingdom of Saudi Arabia. Besides that, most of publications are focusing in formulating a new method for the optimal road maintenance prioritization. Meanwhile, the main aim of this research is to propose recommendations for improving the current practices of local road maintenance prioritization in WLR including the method used, criteria considered, and actors involved. Therefore, it is very important to examine the current prioritization practice

in order to identify the weaknesses and strengths so that the suitable improvement strategies can be suggested. In order to have references of the best practices of local road maintenance prioritization, this thesis will take lessons from other countries that have already proven their success in maintaining local roads. For that reason, the City of Hamilton and EMM are taken as comparator countries that will be explored since both countries have better road quality as the achievement of successful practices of road maintenance prioritization. Henceforth, methods used, criteria considered, and actors involved in local road maintenance prioritization practiced in WLR, the City of Hamilton and EMM will be explored in this thesis.

I.2. Research Goals

The main goal of this research is to get lessons from local road maintenance prioritization practiced in the City of Hamilton-Canada and Ekurhuleni Metropolitan Municipality-South Africa. After that, recommendations for improving the practice of local road maintenance prioritization in West Lombok Regency-Indonesia can be generated based on those lessons. Finally, the recommendations can contribute in maintaining and improving the local road quality in the regency.

I.3. Research Questions

The main research question is:

How is the local road maintenance prioritization practiced in West Lombok Regency-Indonesia, The City of Hamilton-Canada, and Ekurhuleni Metropolitan Municipality-South Africa, and to what extent can the prioritization practiced in The City of Hamilton-Canada and Ekurhuleni Metropolitan Municipality-South Africa be adopted by West Lombok Regency-Indonesia in order to improve the prioritization?

The main research question is divided into four sub questions as listed below.

1. Which methods are used in conducting local road maintenance prioritization in West Lombok Regency-Indonesia, the City of Hamilton-Canada and Ekurhuleni Metropolitan Municipality-South Africa?

2. Which criteria are considered in conducting local road maintenance prioritization in West Lombok Regency-Indonesia, the City of Hamilton-Canada and Ekurhuleni Metropolitan Municipality-South Africa?
3. Which actors are involved in conducting local road maintenance prioritization in West Lombok Regency-Indonesia, the City of Hamilton-Canada and Ekurhuleni Metropolitan Municipality-South Africa?
4. What are the differences and similarities in practicing local road maintenance prioritization among West Lombok Regency-Indonesia, the City of Hamilton-Canada and Ekurhuleni Metropolitan Municipality-South Africa; and to what extent can practices be transferred to West Lombok Regency-Indonesia?

I.4. Research Structure

The second chapter will describe the research methodologies selection criteria and data required for this research. After that, third chapter will discuss a literature review which explores relevant theories related to the road maintenance prioritization including methods used, criteria considered, and actors involved. The general concept of local road maintenance, road maintenance prioritization methods used, criteria considered, and actors involved in prioritization in the context of WLR, the City of Hamilton, and EMM will be explored in fourth, fifth, and sixth chapter respectively. Then, chapter seven will compare the similarities and differences of local road maintenance prioritization practiced in those three case studies, and present lessons learned and the possible practices of local road maintenance prioritization in the City of Hamilton and EMM that can be adopted by WLR. Finally, chapter eight will summarize all research results, provide some recommendations for future actions, and present the author's reflections of this research.

CHAPTER II

METHODOLOGY

This chapter discusses methods used in this research. In order to answer the main research question, this research will use two methods: comparative analysis and case study approach. The former will be used in identifying the similarities and differences of local road maintenance prioritization practiced in different places. Meanwhile, the latter is used to explore the practices of local road maintenance in those different places taken as case studies. From analyzing the methods used, criteria considered, and actors involved in prioritizing local road maintenance in case studies, the strengths of local road maintenance prioritization in the city of Hamilton-Canada and Ekurhuleni Metropolitan Municipality-South Africa (EMM) can be determined as lessons learned for improving the current practices in West Lombok Regency – Indonesia (WLR). Furthermore, the criteria in choosing countries to be case studies are explained and the case studies are described. After that, data required to conduct the research are revealed in this chapter. Finally, literature review to extract the theories as a tool for analyzing those data will be explained.

II.1. Comparative Analysis

Research can be conducted through observing our surrounding world such as people or other events (Driscoll, 2011). For example, many researches take the city of Chicago as a laboratory for solving social problems in the United States of America since this city has a diverse culture. However, difficulties are often found in interpreting the observation data at specific places. Scheuch (1990) argued that comparison across localities can be used to deal with this situation since local is the lower-order unit so that there will be no third factors between the presumed cause and the effect, and the explanandum would be proportional. For that reason, this research will explore the road maintenance prioritization at the local level.

Comparison also can explore basic information for realizing general values (Teune, 1990). Therefore, comparative analysis can be used to understand the practices of certain policy in order to design the new policy for solving problems.

Furthermore, Mills et al. (2006) stated that comparative analysis can be used for comparing social entities both qualitatively and quantitatively based on many lines in the scope of cross-national or regional. It means that the similarities and differences among countries in certain topic can be found out through comparative analysis.

Recall to those benefits of comparison, this research will use comparative analysis since this analysis will enable the research to identify and compare the strengths and weaknesses of local road maintenance prioritization in WLR, the City of Hamilton and EMM. After that, this research can produce recommendations of the possible adoptions for WLR from local road maintenance prioritization practiced in other places. Therefore, the main research objective (to get lessons from local road maintenance prioritization practiced in the City of Hamilton and EMM that can be adopted by WLR in order to improve the current prioritization practiced in WLR which eventually can maintain and improve the local road quality in this regency) can be achieved properly and scientifically.

II.2. Case Study Research

In order to answer the main research question, the explanative case study method is the best method because this method is used in order to answer the questions like “how” or “why”. Therefore, by using this method, the research is able to identify and explain how local road maintenance prioritization is practiced in case studies. Besides that, there are some other reasons underlining the selection of this model. Firstly, in exploring the implementation of road maintenance prioritization methods the researcher cannot intervene the process. Therefore, this method is the suitable one since Yin (1994) argued that this method can be used by investigator who has no little or no possibility to control the events. Secondly, it is widely accepted that there are many interests from different stakeholders in decision making process of road maintenance. For this reason, case study is the appropriate one because it is suitable for studying the complex social phenomena (Yin, 1994). This method will be conducted by using multiple sources of information that discuss the road maintenance prioritization practices. However, Yin (1994) also mentioned some drawbacks of this method and alternative solutions. First, there is a lack of systematic management of data which can be managed by constructing systematic

data report. Second, there is no basis for scientific generalization which can be overcome by establishing theoretical framework as guideline. Third, this method often takes a long time and end up with unreadable documents. Those solutions will be presented in research structure which shows a systematic data reporting, literature review that provide theoretical background which will be used as a tool to look at the case studies, and research methodology which will explore methods and data used in conducting research. Furthermore, this thesis takes multiple-case studies research in which it explores the practice of road maintenance prioritization in WLR, Hamilton city, and EMM. The case selection criteria and case description will be explained further in the next section.

II.3. Case Selection Criteria and Case Description

In order to gain the optimum results, there are three criteria in selecting countries which have already implemented the best practices of local road maintenance prioritization. Those criteria are the better quality of road, the similar government system, and the better and similar economic background. Based on those criteria, this research takes three places as case study: West Lombok Regency - Indonesia, Ekurhuleni Metropolitan Municipality - South Africa, and Hamilton City – Canada.

Related to the first criterion, the road quality in other countries that become case studies should have the better road quality than Indonesia. Figure 1 shows that Canada and South Africa have the better road quality. In the respect of the second criteria, the case studies have the similar government system with the government system in Indonesia. This requirement will be beneficial in facilitating policies transfer since Dolowitz and Marsh (2000) found that one constraint in transferring policy is structural institutional feasibility. In this case, both Canada and South Africa have three level of government: national, provincial/state, and municipality/local. According to the third criteria, this research takes one developed country and one developing country in order to have the balanced view of different countries with different economic background in generating lessons for Indonesia. In this case, South Africa represent developing country and Canada represent developed country (<http://data.worldbank.org/about/country-classifications/country-and-lending-groups>). In this case, South Africa and Canada have GDP per capita \$

3745.34 and \$ 39050.17 respectively which much better than Indonesia that have \$ 1143.83 (<http://www.tradingeconomics.com>). In the next section, each case study will be elaborated thoroughly based on those criteria.

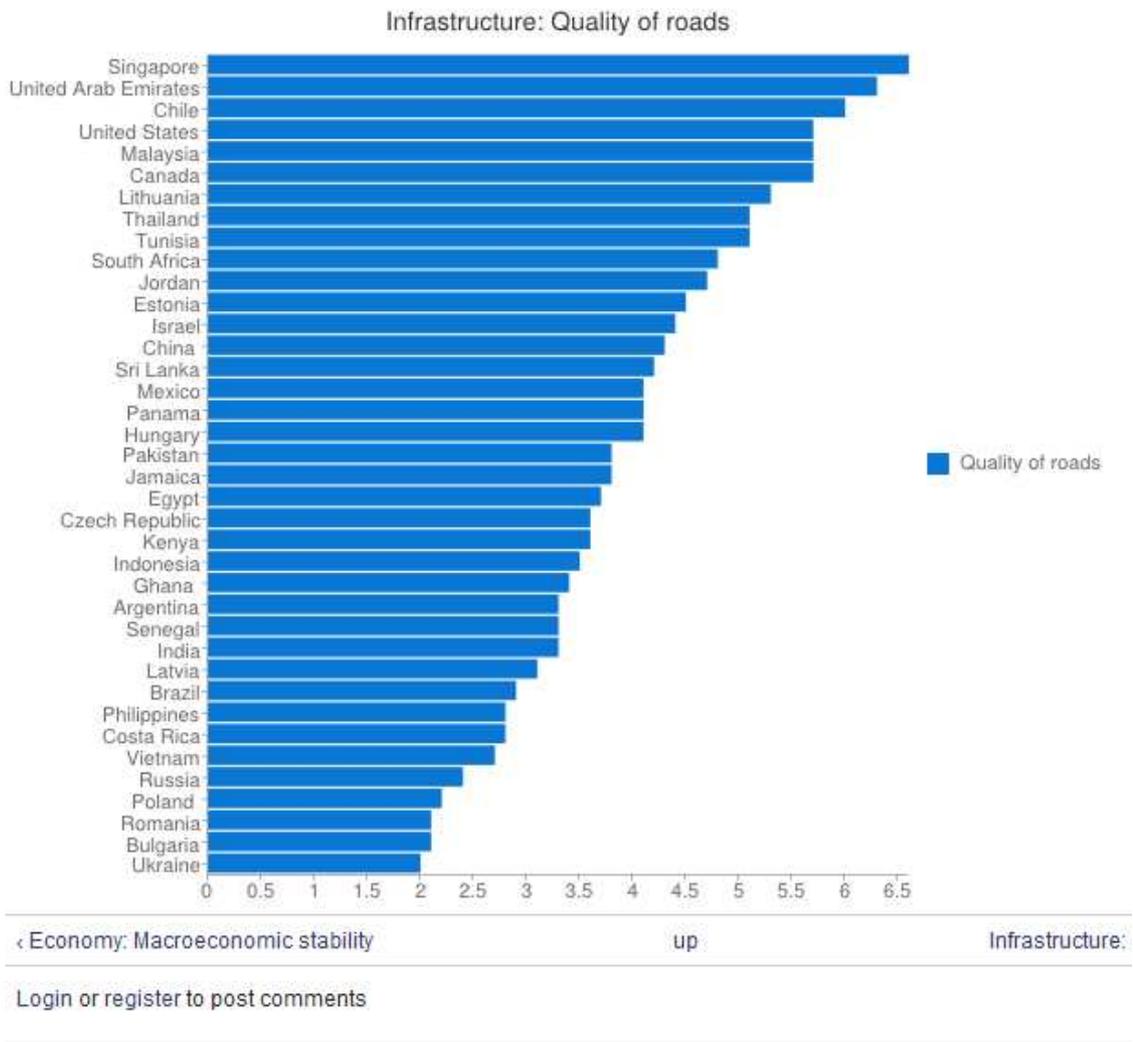


Figure 1. The quality of roads (source: SourcingLine dn, 2011)

West Lombok Regency – Indonesia

West Lombok Regency (WLR) is regency in south east of Indonesia. Regarding to road condition, WLR has 446.48 km local roads in which 156.60 km (35.08 %) in good condition, 68.96 km (15.45 %) in moderate condition, 96.78 km (21.68 %) in slightly damaged, and 124.12 km (27.80 %) in heavily damaged (Dinas Pekerjaan Umum Kabupaten Lombok Barat, 2010). It can be seen that almost 50 percent of

local roads are not in desired condition so that this region needs an improvement in local road maintenance prioritization.

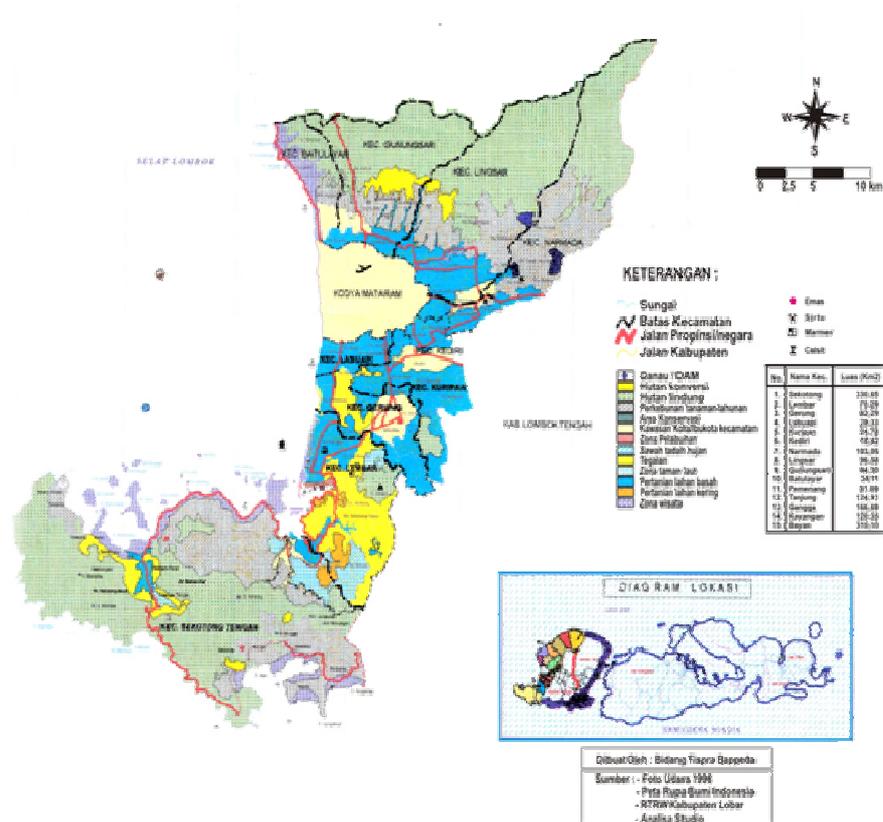


Figure 2. Map of West Lombok Regency

Moreover, WLR has much potency such as the big number of human resources reflected by the population number of 816,523 people with the average growth rate of 2.56 % per year, many natural resources such as a vast fertile land, the beautiful view and unique culture for tourism (West Lombok in Figure, 2008). Besides that, it covers the area of 897 km² and consists of 10 districts. Furthermore, Indonesia is a developing country with GDP growth of 5 per cent (WDI, 2010).

Regarding to political structure, the government system in Indonesia is changing from centralized to decentralized government since 1999. It led to the change of power sharing between central government and local government in which the responsibility of managing the local roads today is on the hand of local government (Indonesian Act No. 22 year 1999 about Local Government and Act No. 25 Year 1999 about Financial Balance between Central Government and Local Government).

Take into account the relatively bad condition of local roads in this region and the abundance of resources that can be used to improve the quality of roads, it is important to establish the suitable local road maintenance prioritization so that the road condition can be maintained in the minimum level of services.

The City of Hamilton – Canada

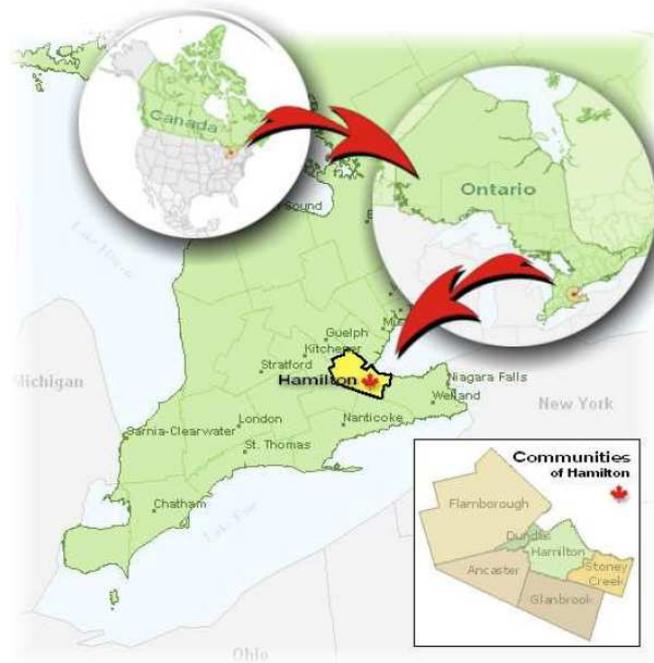


Figure 3. Map of The City of Hamilton

Hamilton city is the capital city of Ontario province – Canada. The city has 1486.129 km local roads. The condition of those roads are 139.197 km very good (9.37%), 765.530 km good (51.51%), 497.541 km fair (33.48%), 83.205 km poor (5.6%), and 0.656 km very poor (0.04%). It can be seen that the overall local road condition in the city of Hamilton is very good reflecting the good practices of local road maintenance prioritization.

Hamilton is a port city that is important for industries. This city is the most populous city in Ontario with 503,000 people (<http://www.hamilton.ca>). In Canada there are three types of municipalities: upper tier municipalities within a two tier municipal structure, lower tier municipalities within a two tier municipal structure, and single tier municipalities which are not part of a two tier structure. In the two tier

municipal structure, the upper tier municipality delivers certain services for the lower tier municipalities within its geographical boundaries. Meanwhile, the lower tier municipalities and the single tier municipalities are referred as local municipalities. In this case, Hamilton is a single tier municipality created by the amalgamation of seven cities in 2001. There are 15 ward councilors in the city of Hamilton who should communicate actively with the communities and convey the communities' issues and aspirations to the local government to be followed up. Canada is one of developed countries who divide road maintenance responsibility into state and municipalities. In the case of Hamilton as a single tier municipality, the city is responsible in managing expressway, arterial roads, collector roads, and local roads. (Ontario Ministry of Municipal Affairs and Housing, 2010)

Ekurhuleni Metropolitan Municipality - South Africa

Ekurhuleni Metropolitan Municipality (EMM) is located in Gauteng Province, South Africa. It was established in 2000 and covers 1,928 km² of land and it is occupied by 2,699,394 people. Annual per capita income is 34,557 Rand. The municipality is an industrial municipal because there are many factories. (Global Insight Regional eXplorer (ReX) v.351 in Ekurhuleni IDP, Budget & SDBIP 2011/12-2013/14). The condition of local roads is 42% in very good condition, 20.33% in good condition, 6.00% in fair condition, 8.00% in poor condition, and 24.00% in very poor condition.



Figure 4. Map of Ekurhuleni Metropolitan Municipality

Based on the Constitution of Republic of South Africa (1996), South Africa embraces three-tier of government: national, provincial, and local legislation. Municipalities are based on local legislation in which they have a right to govern on their own initiative. On the other hand, the local government affairs subject to national and provincial legislation. Therefore, the municipalities should refer to the guidelines issued by the higher level of government in managing local roads located in their territory.

Furthermore, the local authorities in South Africa are subdivided into three categories: metropolitan (A), district (B), and local councils (C). Municipal Structures Act of 1998 stated that the metropolitan municipalities (category A municipalities), which have exclusive executive and legislative authority in their area, can only be established in metropolitan areas. At the moment there are nine metropolitan municipalities, one of them is EMM. The metropolitan councils are responsible for delivering all municipal services. The task of the district and local councils is to negotiate appropriate distribution of services according to local circumstances.

In order to take into account the community, EMM implement a mayoral executive and ward participatory. There are 175 councilors in the municipality, consisted of 88 ward representatives and 87 councilors. Each of the 88 ward councilors heads a ward committee as part of the Ward Participatory System. They actively communicate with communities through reporting back regularly in ward meeting, and assisting the community in identifying needs and priority areas of development. This process is included into municipality planning processes.

II.4. Research Data

In order to answer all research questions, data and information on local road maintenance prioritization conducted in WLR, the City of Hamilton, and EMM are collected. Those data and information are taken from literature published on the journal, books, internet, regulations, and policies, and the results of correspondence with the representatives of local government agency who is responsible in road

maintenance prioritization in those three case studies. Data required for answering research questions are listed in Table 1.

Table 1. Data Required for Research

No.	Strategies in answering the questions	Data Required	Main Source of Data
1.	Analyze the method used in conducting local road maintenance prioritization in WLR, Hamilton city, and EMM.	Policies and guidelines related road maintenance.	Roads Division-Public Work Department of Indonesia, Decree No. 77 (1990), Road Management
2.	Identify criteria considered in conducting local road maintenance prioritization in WLR, Hamilton city, and EMM.	Procedure in decision making process, judgments from all stakeholders, strategic plans that will be implemented, standards and regulations of roads maintenance	Technique: Guideline for Regency Road Maintenance (2005),
3.	Identify actors involved in conducting local road maintenance prioritization in WLR, Hamilton city, and EMM.	Procedure in decision making process, strategic plans that will be implemented, standards and regulations of roads maintenance	Annual Report of Road Department – Public Works Agency (2009)
4.	Analyze the differences and similarities in practicing local road maintenance prioritization in WLR, Hamilton city, and EMM. After that, take the lessons and identify transfer possibilities.	The strengths of road maintenance prioritization in Hamilton city and EMM that can improve the weaknesses of road maintenance prioritization in WLR.	Results of number 1, 2, and 3

II.5. Literature Review

In order to conduct the research, the key concepts, terms, and theories related to local road maintenance prioritization is required for providing the theoretical knowledge. The theoretical knowledge will be used to analyze case studies systematically. In this case, this research takes advantage of literature review for reviewing the relevant published literature on the road maintenance prioritization. Literature review can be defined as a critical analysis of the relevant available research literature on the topic being studied (Hart, 1998). According to Bell (1999), there are two steps in

conducting literature review: search for the relevant literature and review critically the literature. Therefore, through conducting literature review the prioritization in WLR, Hamilton city, and EMM can be analyzed scientifically.

Conclusion:

To sum up, comparative analysis is used in this thesis as a tool to compare similarities and differences of the practices of local road maintenance prioritization aimed to improve the current prioritization practices conducted in WLR. For this reason, this research will explore the local road maintenance prioritization practiced in other places. In this case, it takes the City of Hamilton in Canada, and EMM in South Africa. Those places are selected because they have the better local road quality, represent one developed country and one developing country, have the similar government system with the government system in Indonesia, and have the better or similar economic condition than Indonesia. Those criteria are taken in order to create compatibility as much as possible to transfer the good aspects from other places to be adopted by WLR. Data needed in achieving research objectives cover prioritization procedures, regulations, policies, and guidelines in maintaining infrastructure especially local roads. Those data are taken from the local government agencies, internet, and journals. The key concepts, terms, and theories related to local road maintenance prioritization required for analyzing the data will be extracted from the relevant literature through literature review.

CHAPTER III

LITERATURE REVIEW

This chapter discusses the literature on road maintenance prioritization. In order to answer the first and second research sub-questions (which methods are used in conducting local road maintenance prioritization in West Lombok Regency-Indonesia (WLR), the City of Hamilton-Canada, and Ekurhuleni Metropolitan Municipality-South Africa (EMM)?, and which criteria are considered in conducting local road maintenance prioritization in WLR, the City of Hamilton and EMM?), the internationally prioritization practices including methods, and criteria will be explored. Furthermore, to be able to explain the third research sub-questions (which actors are involved in conducting local road maintenance prioritization method in WLR, the City of Hamilton, and EMM?), the type of actors involved in conducting prioritization will be explained.

The remaining of this chapter is as follow. First, internationally practices of local road maintenance are elaborated in order to give the general characteristics of local road maintenance. Second, road maintenance prioritization will be discussed in order to give an overview of literature on the main topic of this thesis. Third, the characteristic of prioritization methods and criteria considered are described for presenting theories to be used to look at the case studies. Fourth, actors involved in prioritization are explained thoroughly aimed to identify the attributes embrace by each actor through presenting their roles which will determine the type of actors.

III.1. Local Road Maintenance

This section will explain the definition of local roads, the role of local road maintenance, and the definition of local road maintenance. In managing roads, every country classifies the function of their roads differently in order to divide the competence of road management into different level of government. Based on OECD (1994), there are six most common classes based on the functional road classification: motorways, main roads (sometimes divided into two sub-classes I and II), collector roads, local roads, urban roads, and private roads. The term of local

roads in this research is roads that are managed by the local government. This research is focused on local roads because nowadays Indonesia embraces decentralization policy in which the local government is the main actor in providing public services for local communities.

Furthermore, road is an important infrastructure in delivering public services since it can improve the economic and social accessibility. Therefore, there is a necessity for the optimal roads condition for the whole year. Activities aimed to maintain the optimal condition of the roads can be defined as local road maintenance. There are some definitions of road maintenance discussed on literature. For instance, Donnges et al. (2006) defined local road maintenance as integrated activities to maintain the structure of local roads in the minimum level of services throughout its design life. Another definition of local road maintenance is all works needed to maintain and to repair the local roads so that they can perform well and prevent the degradation caused by high demand after construction (NAASRA, 1978 in Alie, Asmawi 2006).

Based on those literatures, local road maintenance can be defined as all activities conducted on roads managed by local government, aimed to maintain and improve the roads quality in order to keep those roads serviceable. Since local roads is an important part of road network, it is important to maintain the roads in order to optimize the performance of road network in delivering public services.

III.2. Road Maintenance Prioritization

This section will explain the definition of prioritization, the objective of prioritization, and the roles of prioritization in road maintenance. The main obstacle in the development is a gap between the amount of infrastructure funds needed and the amount of funds available. Moreover, along with the population increase, the human requirements for infrastructure in facilitating their activities aimed to meet their needs are also increasing. However, the resources owned by the government such as money and time are limited so that the number of infrastructure projects that can be conducted within certain period is restricted. It causes the need for maintaining roads will compete not only with other roads but also with other fields' projects that have the same role in public services. This situation in turns will create

a selection process which will generate a list of candidate projects to be implemented. Project selection is not an easy process in decision making process since it should consider many criteria in identifying the best project (Ciutiene and Neverauskas, 2011). In general, project selection can be defined as a process to evaluate the criteria of different candidate projects for the purpose of funding and execution because in reality some criteria are more essential than others. This process involves prioritization process with certain prioritization method in identifying and assessing their usefulness and overall impacts (Flintsch and Bryant, 2006). Therefore, prioritization is involved from the beginning of decision making process.

In general, prioritization can be seen implicitly when making choices. Priority is interpreted by Gilb and Maier (2005) as relative right of a requirement to the utilization of limited (or scarce) resources. Botta and Bahill (2007) defined prioritization as a negotiation process in achieving tradeoff among different stakeholders with different interests. Furthermore, Agarwal et al. (2004) argued that prioritization is an analysis process to rank the best alternatives of candidate projects based on several factors in order to make the use of limited resources as optimal as possible. According to that definition, it can be said that prioritization in road maintenance is a significant initial step of road management to rank roads to be maintained.

The objective in conducting prioritization is to evaluate the identified projects and to rank them in order of importance (Trigueros, 2008). Through conducting the right prioritization, the decision makers will be capable in deciding which alternatives should be implemented and which one should be eliminated, utilizing the funds effectively and wisely, reducing risks, selecting the highest priority alternative, reducing discussion time, and identifying the high priority alternatives (Botta and Bahill, 2007). Therefore, the prioritization process determines the efficiency in conducting project.

In the case of road maintenance, the available resources cannot match with the requirements of roads that need to be maintained. Realizing that there are some roads that have more significant impacts than the others, Shen and Spedding (1998) argued that prioritization process can be a solution for the lack of funds through

conducting the assessment and setting the priorities for planned maintenance works. In this case, the decision makers can maintain the most significant roads through assessing the roads based on certain standards in order to utilize the limited resources for the optimal results. Recall to those benefits of road maintenance prioritization, it is important to formulate and practice the right road maintenance prioritization.

III.3. Road Maintenance Prioritization Methods

This section will examine the common prioritization procedures conducted in planning process reflecting prioritization methods used in road maintenance prioritization. There are many literatures discuss prioritization methods used in infrastructure planning process. Every prioritization method has different procedures reflected by some sequential steps in ranking a set of alternatives. Normally, there are four common steps used in prioritization process (Trigueros, 2008) as explain bellow.

1. Choose criteria for evaluating projects. It is important to apply the same range of criteria scales for all criteria (Botta and Bahill, 2007). They also suggested some value of criteria/criteria scales. The scales can be low, medium, high; optional, conditional, and essential; nice-to-have, goal, highly desired, and must achieve; and numeric (e.g. 0 to 10)
2. Generate performance measures to compute project compliance to those criteria. In valuing criteria, basically almost all the selection processes are performed in a subjective manner (Vanier et al., 2006) since there is a close linkage between the criteria and the objective of planning process (Hudson et al., 1997).
3. Combine scores for each performance measure in some way.
4. Rank the project in order of importance.

Every method cannot be applied for every case and place because there will be different considerations and situation faced. Hassab-alla (2001), for example, mentions that prioritization based on defective indices which mostly consider rainfall, freeze and thaw cannot be applied in places with a low rain fall rates. Furthermore, Robinson et al. (1998) explain that the prioritization process that covers the small scale area will need a simpler method because there is less possibility of

conflicting interests. The methods are varied from the simple one to the complex one. It can be seen in the six classes of prioritization methods proposed by Hudson et al. (1997): simple subjective ranking based on judgments; ranking based on parameters; ranking based on parameters with economic analysis; optimization by mathematical programming model for year-by-year basis; near optimization using a marginal cost-effectiveness approach; and comprehensive optimization by mathematical programming model. In my view, those six methods can be simplified into four group of methods because the last three methods is similar. In identifying methods used in prioritization process, this thesis will use the four groups of prioritization method extracted from methods proposed by Hudson et al. (2006): simple subjective ranking; ranking based on parameters with scoring and/or weighting; ranking based on parameters with economic analysis; and optimization.

1. Simple subjective ranking

This method just relies on the judgments and experiences of decision makers and can be conducted by using matrix and decision tree. For instance, Haas et al. (1994) in Agarwal et al. (2004) said that this method is a traditional method in which the choices of roads are based on the experiences and subjective judgments of road engineers. Thus, it can be conducted very quickly. Other researchers, Meyer and Miller (2001) stated that subjective ranking involves a subjective assessment of how each project is related to goal achievement by determining cost-effectiveness measures of “high, medium, and low”. In this case, there is no analytical tool used in selecting the roads to be maintained. Therefore, the priorities resulted tends to be bias and inconsistency, far from optimal. Mak (1973) in Trigueros (2008) emphasized that the use of this method can cause the selection process vulnerable to personal engineering biases, lack of comprehension, lack of consistency and transparency, and become unmanageable. Furthermore, National Cooperative Highway research Program (1978) in Trigueros (2008) stated that the use of this method also will create political bias. These flaws generate the requirement for the new prioritization methods that promote objectivity, rationality and defensibility (Trigueros, 2008). It reveals the clear sequence steps, the transparency of the data, criteria, and performance measures used (Turochy and Willis, 2006 in Trigueros, 2008). This

new prioritization method is developed time to time and will be further elaborated in the following sections.

2. Ranking based on parameters with scoring and/or weighting

This method is also simple, easy to use, and quick but the results may be far from optimal (Hudson, 1997). In the field of road maintenance, Haas et al. (1994) in Agarwal et al. (2004) argued that there are some priority assessment schemes in developing priority rating scores according to certain numerical composite index such as defects rating index, pavement condition index, maintenance need index, rate, priority, and fuzzy condition index. However, most of those schemes focus only on the pavement condition. It causes the prioritization results are far from optimal. For that reason, the other methods using multi criteria become popular. For example, there are also some approaches that combine those indexes such as unique sum approach, utility theory, Delphi method, factorial rating method, and fuzzy set theory. Shen and Spedding (1998) argued that ranking based on multi criteria can minimize the subjective elements that are predominant in the decision making process for planned maintenance, and can increase the transparency of the prioritization process which eventually will improve public accountability. Therefore, prioritization that based on parameters is better than prioritization based on parameter.

3. Ranking based on parameters with economic analysis

According to Zimmerman (1995) in Agarwal et al. (2004), this method is the most well-known method in prioritization process because this method is reasonably simple. The decision making tools that can be used in this method are benefit/cost ratio, life cycle cost analysis, or cost-effectiveness. In practice, it transforms all maintenance factors to equivalent monetary values, and then uses an economic index to evaluate the alternative projects so that it should be closer to optimal (Haas et al., 1994 in Agarwal et al., 2004). However, it is difficult to measure all relevant impacts of a project in money terms (Hudson et al., 1997). Thus, this method needs a thorough analysis.

4. Optimization

Haas et al. (1994) in Agarwal et al. (2004) explained that this method is quite complex and often be the most time-consuming method. On the other hand, it has

the advantage of producing the most optimal decision in which it maximizes the benefits and minimizes the costs (Hudson et al., 1997). Besides that, the optimization technique considers both time (current and future) and space (entire network). To accomplish this, road sections are categorized into different condition categories based on factors such as pavement condition and traffic volume. The proportion of road network in each of the condition category at different time period reflects the performance of road network over time. The objectives of the optimization technique are maximization of performance standards, and minimization of costs and the deficient portion of the network. The required components to accomplish these objectives are the selection of a functional criteria, performance variables, road classes, and condition categories; the specification of maintenance alternatives; and the development of the mathematical model. There are three components of the mathematical representation in this technique: decision variables, objective function, and constraints. (Peng and Ouyang, 2010). In line with the development of science, optimization has been developed through the time. Along with the development of this method, optimization can be divided into three groups as explained below:

- a. Optimization by mathematical programming model for year-by-year basis. This method is less simple and may be close to optimal, but the effects of timing are not considered.
- b. Near-optimization using a marginal cost-effectiveness approach. This method is reasonably simple, and it is close to optimal results.
- c. Comprehensive optimization by mathematical programming model, taking into account the effects of ‘which’, ‘what’, and ‘when’.

The sequential steps of procedures which implicitly show prioritization methods used are depended on the decision maker’s considerations. Therefore, every method conducted by different actors tends to represent the different sequential steps. Based on many literatures discussing this issue, there are basic procedures conducted for every prioritization method, as shown in Table 2.

Table 2. The Characteristic of Prioritization Methods

Methods	Procedures	Sources
Simple Subjective Ranking	<ul style="list-style-type: none"> - Use a subjective assessment of how each alternative related to certain goal achievement - Based on the experiences and subjective judgments of road engineers. - Can be conducted by using matrix and decision tree. 	Meyer and Miller (2001); Hudson et al. (1997); Haas et al. (1994) in Agarwal et al. (2004)
Ranking based on parameters with weighting and/or scoring	<ul style="list-style-type: none"> - Define the set of alternatives - Identify criteria used - Assign weights to each of the criteria on the basis of its relative importance - Normalize the criterion weights which reflect the relative importance of the criteria - Measure all alternatives and give score in respect of each criterion selected earlier - Calculate the overall priority index for alternatives by using certain formula - Rank the alternatives in descending order of that index. - Program the alternatives based on the rank until the budget constraint is reached. 	Shen and Spedding (1998); Hudson et al. (1997); Meyer and Miller (2001); Steinthal (1984); Haas et al. (1994) in Agarwal et al. (2004); Sharaf and Mandeel (1998); Tsamboulas (2006); Karvetski et al. (2009); Agarwal et al. (1994); Karydas and Gifun (2005); Agarwal et al. (2004); Fwa et al. (1988); Vanier et al. (2006); PEPA/23 (http://ec.europa.eu/environment/enlarg/pdf/projprioritercriteria.pdf , accessed on 7 th May 2012); Wiegers (1999); Zangeneh et al. (2009); Botta and Bahill (2007); Kulkarni et al. (2004); Kitsap County Public Works (2007); Jiang and Klein (1999); Mohanty (1992)
Ranking based on parameters with economic analysis	<ul style="list-style-type: none"> - Transform all maintenance factors to equivalent monetary values, and then uses an economic index to evaluate the alternative projects. 	Meyer and Miller (2001); Sharaf and Mandeel (1998); Fwa et al. (1988); Vanier et al. (2006)
Optimization	<ul style="list-style-type: none"> - Select of a functional criteria, performance variables, road categories and condition states, specification of maintenance alternatives. - Develop the mathematical model. 	Sharaf and Mandeel (1998); Fwa et al. (1988); Vanier et al. (2006); Meyer and Miller (2001)

III.4. Road Maintenance Prioritization Criteria

The final output of prioritization is a ranking of projects so that prioritization can be defined as the preference ranking of projects (Vanier et al., 2006). In this case, projects with the worst score will have the highest priority. One essential step in

ranking the alternatives is assessing the criteria. Regarding to the criteria, Vanier et al. (2006) divided the existing prioritization techniques into two groups: single criteria prioritization technique and multi criteria prioritization technique.

1. Single criteria prioritization technique is a prioritization technique which only considers one criterion. This method is conflicting because every technique with different criterion can produce different ranking (Vanier et al., 2006). For example, the prioritization based on the age of road maintenance will generate the different ranking with prioritization based on road condition. Sharaf and Mandeel (1998) also found the different output when they assessed the alternatives based on lowest life cycle cost, highest traffic, and highest benefit/cost ratio.
2. Multi criteria prioritization technique is a prioritization technique that assesses several criteria. This method potentially gives the better result than the single criteria prioritization technique because it is more comprehensive in addressing the issues. In choosing the most suitable prioritization technique, it is important to look at the situation faced. For instance, if there are many conflicting interests among stakeholders, Nijkamp et al. (1998) in Tsamboulas (2007) proposed to use multi criteria analysis rather than single criteria analysis.

For the respect of effectiveness and efficiency, not all proposed criteria will be considered in prioritization process. The criteria chosen are based on the level of importance decided by planners. Furthermore, the criteria used for assessing the alternatives in every prioritization method used can be single criteria or multi criteria, based on the situation and issued faced. For example, Vanier et al. (2006) argued that decision makers in road maintenance should decide the alternatives based on several criteria such as type of maintenance interventions, overall network performance, risk and reliability, life cycle costs, desired levels of service, budgetary constraints, construction costs, social and costs. In another case, Flintsch and Bryant (2006) claimed that the prioritization methods are usually used in selecting projects in order to evaluate the attributes of different candidate projects for the purpose of funding and implementation, economic impacts, and timing parameters. According to their research, there are several criteria considered in selecting projects: available budgets, engineering parameters, public demands, project significance, agency costs/benefits, usage of project, environmental considerations, geographic

distribution of projects/funds, user costs/benefits, distribution among asset types, ease/difficulty of implementation, and proximity of project to major urban areas. Li and Sinha (2004) added other criteria such as the effect of certainty, risk, and uncertainty. Based on many literature discussing prioritization criteria, criteria that commonly used in road maintenance prioritization can be seen in Table 3.

Table 3. The Criteria Considered in Road Maintenance Prioritization

Criteria	Sources
- Regional goals and objectives	Meyer and Miller (2001); Hudson et al. (1997); Haas et al. (1994) in Agarwal et al. (2004); Shen and Spedding (1998);
- Technical such as road condition, traffic volume, and other performance variables	Hudson et al. (1997); Meyer and Miller (2001); Steinthal (1984);
- Political	Haas et al. (1994) in Agarwal et al. (2004); Sharaf and Mandeel (1998); Tsamboulas (2006); Karvetski et al. (2009); Agarwal et al. (1994); Karydas and Gifun (2005); Agarwal et al. (2004); Fwa et al. (1988); Vanier et al. (2006); PEPA/23 (http://ec.europa.eu/environment/enlarg/pdf/projprioritycriteria.pdf); Wieggers (1999);
- Financial	
- Social	
- Economical	
- Legal	
- Environmental	Zangeneh et al. (2009); Botta and Bahill (2007); Kulkarni et al. (2004); Kitsap County Public Works (2007); Jiang and Klein (1999); Mohanty (1992)
- Risk	
- Intangible factors	

III.5. Actors Involved in The Prioritization

This section will discuss the definition of actors, the roles of actors involved, the actors' attributes, and the types of actors in road maintenance prioritization process. Actors can be defined as any group or individual who (can) affect or is affected by the achievement of the organization's objectives or actions (Freeman, 1984; Jones, 1995; Kreiner & Bhambri, 1988 in Mitchell et al., 1997).

In decision making process, actors have their own role which is closely related to their salience. The key success of actors' involvements is the integrity and capability of actors involved. Moreover, the extent of actors' involvement in decision making process will influence the final decision. For that reason, it requires a good understanding of actors involved in decision making process include prioritization. Technically, actors take an important part in the prioritization process. It can be seen when a planning team selects the criteria that need to be considered. This team is consisted of the representatives of all relevant actors who are affected by and/or influence the decision making process. Then, the team weights each criterion and

applies to every candidate project. After that, the team can calculate the scores, and finally rank all alternatives. Furthermore, when a prioritization will be started, the leader of the team can identify and select the actors that will be involved.

Furthermore, Ward (2001) suggested involving the diverse actors in transport planning process. The reason for his suggestion is the involvement of various actors who represent the different interests in planning process will reveal the diversity of problem definitions and innovations which will be beneficial in calculating the level of importance of alternatives. Therefore, the prioritization becomes more representative in accommodating all actors' interests. For example, based on World Bank document discussing rural road maintenance (Ward, 2001) actors involved in prioritization are focused on various government agencies, commercial interests, and local communities. This best practice states that local participation is very important since they have the most updated data as they use the roads daily. Moreover, Schroeder (http://pdf.usaid.gov/pdf_docs/PNACB393.pdf) argued that the centralized decision making which is often ignoring local preferences will lead to a less efficient outcome and their willingness to participate. Besides that, in this system the higher level of government set the guidelines. Furthermore, Ward (2001) stated that the involvement of diverse actors does not make the planning process become expensive and inconclusive. However, the effort to involve the diverse actors is not easy since it is related to the current power structure that constraint the involvement of diverse actors. For that reason, it is important to identify the type of actors involved based on their roles in road maintenance prioritization so that there will be recommendations proposed related to actors involved in order to improve the prioritization practices.

Mitchell et al. (1997) proposed three attributes (power, legitimacy, and urgency) in identifying the different classes of actors, as explained below.

1. Power. Power is a relationship among social actors in which one social actor, A, can get another social actor, B, to do something that B would not otherwise done (Dahl, 1957; Pfeffer, 1981; Weber, 1947 in Mitchell et al., 1997). Actor who has power is one who has the (potential) ability to impose their will on a given relationship through coercive, utilitarian, or normative means (Etzioni, 1964 in Parent and Deephouse, 2007)

2. Legitimacy. Legitimacy is a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions (Suchman, 1995; Weber, 1947 in Mitchell et al., 1997). It can be attained in the level of individual, organizational, and societal (Wood, 1991 in Mitchell et al., 1997).
3. Urgency. Urgency is the degree to which actor claims to call for immediate attention based on time sensitivity. Furthermore, it is the degree to which managerial delay in attending to the claim or relationship is unacceptable to the actor. It also can be defined as the importance of claim or relationship for actor (Mitchell et al., 1997).

In their research, Parent and Deephouse (2007) found that the more attributes belong to certain actors, the more important their roles in the planning process. Besides that, they rank those attributes in which power in the first place as an influence attribute, followed by urgency, and then legitimacy. Mitchell et al. (1997) established eight types of actors based on various combinations of those three attributes: dormant actor, discretionary actor, demanding actor, dominant actor, dangerous actor, dependent actor, definitive actor, and non-actor. As illustrated in Figure 5, dormant actor, discretionary actor, and demanding actor are actors that only possess one attribute. Dominant actor is actor that possesses power and legitimacy. Dangerous actor is actor that possesses power and urgency. Dependent actor is actor that possesses legitimacy and urgency. Definitive actor is actor that possesses power, legitimacy and urgency. Non actor is actor that possesses no attribute.

From Table 4, it can be seen that there are diverse name of actors. In this case, there are some researchers who already classified those actors. For instance, Ward (2001) classified actors into planners, politicians, monitoring organizations, and business. Taschner and Fiedler (2009) divide actors into four general groups: government/authorities, businesses/operators, communities/local neighborhoods, and others. In this thesis, those actors will be classified into nine groups: authorities, technical agency of local government, non technical agency of local government, higher level of government, politicians, communities, funding donor, business, and others.

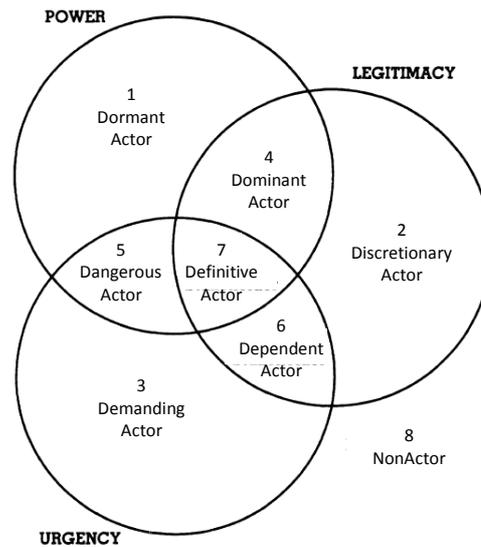


Figure 5. Types of Stakeholders (source: Parent and Deephouse, 2007)

Furthermore, based on those eight types of actors as shown in Figure 5, there are 4 (four) groups of actors according to the number of attributes they possess. First, latent actors are those possessing only one attributes, and include dormant who only hold power, discretionary that only hold legitimacy, and demanding stakeholders who only hold urgency. Second, expectant actors are those possessing two attributes, and include dominant who hold power and legitimacy, dependent that hold legitimacy and urgency, and dangerous stakeholders that hold power and urgency. Third, definitive actors are those possessing all three attributes. Fourth, non-actors or potential actors are individuals or entities possessing none of the attributes. There are many actors involved in prioritization process discussed on many literatures. Their types can be identified by first putting them on the attribute they possess, as shown in Table 4.

Based on the above explanation, actors listed in Table 4 can be classified into eight types described in Figure 5. Dormant actors: donor-funded road maintenance projects, the project manager; discretionary actors: technical expert except planners, development representatives; demanding actors: road users (key customer representatives), road engineering industry, businesses affected; dominant actors: political actors or legislative (local politicians); dangerous actors: community (the general public); dependent actors: planners, contractor or consultant; definitive

actors: road administration (public authorities), transportation decision makers; and none actors: none. They also can be grouped into four groups: latent actors: donor-funded road maintenance projects, the project manager, technical expert except planners, development representatives, road users (key customer representatives), road engineering industry, and businesses affected; expectant actors: political actors or legislative (local politicians), community (the general public), planners, and contractor or consultant; definitive actors: road administration (public authorities), and transportation decision makers; and non-actors: none.

Table 4. The Actors Involved in Prioritization and Their Attributes

Sources	Power	Legitimacy	Urgency
Nick Osborne (1995)	- Local politicians - Community	- Local politicians - Planners - Other technical experts	- Planners - Community
Hassab-alla (2001)	- Road administration (public authorities) - Political actors or legislative - Donor-funded road maintenance projects	- Road administration (public authorities) - Political actors or legislative - Contractors and consultants	- Road users - Road engineering industry - Contractors and consultants - Road administration (public authorities)
King (1978)	Individuals that have various claims on the organization (stock holders)	Individuals that have various claims on the organization (regulators)	Individuals that have a stake in the way the organization is operated (e.g. managers, employees, vendors, customers, etc.)
Wieggers (1999)	- The project manager	- Development representatives	- Key customer representatives
Orndoff (2003)	- Transportation decision makers - The general public	- Transportation decision makers	- Businesses affected - The general public - Transportation decision makers

Conclusion:

In conclusion, the prioritization is a crucial part in local roads maintenance because it helps the decision makers in allocating the resources in maintaining local roads efficiently and effectively so that roads can be kept in their optimal condition. Given the importance of prioritization, it is important to identify methods used, criteria considered, and actors involved. According to the literature, there are four groups of prioritization methods based on procedure they conducted, and there are eight types of actors involved in prioritization process determined by the attributes (power, legitimacy, and urgency) they possess. The four classes of prioritization methods are simple subjective ranking; ranking based on parameters with scoring and/or weighting; ranking based on parameters with economic analysis; and optimization. The criteria used in assessing the alternatives can be single criteria and multi criteria. Furthermore, the eight types of actors are dormant actor, discretionary actor, demanding actor, dominant actor, dangerous actor, dependent actor, definitive actor, and non actor.

CHAPTER IV

THE IMPLEMENTATION OF ROAD MAINTENANCE PRIORITIZATION IN WEST LOMBOK REGENCY - INDONESIA

In order to answer the main research question of how the local road maintenance prioritization is practiced in West Lombok Regency-Indonesia?, the practices of local road maintenance prioritization in West Lombok Regency (WLR) located in Nusa Tenggara Barat province, Indonesia will be explored in this chapter. The exploration will cover local road maintenance concept, methods used, criteria considered, and actors involved in local road maintenance prioritization.

Since every country has their own framework for road management including local road maintenance prioritization, it is important to understand the local road maintenance concept legally used by the local government of WLR before further exploring the practices of local road maintenance prioritization. For that reason, the overview of local road maintenance concept will be put in the first stage. After that, the local road maintenance prioritization methods will be identified through examining prioritization procedures conducted in WLR. Furthermore, all criteria considered in prioritization will be discovered through identifying factors considered and/or influencing the practices of prioritization. Finally, the actors involved in the prioritization will be identified and grouped into their types by tracking their attributes.

IV.1. The Overview of Local Road Maintenance

According to Roads Division-Public Work Department of Indonesia (1990), road works can be divided into three groups which are maintenance works, heavy works, and holding works. In this case, road maintenance can be defined as a road works that are performed to all roads in good and fair condition in order to maintain the road quality to be as much as the original quality and to extend roads service life (Roads Division-Public Work Department of Indonesia, 1990). Faced with the limited resources, roads that need to be maintained should be prioritized appropriately. It is aimed to ensure the services will be delivered well.

According to Article 14 Act No. 38 year 2004 about roads, government authorities manage roads through issuing general arrangement and general guidance for road development such as road maintenance prioritization guideline. Based on the Decree No. 77 year 1990 about Regency Road Management Guideline for Regencies in Indonesia, there are two kinds of maintenance activities conducted in WLR: routine and periodic maintenance. The former is activities in maintaining and repairing the failures on the steady roads. Meanwhile, the latter can be defined as activities in maintaining every failure counted in design so that the reduction in road condition can be restored to the initial stability as planned.

The implementation of local road maintenance in WLR is still based on the Decree No. 77 year 1990 about Regency Road Management Guideline for Regencies in Indonesia with some modifications adjusted to decentralization. The new guideline titled Road Management Techniques: Local Roads Maintenance Guideline issued by Public Works Department year 2005 has not been implemented yet in WLR. In this guideline, the prioritization is suggested to use matrix relation between traffic volume hierarchy and maintenance activities hierarchy. In this case, the highest priority are given to the urgent maintenance for strategic roads, and the lowest one are given to overlay works for very low traffic roads. The reason for this suggestion is the roads with high traffic volume usually important for economic activities so that those roads become easily damaged. The prioritization methods used will be explored in the next section.

IV.2. Local Road Maintenance Prioritization Methods Used

In practice, the prioritization methods for district roads and rural roads in Indonesia are the same, the difference is on the budget allocation. There are some steps of local road maintenance prioritization conducted in WLR based on the Decree No. 77 year 1990 about Regency Road Management Guideline for Regencies in Indonesia, as explained below.

1. List the proposed roads to be maintained. These proposals are sent by village government, sub-district government, and communities. In this case, the proposals related to local road maintenance are delivered through letters.

2. Conduct road survey for all local roads because there should be sufficient data in order to make a rationality budget allocation. There is a road condition survey for steady roads, and road screening survey for unsteady roads conducted for one third of road length. However, because the limited budget, survey conducted only to the damaged roads that has not been managed in previous year.
3. Classify the condition of roads into good, fair, poor, and very poor. Good is for roads that have really excellent flat surface; there is no wave and no failure on the pavement. Fair is for roads that have the medium flat surface, no wave and no failure at all. Poor is for roads which have waved surface, there is a little failure detected and some patches are existed. Very poor is for roads which have many failures such as waved surface, big cracks, and already exfoliated with foundation damage. After that, roads can be classified into two groups: steady roads and unsteady roads. (Roads Division-Public Work Department of Indonesia, 1990)
 - Steady roads are roads that can serve four-wheeled vehicle within one year, and they have certain design life based on technical planning. Roads that take into this category are roads with good or fair condition. The road maintenance activity for this group is routine maintenance.
 - Unsteady roads are roads that not reliable for serving four-wheeled vehicle within one year, but cannot be counted in life design and did not follow technical planning standards. Roads that take into this category is road that in poor or very poor condition. There are two kinds of work that can be done to this group: hard work including periodic maintenance/rehabilitation and improvement, and holding work.

Those classifications also determine the next survey. In this case, in updating the road inventory data within three years, the steady roads need to be surveyed every year. Meanwhile, for unsteady roads, it just needs to be surveyed one third for every year so that all roads can be completely surveyed within three years. Ideally, every steady road has to get priority to be maintained with routine and periodic maintenance.

4. Determine the type of road maintenance activity needed for each condition. There are several types of road maintenance activities based on execution time,

physical form of work, and the value of work. For WLR, they emphasize the consideration of execution time in distinguishing the road maintenance activities for prioritizing road maintenance. In this case, routine maintenance for the execution time of less than one year, periodic maintenance for the execution time of less than several years, and emergency maintenance which is unpredictable. Routine maintenance is small scale works done on all road networks spread and routinely. Through routine maintenance, the decrease level of structural pavement condition will be close with the design. Meanwhile, periodic maintenance is maintenance works done within several years, done completely for one or some road routes and the characteristic of these works is functional, and not subject to improve the structural pavement. This program is aimed to maintain road condition as planned during the service life.

5. Conduct the first ranking based on road condition, roads class, and the level of importance for communities. After that, calculate the budget required based on unit cost of road maintenance work issued by the Regent. The ranking in this stage is based on the worst first condition established subjectively in order to determine the level of importance of roads. Besides that, this stage shows the appreciation to the communities' interests as stated by Act of Republic of Indonesia Number 38 year 2004 about roads in which communities have both rights and responsibilities. In this case, they can give inputs to road management in managing the roads, gain the benefits in accordance with the minimal standard of services, get the information related to roads, obtain the adequate compensation caused by the mistakes in road development, and file a lawsuit caused road development. Meanwhile, they are responsible to be involved actively in road maintenance.
6. Discuss the first rank in Development Planning Consensus (*musyawarah perencanaan dan pembangunan*) which is a meeting between the representatives of public works agency, local planning agency, communities, and council to discuss government development plans. The meeting is conducted from village, sub district, until district level. In this meeting, the first ranking product is presented by the road planning section of public work agency. After that,

communities and local government agencies give responses, either they agree or not. If not, they will convey their reasons and can deliver their proposals.

7. Conduct the second ranking based on the result of Planning and Development Consensus. The rank will be brought to the funding donor organization to be legalized. For instance, the proposed roads to be maintained using General Allocation Funds (*Dana Alokasi Umum*) will be brought to the Local Council. Meanwhile, roads proposal using Special Allocation Funds (*Dana Alokasi Khusus*) will be brought to the National Treasury.

Based on the procedures conducted in prioritizing the local road maintenance described above, the engineers in WLR make the rank based on the worst first criteria in which the more damaged roads, the more those roads will be prioritized. After that, the roads are ranked based on the level of importance for communities based on the letters that they sent to the government agencies and based on the results of Planning and Development Consensus. This process is done subjectively based on actors' judgments such as community preferences, and government staff experiences and judgments without using any analytical tools. Therefore, the method used in local road maintenance prioritization in WLR can be categorized as simple subjective ranking method.

IV.3. Criteria Considered in Prioritization

In ranking the roads to be maintained, the technical agency of WLR government (public works agency) assesses every road based on certain criteria. Criteria considered in prioritization in WLR can be explained below.

1. Technical criteria include road condition, and the surface type of roads. Road condition determines the road maintenance activities that should be conducted and can be identified from visual surveys. Based on Indonesia Decree No. 77 year 1990, road condition is divided into four categories: good, fair, poor, and very poor. In surveys, the surface type of roads is identified, and through visual assessment the condition is determined. The general road condition characteristics for pavement are smooth surface for good, relatively smooth surface with some cracks for fair, uneven surface for poor, and the severely

damaged surface for very poor. Meanwhile, the surface type of roads is needed to be surveyed because it will determine the type of maintenance treatment and maintenance unit cost. Road surface types in WLR are divided into four types: asphalt, gravel, stone, and earth.

2. National and local goals and objectives. The local road maintenance prioritization in WLR is intended to support the national projects affecting local development so that it can create the integration of road network function, improve accessibility, and support regional development. The national goals and objectives that need to be supported can be seen through letter sent by national agency to local agency. According to Indonesia Decree No. 77 year 1990, the local roads should also support provincial roads which link to the national roads or national strategic roads, and improve accessibility to the provincial areas, isolated areas, disaster areas, and border areas. However, since decentralization there is no regular coordination between local government and provincial government. They only will coordinate if there is a requirement from national government regarding to national project located in WLR. This criterion is considered in prioritization through examining the projects location that need to be supported in short term and long term planning based on the information from local planning agency.
3. Political criteria. This criterion has great influence on the prioritization in WLR. For example, in ranking the proposed roads to be maintained planners should consider the equity among regions. In this case, WLR area is divided into three regions: northern, middle, and southern. Therefore, the area of local road maintenance is also divided into three regions as mentioned before. In order to be fair for all residents, the length of roads that will be maintained will be spread evenly into those three regions. It will change the order of the first rank prepared by using technical criteria.
4. Financial criteria. This criterion can be seen in the form of budget availability decided by the council, and donor funding. There is always a big gap between the required funds and the available funds for infrastructure development in the regency include road maintenance. For example, based on the report of Public Works Agency of WLR titled Operational Planning of Road Department, in year

2010 more than 35,000 million rupiah is needed for maintaining all roads. However, funds allocated are only 4,394 million rupiah. This situation will influence the last rank because the order of the rank can be changed if the budget available is less than the budget needed. In this case, the budget will be used to maintain more road routes by changing the rank. Most of road maintenance fund in Indonesia is sourced from Special Allocation Funds. Regarding to budget sourced from financial agencies, there are some requirements from them to be obeyed. In this case, every funding donor has certain requirements that should be fulfilled by the recipients. Based on The Regulation of Public Works Minister Number 15/PRT/M/2010 of Technical Guideline in managing Special Allocation Funds for Infrastructure Development, special allocation funds only can be used for regency roads and for periodic maintenance purposes, not for rural roads or routine maintenance purposes. For road maintenance using special allocation funds as funding source, the required procedures are programming and budgeting (compose the list of road, the road prioritization, treatment program, and operational planning); road technical planning, construction; monitoring and evaluation, reporting; and performance rating.

5. Social criteria. This criterion can be seen in the form of the level of importance of roads determined by actors' preferences. For example, the level of importance for communities can be revealed within meetings attended by communities and technical agencies of local government in Development Planning Consensus. It also can be seen through the proposal sent by communities to the local agency regarding roads maintenance. For example, roads that link residential areas with schools, hospitals, government services, market, and places for worship such as mosques and temples will be prioritized.
6. Legal criteria. Based on road status, there are national roads, provincial roads, regency roads, city roads, and rural roads (Public Works Department, 2005). Regency is responsible in managing regency roads and rural roads (Public Works Department, 2005). In this case, the former are local roads in primer road network system which are not included as national roads and provincial roads, that link the capital of regency with the capital of district, between the capital of districts, the capital of regency with the center of local activities, between the

center of local activities, and public roads within secondary road network system, and regency roads strategic. Meanwhile, the latter are public roads that link areas and/or residential within village, and neighbor roads. There are also roads located in the regency but those roads are not included into regency roads and rural roads. Those roads are called non status roads. There are about 446 km of regency roads that should be surveyed every year, and prioritized to be maintained. However, if there is very limited funds available, road planning will only refer to the latest data. For now, the survey conducted for rural roads is very rare because the limited budget for survey. Therefore, the survey will be conducted only for rural roads proposed by communities to be maintained.

Since the implementation of local road maintenance prioritization in WLR considers some criteria, the prioritization can be said use multi criteria consisted of technical criteria such as road condition, the level of importance, and the surface type of roads; national goals and objectives; political criteria, financial criteria, social criteria, and legal criteria.

IV.4. Actors Involved in Prioritization

Generally, there are different road management authorities responsible for different status of roads. Road management authorities in Indonesia were divided into two groups: national government and local government. The former manages the primer road networks: national roads and provincial roads. Meanwhile, the latter manages the secondary road networks: municipal or regency roads. The government of Indonesia gives the authority to manage regency and rural roads to local government. Actors that are involved in road maintenance prioritization are explained below.

1. Authority. In this case authority is Regent. He or she legalizes the list of regency roads and rural roads in the form of Regent decree. The maintenance of those roads is the responsible of the local government. Furthermore, he or she approves the final rank of roads proposed to be maintained, and then submit the rank to the local council or funding donor. These roles show that he or she holds power. Besides that, he or she determines the maximum maintenance unit cost for every maintenance activity. It means that he or she holds legitimacy.

2. Technical agency of local government. There are two technical agencies involved in local road maintenance prioritization in WLR: public works agency and local planning agency.
 - Public works agency is represented by the head of the agency and the road planning team. According to the Act of Republic of Indonesia Number 38 year 2004 about roads, the responsibility of maintaining roads in WLR is on the regency government. In this regency, the official executor for road maintenance prioritization is road planning section of public works agency (The local government of West Lombok Regency Regent, 2010). In carrying out their duties, the final decision should be approved and issued by the head of agency. He or she will approve the final rank of roads to be maintained proposed by the planning team. This approved rank will be proposed to local council. Besides that, he or she proposes guidelines for local government in maintaining their roads. Those standards should be implemented by local government agencies and become the reference for monitoring and evaluation. Therefore, he or she takes power and legitimacy. As mentioned before, there is a planning team that proposes the rank of roads that need to be maintained. This planning team consisted of minimum four technical staff taken from technical government local agencies related to road maintenance, as stated in Indonesia Decree No. 77 year 1990. The team will conduct road condition survey and analysis. This team, as listed below, will work for two until four months every year, and will be responsible to the head of public work agency. The team is consisted of some personnel, as listed below.
 - ✓ Planning team coordinator is the head of road planning section. He or she should have socio economic experiences, ability in organizing staff, and communication skill. He or she coordinates all steps in prioritizing the roads to be maintained. Thus, he or she can be said embraces power, legitimacy, and urgency.
 - ✓ Transport planner should have socio economic experiences, ability in organizing staff, and communication skill. He or she decides the proposed roads to be maintained, maintenance activities, criteria considered, value and weight. Therefore, he or she holds power, legitimacy, and urgency.

- ✓ Planning Engineer should have background in technical skill and maintenance cost calculation. He or she decides maintenance costs and analyzes the data. Thus, he or she has power and legitimacy.
- ✓ Traffic surveyor coordinator takes data from survey. Therefore, he or she takes the attribute of urgency because the output of his or her work is used for identifying the degree of road damages.

Since the main actor is the local government, the performance of road maintenance prioritization is depended on the quality of civil servants who are in charge in the local government of WLR. According to data provided by Public Works Agency of WLR, in 2009 road planning section has nine personnel consisted of five civil engineering staff, and four high school graduation. However, not all technical staffs work on road maintenance prioritization since some of them are also involved in roads procurement which consumes their time. Therefore, they cannot fully concentrate in conducting road survey and road prioritization analysis. Besides that, in every district there is a technical staff that is in charge as road observer. The road observer is assisted by minimum one technical staff and one administration staff. They are in charge to observe the road condition and submit the report to the road department every month.

- Local Planning Agency. This agency is responsible for coordinating the meeting among actors in discussing the rank of roads to be maintained. This agency will evaluate whether the proposed roads support the goals of local development or not. Therefore, this agency embraces legitimacy.
3. Politician. In this case, politician is local council. They decide some mandatory local regulations that influence the local road maintenance prioritization. Besides that, council issues the budget allocated for local road maintenance, and approves the final list of roads to be maintained proposed by the local government. These roles indicate that they embrace power and legitimacy.
 4. Communities. The importance of society's participation in road management is stated in Act number 38 year 2004 of roads. In this Act, communities' involvement in all infrastructure planning is a mandatory include road maintenance prioritization. The involvement of communities is conducted

through letters or through meeting attended by local government agencies, local council, and communities. Their aspirations can be delivered either by themselves or by their representatives. Those aspirations usually show the level of importance of the roads. In this case, they usually only propose to maintain the roads that have a significant role in their daily life. For those reasons, it can be said that communities hold urgency.

5. Financial agency or funding donor determines the budget allocation for local government to be used to maintain the local roads. Besides that, this agency also regulates guideline as a reference in conducting road maintenance prioritization using their funds. Those roles cause funding donor holds power and legitimacy.

According to the above explanation, it can be seen that council, regent, and communities has the equal relationship, as illustrated in Figure 6. Furthermore, based on the attributes owned by each actor, those actors can be classified, as shown in Table 5.

Table 5. The Type of Actors in West Lombok Regency

Actor		Power	Legitimacy	Urgency	Type of actor
Authorities	Regent	√	√		Dominant
Technical agency of local government	The Head of Public Works Department	√	√		Dominant
	Coordinator planning team	√	√	√	Definitive
	Transport planner	√	√	√	Definitive
	Planner engineer	√	√		Dominant
	Traffic survey			√	Demanding
	Local Planning Agency		√		Discretionary
Communities	Communities			√	Demanding
Politicians	Council	√	√		Dominant
Funding donor	Financial agency	√	√		Dominant

According to Table 5, there are four types of actors involved in road maintenance prioritization in WLR: dominant, definitive, demanding, and discretionary actor. In this case, coordinator planning team and transport planner embrace power,

legitimacy, and urgency so that they are classified into definitive actor. Furthermore, planner engineer, regent, the head of public works department, council, and donor funding that hold power and legitimacy are the dominant actors. Meanwhile, traffic survey and affected communities hold urgency that makes them as demanding actors. Whereas, local planning agency which only hold legitimacy attribute is classified into discretionary actor.

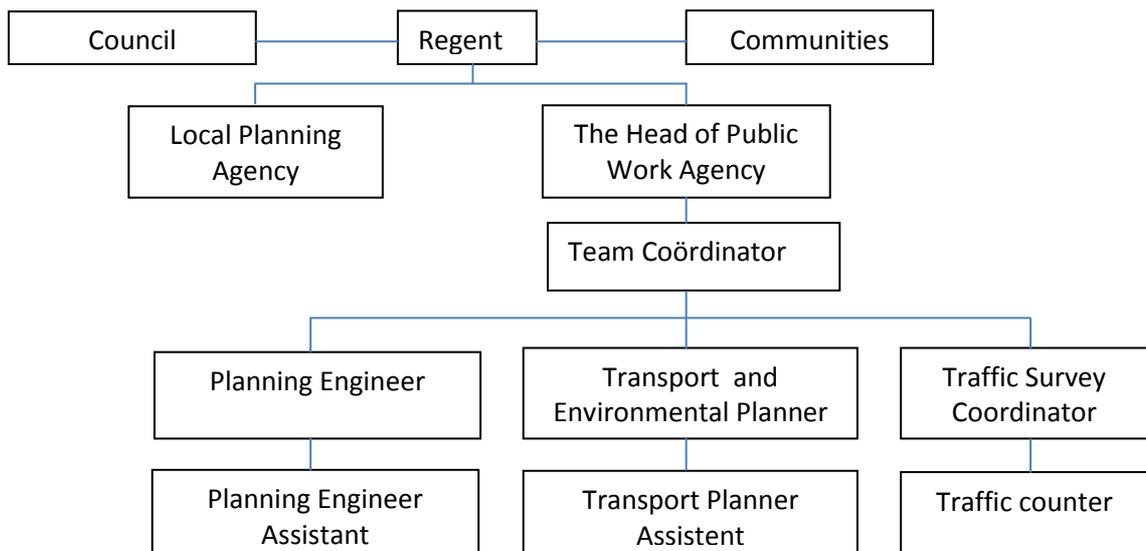


Figure 6. The scheme of actors involved in local road maintenance prioritization in West Lombok Regency (Modify by author)

Conclusion:

The local road maintenance prioritization in WLR is conducted by using simple subjective ranking method. In this prioritization, technical, national and local goals and objectives, political, financial, social, and legal criteria are considered. Authority, technical agency, politician, communities, and financial agency are involved in the prioritization. They can be divided into four types: dominant, definitive, demanding, and discretionary actor.

CHAPTER V

THE IMPLEMENTATION OF ROAD MAINTENANCE PRIORITIZATION IN THE CITY OF HAMILTON - CANADA

This chapter will discuss the overview of local road maintenance concept, prioritization methods used, criteria considered, and the type of actors involved in conducting local road maintenance prioritization in the City of Hamilton located in Ontario province, Canada. Local road maintenance prioritization can be defined as one stage in managing the roads in order to keep the roads in their optimal condition (certain level of service). That definition brings the analysis of local road maintenance. It will not only explore the guidelines and practices of road maintenance prioritization in the City of Hamilton, but also examine the asset management guidelines and practices for the municipalities in Canada.

In the first section, the overview of local road maintenance concept in the city of Hamilton will be explained. This section includes the definition of road maintenance and other terms used in the prioritization, goals and benefits. Therefore, all terms used in the next sections can be understood. The methods used in prioritizing road maintenance in the city of Hamilton are explored in the next section. Then, the criteria considered in the prioritization can be identified through finding out factors influencing in practicing road maintenance prioritization. Finally, the type of actors involved in the prioritization will be identified through looking which actors participate and what are their roles.

V.1. Overview of Local Road Maintenance

The City of Hamilton views that road maintenance can keep the roads in good condition. Therefore, people and goods can move safely on the roads. Besides that, road maintenance has a significant benefit for extending the service life of roads as illustrated in Figure 7. It can be seen that through conducting road maintenance, the service life of road pavement can be extended into 2.5 years. Local road maintenance is focusing on a process in determining which roads to be maintained and the maintenance activities which will be implemented (Hein, 2004). Since there are

many other factors influencing road maintenance such as road structure and type, the local government of Canada is suggested by the national government of Canada to apply the right maintenance activities to the right roads at the right time (Federation of Canadian Municipalities and National Research Council, 2003). In this case, which roads to be maintained, when they should be maintained, and what maintenance activities should be conducted can be determined accurately through implementing the right prioritization. Therefore, prioritization has a significant role in achieving the benefits of road maintenance.

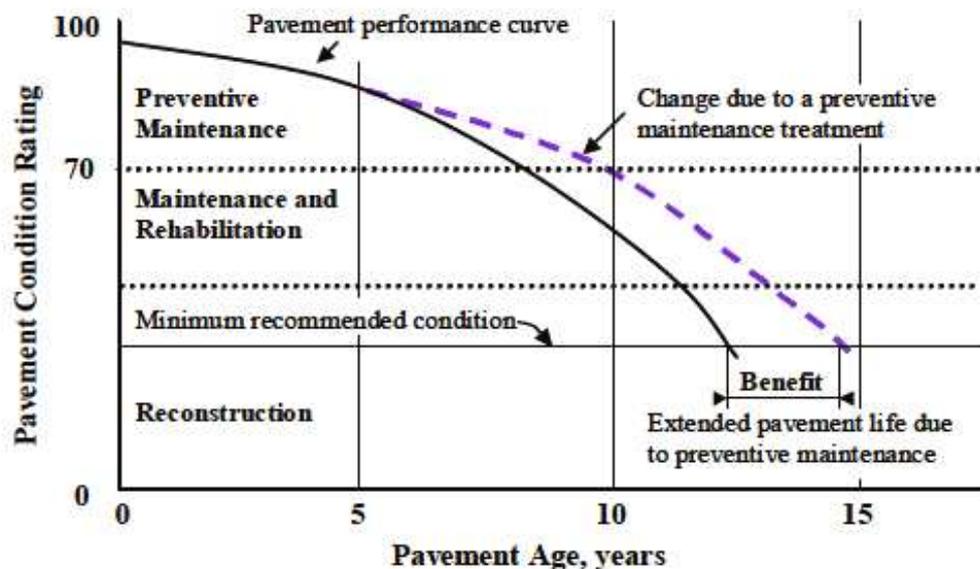


Figure 7. The Benefit of Practicing Local Road Maintenance (source: Federation of Canadian Municipalities and National Research Council, 2003)

Road maintenance is an activity of road management. There are two road management strategies regarding road maintenance implemented in the city of Hamilton: minor and major maintenance. These maintenances are planned regularly for maintenance and inspection programs including condition assessments, pothole repairs, and cleaning of catch basins. It would also includes regular inspections and repairs to the traffic systems (replacing lights, testing signals, etc). (The City of Hamilton, 2007)

V.2. Local Road Maintenance Prioritization Methods Used

This subsection will examine the procedures in conducting road maintenance prioritization in the city of Hamilton. According to InfraGuide Best Practices:

Priority Planning and Budgeting Process for Pavement Maintenance and Rehabilitation (2003) issued by Federation of Canadian Municipalities and National Research Council, and Paper 29 of Compendium of Papers from the First International Conference on Pavement Preservation: Guidelines for the Implementation of a Pavement Preservation Program for Municipal Pavements in Canada by Hein, David K., there are some steps in road planning and prioritization listed below. These steps can also be seen in Figure 8.

1. Determine the level of services (LOS). LOS relates to customer preferences, strategic directions, financial resources, and condition of road network. Ideally, all roads should meet the minimum standard of LOS. The aim of road maintenance prioritization is to maintain and improve road quality. It means that the prioritization will trigger the improvement of LOS into certain level. LOS is developed from strategic infrastructure planning so that the prioritization will be in line with the goals and objectives of the city. In the city of Hamilton, LOS is issued by the municipal council.
2. Identify road maintenance needs. There are two types of needs identification are described in the InfraGuide: short term for less than five years, and multiyear for five years or more. Hein et al. (2004) argues that prioritization is one of the most important steps in road management cycle. This step includes activities to select the best maintenance activities to be conducted for each roadway section. Therefore, it is important to conduct pavement surveys. After that, road location, road class, maintenance activities, time, estimated cost, and priority level can be described clearly. Priority level reflects the main reason why certain maintenance activities are proposed for each pavement section. There are four priority levels: A represents minimum safety-related LOS that need to be met, B represents minimum acceptable LOS that need to be met, C represents the preventive maintenance and cost effectiveness concerns, and D represents projects initiated to achieve a certain target LOS.
3. Rank road maintenance needs. The priority level and roadway classes are the basic consideration in prioritization and also can cause certain roads not to be maintained. For example, project with minimum safety is mandatory and do not need to be involved in prioritization. Since the authority in conducting local road

maintenance prioritization in Canada is fully on the city, Hamilton city arranges certain prioritization procedures based on national and provincial guidelines. Furthermore, in conducting road maintenance prioritization, technical agencies are allowed to use one of various technical design aids and ask consultants for assisting them. In this case, the city of Hamilton uses computer software to store roads inventory data, and excel spread sheet for assisting the technical staff in prioritizing roads to be maintained. In Capital Budget Procedure document, the city takes the advantage of software called Hansen Pavement Management System (PMS) as a tool for storing, and updating the city's road network.

Hansen software was created in 2001 and started to be introduced in the city of Hamilton around 2005. It is a kind of software that can be used in prioritizing the roads. Based on the document called the review of commercial municipal infrastructure asset management system, Hansen is a major asset management application developed by Hansen Information Technologies to provide capabilities for managing government operations including asset and property management, utility billing, permits, financial and human resources management. The software supports inventory data collection and asset valuation in determining the deferred maintenance and condition assessment, estimating the remaining service life of roads, and prioritizing maintenance and rehabilitation options.

Because of its price, and the high technology used which require high qualified human resources, Hansen is usually applied in medium to large municipalities. Hansen provides a detailed asset inventory and valuation capability using one or more of the following asset data models: hierarchical, directional, pressurized, segmented, point, area, linear and network models. Except for the pavement management module, Hansen does not have a built-in condition assessment capability. The pavement management module incorporates a condition assessment and rating tool, along with deterioration curves to predict future asset conditions. The user can define rating criteria to obtain asset condition ratings. Activities based budget and planning capabilities within the transportation module allows the prioritization of maintenance and rehabilitation activities.

Technically, there are some steps conducted in ranking local roads maintenance needs in the city of Hamilton, as listed below.

- Calculate road indexes. Hansen software utilizes some data for providing information called road indexes which will be used to determine the rank for local road maintenance. In this case, data stored in Hansen are used for calculating road indexes by using certain formula in excel spread sheet. This calculation covers distress measurements, their extents and severities, and distress weightings in order to derive an overall Surface Condition Index (SCI). This index is ranged between 100% (excellent condition) and 0% (completely failed). After that, roughness inspection data will be calculated to derive an overall Roughness Index (RI) between 100% and 0% for each segment. Based on SCI and RI, Overall Condition Index (OCI) can be calculated and the range is between 100% and 0% for each segment.
- Rank the roads to be maintained based on the above output (1st list). The roads will be ranked based on OCI. OCI is used to determine LOS. In this case, road maintenance is aimed to improve LOS. This index will classify roads into five road classes: A, B, C, D, and E.
- Classify the roads based on capacity and funding. In this case, capacity is related to traffic volume, and funding is related to budget required. In deciding the level of importance of those indicators reflected from weighting and valuing the criteria, the city will identify first aspects that need to be measured, define the necessary indicators, and ensure that the indicators are manageable, relevant, meaningful, measurable, quantifiable, well-defined, and aligned with objectives.
- Rank the roads based on the other non technical criteria (final list). The rank of roads resulted from the first prioritization process explained above is not the final rank which will be proposed to the council for their approval and funding availability. There will be the second prioritization process conducted. In this process, the first rank will be sorted again based on those non-technical criteria subjectively. The result of this second process will be the final rank that will be brought to the council for getting their approval.

4. Conduct budgeting for road maintenance. During deliberation of budgeting sessions, councilors can add/remove/change projects and/or the budget allocation for the program.

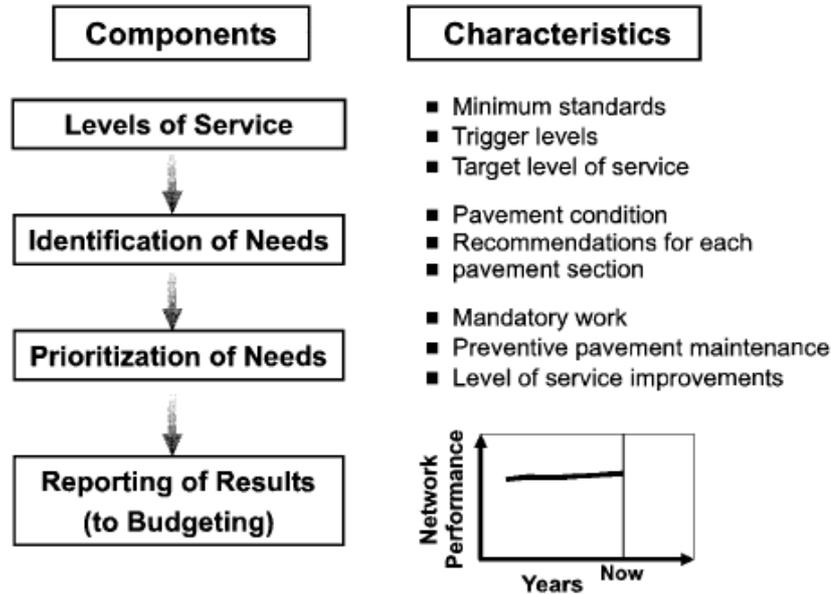


Figure 8. Short-term Planning and Prioritization (source: Paper 29: Guidelines for the Implementation of a Pavement Preservation Program for Municipal Pavement in Canada)

Based on the above description, it can be seen that the implementation of local road maintenance in the city of Hamilton combines two kinds of prioritization methods. Firstly, they use ranking based on parameters with scoring and weighting in which the road indexes are calculated through weighing and valuing the score of each data entered. Secondly, they use subjective ranking for non technical criteria since there are many interests with different degree of urgency influencing the decision making process.

V.3. Criteria Considered in Prioritization

The city of Hamilton considers some technical criteria and non technical criteria in conducting local road maintenance prioritization, as listed below.

1. Technical criteria. The criteria are listed below.
 - Road attributes such as community, ward, road classification, surface type, surface width, segment length, number of lines, and traffic volume. Those attributes are needed to create network inventory report. Besides that, this information will be very useful in providing the detail information of roads.

- Road condition which will determine the level of services such as number and types of cracks, and smoothness. These data are taken from pavement inspection data on a 5-year cycle including thirteen types of surface distress data and ratings, and roughness data and ratings. This criterion shows road performance by presenting a measure of the current condition of the assets based upon a visual inspection or other qualitative assessment if a physical inspection is not available. There are five classes of road condition. Those classes are A (excellent), B (good), C (fair), D (poor), and E (failed).
 - Traffic volume of commercial vehicles related to the capacity and reflecting the need. Road capacity is a measurement of the ability of assets to meet the current demand. In the case of road network, it could relate to the network's ability to accommodate existing traffic volumes. There are five level of capacity measurements: level A means that road supports ≥ 100 % of demand; level B for 90 - 99 % of demand; level C for 80 - 89 % of demand; level D for 70 - 79 % of demand; and level E for < 70 % of demand.
2. Regional goals and objectives. Roads are prioritized to be maintained in order to support the objectives of the development that stated in master plans such as transportation master plans. Besides that, the consideration of goals and objectives can be seen through coordination with other non technical agencies of local government in order to ensure the integrated development.
 3. Political criteria. The order of roads to be maintained is influenced by councilor meetings that deliver the initiatives development from their constituents.
 4. Financial criteria. Budget availability reflects the status of funding dedicated for maintaining, replacing, and improving the current condition of existing infrastructure, and for building new infrastructure needed to keep up with the city growth. Thus, budget availability for roads presents the capability of government resources in meeting road requirements. The annual budget for road management in Hamilton city is approximately \$40 million dollars, but the estimated annual funding requirement would be \$125 million dollars. Therefore, there is still a big gap between the budget available and the budget required. It means that financial is very influence the prioritization.

5. Social criteria. Prioritization considers road functional review which closely related to social benefits such as mobility and accessibility for delivering public services. This process also counts proposals related to road maintenance from residents to technical agency and/or councilors.
6. Economical criteria. The importance of certain roads to be maintained is determined also by its effects to the economic development. For example, external agency planned projects/other nearby priority projects or special projects from non government company are considered in maintaining certain roads because all projects should support each other and do not interfere with each other. Eventually, this situation will save much money since it will reduce transportation cost and time. Besides that, roads that link the important facilities of upcoming special events will be prioritized to be maintained so that when the events take place, there is no transportation issue.
7. Environmental criteria through considering Environmental Assessment from the proposed road maintenance project.
8. Risk analyses are considered in the prioritization practiced in Hamilton city, such as high volume arterial roads versus low volume local roads, and tourist routes.

Based on the above explanation, the local road maintenance prioritization in the city of Hamilton uses multi criteria technique. This is because the prioritization considers technical criteria, and some non technical criteria such as regional goals and objectives, political criteria, financial criteria, social criteria, economical criteria, environmental criteria, and risk analyses.

V.4. Actors Involved in Prioritization

In order to identify which actors are involved and the type of those actors, actors' attributes will be identified first through exploring their role in prioritization process in the City of Hamilton. Planning system conducted in the level of municipalities in Canada is a bottom up planning in which communities are involved actively in this process. Based on a document called A Guide for Road and Bridge Asset Management Plan Development issued by Ontario Good Roads Association in 2011, there is a planning team led by a team leader and consist of elected official (council), senior management, road users (customer), city manager, finance staff, and

team members. The roles of that team are collecting and analyzing road data, policies, legislative requirements, road maintenance strategies, and funding strategies for road maintenance. Besides that, the planning team coordinates the needs of road maintenance with other city sections/divisions/departments for integrated development. In planning team, senior management is the head of road agency. Meanwhile, team leader is a person who can influence the organization so that the team leader is the head of road planning section, and team members are consisted of technical staff who is in charge to conduct prioritization.

In local road maintenance prioritization, there are eight steps of asset management that can be included in road maintenance prioritization. Based on State of the Infrastructure Review: Road Network and Traffic Systems (the Government of the City of Hamilton, 2011), actors involved can be identified in each step as explained below.

1. Determine scope means that determine asset to include and other consideration like the new technology. Actors such as council, senior management and city manager are involved in this stage.
2. Policy review means evaluation process of the preferred criteria and procedure that already implemented in the last prioritization process. This step involves elected official (council), senior management, team leader, and city manager.
3. Program review means evaluation process of the proposed type of maintenance including routine and periodic maintenance that already implemented in the last prioritization process. It involves council, senior management, and team leader.
4. Services review means evaluation process of the proposed maintenance activities that already implemented in the last prioritization process. It involves team leader, team members, road users, community, and council. In the recent prioritization, the planning section will engage with the citizens of Hamilton as road users. This engagement is aimed to capture their thoughts on LOS supplied for infrastructure services (including roads) and whether they think there is value for their tax dollar or not, and whether they are willing to pay more for additional service or not. Furthermore, communities convey their issues related to LOS of roads to the councilors and the councilors will bring those issues forward in the meeting with technical staff to be followed up as soon as possible.

5. Determine goals and objectives that want to be achieved in order to fulfill the customer expectation through road maintenance. It will be associated with alternatives (the list of proposed roads), criteria considered and value and/or weight of criteria and alternatives. It involves elected official (council), senior management, and city manager.
6. Determine programs and services means determine the type of proposed maintenance activities that will be implemented. It involves senior management, team leader, city manager, the higher level of government, council, community, road users, and non technical agency of government. It also involves project coordination with the higher level of government such as Ministry of Transportation of Ontario (Provincial Government), and consider the local roads proposal brought by each Ward Councilor contained the concerns of his or her constituents regarding road maintenance request/project. In addition, staffs meet with councilors at various times to review the capital program for their ward. Councilors will bring forward constituent issues forward that may be accelerated into the budget for the following year or will be programmed for subsequent years. Also, councilors often forward constituent phone calls or e-mails to Asset Management staff for the appropriate responses back to the residents and also for consideration to be entered into the budget.
7. Capital and financial plan means decide the budget required for road maintenance that will be conducted, maintenance costs needed for each program. It involves city manager, council, team leader, finance staff, and team members.
8. Conduct prioritization method including collect data, analyze the data, and produce the rank of roads to be maintained. It involves team leader, and team members.

In order to classify actors, the attribute embraced by each actor involved in those steps will be identified based on the role of each step. Power can be identified when determining the scope, when determining goals and objectives because the output from these steps will become the basis of road maintenance prioritization process that will guide the whole process from the beginning into the end. Meanwhile, other steps show the legitimacy since they closely related with the appropriateness and the

use of standard in deciding the proper action that will be taken. They are policy review and the implementation of road maintenance prioritization method. Program review, service review, and the determination of programs and services indicate urgency since these steps determines the needs of conducting prioritization. Furthermore, capital and financial plan show both power and legitimacy. In this case, the former is used for deciding the budget available and the later for deciding the maintenance cost, constraining the prioritization process, and determining the standards. The differentiation of those actors and their position can be seen in Table 6 and Figure 9 respectively. The table shows that there are ten actors involved in road maintenance prioritization divided into five types. In this case, city manager and council who embrace power, legitimacy, and urgency are the definitive actors. Senior management is the dominant actor since it embraces power and legitimacy. The leader of planning team and team members are dependent actor. Finance staff who embraces legitimacy is discretionary actor. Non technical agency of local government, the higher level of government, community, and road users who embrace urgency are demanding actors.

Table 6. Types of Actors in The City of Hamilton

Actors		Power			Legitimacy			Urgency			Types of actors
		S1	S5	S7	S2	S7	S8	S3	S4	S6	
Authorities	City manager	√	√	√	√			√	√		Definitive
Technical agency of local government	Senior management	√	√		√						Dominant
	The leader of planning team				√	√	√	√	√	√	Dependent
	Finance staff						√				Discretionary
	Team members					√	√		√		Dependent
Non technical agency of local government	Non technical agency of local government									√	Demanding
Higher level of government	Ministry of Transportation Ontario									√	Demanding
Politician	Council	√	√	√	√			√	√	√	Definitive
Community	Community								√	√	Demanding
Road users	Road users								√	√	Demanding

Note: S = the number of step

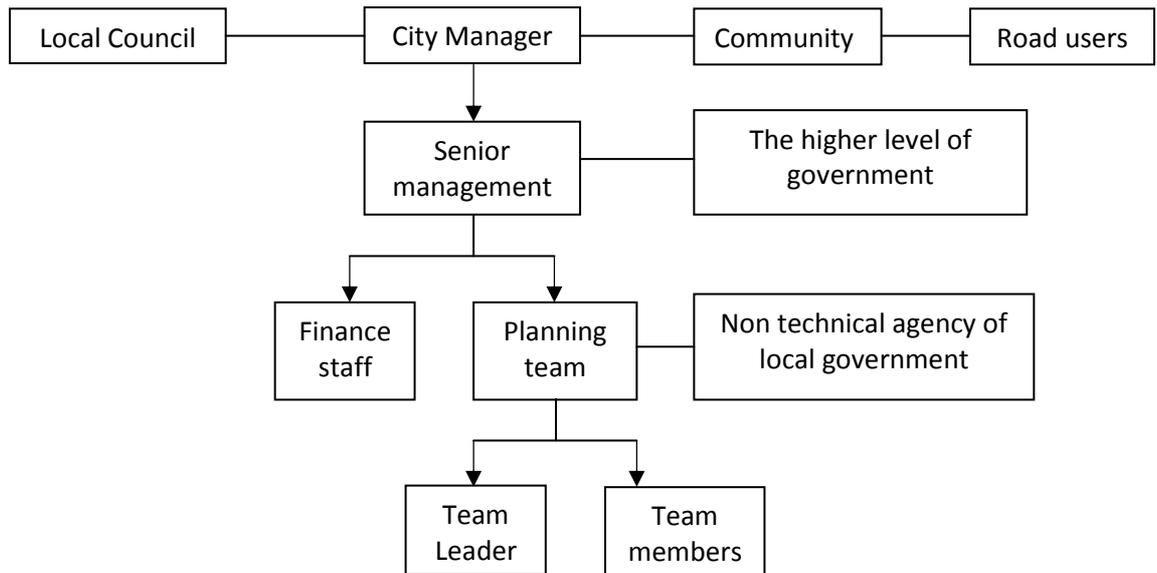


Figure 9. The Scheme of Actors Involved in The Prioritization in The City of Hamilton-Canada

Conclusion:

In conducting local road maintenance prioritization, Hamilton city combines two prioritization methods, ranking considering parameters with scoring and/or weighting method and subjective ranking method. In this case, this city considers regional goals and objectives, technical criteria, political criteria, financial criteria, social criteria, economical criteria, environmental criteria, and risk analyses. Furthermore, there are ten actors which can be divided into five types that are involved in this prioritization. They are authorities acting as definitive actor, technical agency of local government acting as dominant and dependent actor, non technical agency of local government acting as dominant actor, the higher level of government acting as demanding actor, politician acting as definitive actor, communities and road user acting as demanding actor.

CHAPTER VI

THE IMPLEMENTATION OF ROAD MAINTENANCE PRIORITIZATION IN EKURHULENI METROPOLITAN MUNICIPALITY - SOUTH AFRICA

In order to explore and take lessons from local road maintenance practiced in Ekurhuleni Metropolitan Municipality-South Africa (EMM), this chapter will examine the methods used, criteria considered, and actors involved in the local road maintenance prioritization in EMM. For that reason, the overview of local road maintenance concepts will be presented so that the terms and their definition can be illustrated clearly. After that, in order to identify the prioritization method used in local road maintenance prioritization, the sequential steps conducted in ranking the roads to be maintained will be elaborated. Through examining attributes considered in the prioritization, the prioritization criteria can be found in the next section. Finally, which actors involved and their roles will be described in the last section. Thus, the type of actors involved can be identified. That information will provide data for comparing local road maintenance prioritization in EMM with the prioritization in the city of Hamilton and West Lombok Regency-Indonesia (WLR).

VI.1. The Overview of Local Road Maintenance

The government of South Africa realizes that road maintenance is very crucial, not only in keeping the optimal road condition but also in saving road funds. The reason for this argument is the delay of road maintenance will increase the cost for repairing road failures. In this case, South African National Road Agency (SANRAL) found that a delay in road maintenance of 3 to 5 years will increase the repair costs up to 6 and 18 times. Furthermore, it also will decrease road quality that eventually will increase vehicle operating costs and cause the negative economic multiplier effects. However, the funds available in Municipal Infrastructure budget in South Africa only can fulfill 60 percent of road maintenance funds needed (CSIR, 2006).

Road maintenance in South Africa belongs to asset management. Since the goal of asset management is to achieve the required level of service (LOS) in the most cost effective manner through managing the asset's life cycle, the main

objective of local road maintenance is to maintain road quality for certain LOS (Local Government Capital Asset Management Guideline, 2008). Based on Roads Condition and Needs Report 2011, there are four treatment categories for local road maintenance in EMM: routine and periodic maintenance for paved roads in order to keep roads in usable condition, special maintenance for paved roads and for segmented block pavements in order to restore roads to acceptable LOS,.

In order to ensure the maintenance conducted by municipalities is on the right track, there are some guidelines issued by national government in arranging road maintenance as one kind of activity in local asset management, as listed below.

1. National treasury issued Local Government Capital Asset Management Guideline. This guideline is become the main reference in infrastructure assets management for guiding the practices of local road maintenance and the process to formulate Integrated Development Plan (IDP) and Budgets.
2. The Department Provincial and Local Government issued 'Guidelines for Infrastructure Asset Management for Local Government.
3. Besides that, the Constitution of the Republic of South Africa (1996) section 152, Municipal System Act (2000) section 4(2)(d), and Municipal Finance Management Act (2003) section 63 state that all municipalities should deliver the services to their people in a sustainable manner. In managing asset, the municipal government coordinates with national departments.

However, the current available guidelines for EMM is still not enough yet since there is no specific guideline for local road maintenance from national government, provincial government, and municipal government based on the data provided by the internet and information given by engineers in local road department. For that reason, this research uses limited documents in which it mainly focuses on Ekurhuleni Metropolitan Municipality – Road Condition and Needs Report 2010/2011.

VI.2. Local Road Maintenance Prioritization Methods Used

Based on Road Condition and Needs Report 2010/2011 issued by EMM, the local road maintenance prioritization in EMM is using Pavement Management System

(PMS). This system assesses visual condition of all roads in order to determine road maintenance activities that will be taken and roads to be maintained. The visual assessments are taken within 500 m length of segments. According to Local Government Capital Asset Management Guideline (2008), the selection of a maintenance strategy involves consideration of the appropriate mix of procedures and the capacity to undertake minor modifications and enhancements when it is required. There are two kinds of maintenance strategies. First, corrective maintenance is conducted if no maintenance is undertaken unless or until the asset no longer functions to the required standard or has broken down. Second, preventative maintenance is undertaken to reduce the likelihood of failure and to keep the operation of asset at an acceptable level. In developing a maintenance strategy, two considerations are particularly important: the level of asset maintenance and maintenance priorities. There are several steps taken in prioritizing local roads maintenance in EMM which is extracted from Road Condition and Needs Report 2010/2011 of EMM, as explained below.

1. Collect the road data through examining data base. Data include the street name, start description (from street) / end description (to street), and start / end km, number of lanes, road type, road width (m), surface type, and terrain. There are four types of roads in EMM: flexible roads for 7,653 km, block roads for 33 km, gravel roads for 980 km, and earth roads for 1,377 km.
2. Classify the road network based on strategic function. Road class can be identified by examining the location, and the role of the road including arterial, distributor, collector, and access roads. There are four classes of road network according to strategic function. Arterial roads are public roads located between and through centers of provincial and national importance; between provincial capitals, large towns and municipal administration centers; between South Africa and adjoining countries which carry limited economic or social road traffic. These roads are for providing access to transport hubs of regional importance. Distributor roads are public roads located between centers, towns, and rural residential areas and villages, between centers, towns and industrial/ farming areas, between residential areas and local industrial/commercial areas, and between large residential areas. These roads are for providing linkages

between an arterial and collector routes, and linkage between centers, towns, rural residential, industrial/farming areas and arterial or collector routes. Collector roads are public roads located between villages, farming areas and scattered rural settlements and communities. These roads are primarily serving local social services as well as providing access to markets within commercial, residential, industrial areas, and linking the roads in this class. Access roads are public roads located within a residential community. These roads are for providing direct access to industries and businesses, and access to specific destinations such as heritage sites, national parks, mines, forests etc.

3. Classify the road network based on traffic. There are four groups of roads based on traffic: high traffic for typically arterial roads, medium traffic for typically distributor roads, low traffic for typically collector roads, and very low traffic for typically access roads.
4. Survey the current condition of the network. Survey is conducted for all roads based on the type of roads. In this case, the survey is divided into 3 groups: flexible pavements, segmented block pavements, and unpaved roads. The surveys are aimed to examine roads condition. The surveys include the assessment of surface, structural, and functional road condition. Based on the surveys' report, roads can be grouped into five groups: very good condition, good condition, fair condition, poor condition, and very poor condition. The Road Infrastructure Strategic Framework for South Africa, Department of Transport (2005) stated that the maximum percentage for poor and very poor condition should be 10%. In general, the municipality should always aim to decrease the percentage roads in fair condition through a policy of preventive maintenance. From practical experience, the percentage roads in fair condition should not exceed 25%. It proves that the government is really aware about LOS delivered by roads reflecting the importance of road to be maintained. For the current road condition in EMM, the percentage of roads (10%) in fair condition is ideal and the aim of road maintenance is to decrease the percentage roads in fair condition (EMM, 2011).
5. Calculate unit costs for every proposed treatment related to road maintenance based on the results of surveys on road network and average unit costs.

6. Determine treatments that are suitable for every road. There are different procedures conducted in determining the suitable treatment for flexible roads and segmented block roads. The sequence steps for determining the suitable treatment for roads are described below.
- Calculate Visual Condition Index (VCI) for every segment of flexible road or calculate Block Visual Condition Index (BVCI) for every segment of segmented block road. After that, weight the various defects. The values of VCI and BVCI are ranged from 0 indicating a very poor condition to 100 indicating a very good condition.
 - Categorize the VCI or BVCI into five pavement condition categories (very good, good, fair, poor, and very poor)
 - Calculate Reseal Condition Index (RCI) and weight the various defects for flexible roads. The values of RCI are ranged from 0 indicating a very poor condition to 100 indicating a very good condition.
 - Categorize the RCI for flexible roads into five reseal condition categories: very good (70 – 100%), good (50 – 70%), fair (30 – 50%), and very poor (0 – 30%).
 - Calculate a surface need category for flexible roads and segmented block roads indicating the surfacing need of the segment. The categories are very high need, high need, medium need, low need and none.

SC Need category	General description
None (no need)	The surface of the road segment appears very good and there is no need for resurfacing. Binder is new and no stone loss occurs. Newly built roads or roads recently resurfaced typically fall into this category.
Low (low need)	The surface of the road segment appears good, but the binder is not new and a few cracks, stone loss or surface failures are visible, although isolated. A new road surfacing normally deteriorates to this category within three to five years. Spraying of a diluted emulsion to rejuvenate the binder can be considered, in order to maintain an impermeable watertight covering for pavement layers.
Medium (Medium need)	The surface of the road segment still appears to be in good condition but closer examination will show surfacing and other cracks, surface failures, bleeding, stone loss and a dry and brittle binder. These road segments should be considered for resealing, as the deteriorated surfacing can allow water to penetrate the pavement layers and lead to accelerated deterioration thereof. Typically, the pavement structure still has to be in good condition.
High (High need)	The surface of the road segment appears in poor condition. A very dry binder results in commonly occurring surface cracks, surface failures, stone loss and other cracks reflecting through the surfacing. These indicate to surfacing failure. Typically, the pavement structure still has to be in good to fair condition to warrant a resurfacing. These road segments have a high

	need for resealing, as the surfacing will allow water to penetrate the pavement layers and lead to accelerated deterioration and imminent pavement failures.
Very high (Very high need)	The surface of the road segment appears to be in a very poor condition, whereas the distresses seen are not structural but surfacing related. The degree (seriousness) and extent (frequency) is typically high. A very dry binder results in commonly occurring surface cracks, surface failures, stone loss and other cracks reflecting through the surfacing. These indicate to surfacing failure. Typically, the pavement structure still has to be in a good to fair condition to warrant resurfacing. These road segments have a highly urgent need for resealing, as the surfacing will allow water to penetrate the pavement layers and lead to accelerated deterioration and imminent pavement failure.

- Calculate a structure need category indicating the structural improvement need of the segment. The categories are very high need, high need, medium need, low need and none.

SC Need category	General description
None (no need)	The structure of the road segment appears very good and there is no need for rehabilitation. No structural cracking or deformation occurs. Newly built roads or roads recently rehabilitated typically falls into this category.
Low (low need)	The structure of the road segment appears good, but a few structural cracks or slight deformation are visible, although only isolated. A new road structure normally deteriorates to this category within three to five years.
Medium (Medium need)	The structure of the road segment still appears to be in a good condition but closer examination will show structural cracks and deformation, pumping, patching, potholes and failures. These road segments should be considered for light rehabilitation, especially if the extent of occurrence of high degree structural distresses is small.
High (High need)	The structure of the road segment appears in poor condition. Structural cracks, deformation, pumping, patching, potholes and failures are in abundance, of high degree and extent of occurrence.
Very high (Very high need)	The structure of the road segment appears in a very poor condition. Structural cracks, deformation, pumping, patching, potholes and failures are in abundance, of high degree and extent of occurrence. These roads might have even reached the design terminal rutting.

- Calculate a crack seal index (CCI) and patching index (PCI) based on degree and extent ratings of relevant distresses, and specific weight set.
- Recommend the treatment for flexible roads based on two trigger methods (using “decision tree” methods). In the first method, road segments are classified into maintenance and rehabilitation categories based on trigger values for condition indices plus trigger values for degree and extent ratings of specific distress items. The method is considered to have good accuracy, as it combines the use of condition indices and individual distress ratings. However, the classification is sometimes triggered by a single distress item

only causes an inaccurate rating. It will lead to an incorrect classification. The second method is very similar to the first method, but more elaborate. It is based on the calculation of prescribed conditions based on trigger values for condition indices plus trigger values for degree and extent ratings of specific distress items. Meanwhile, the treatments recommended for segmented block segments are based on the visual condition index. In this case, special maintenance for fair condition, rehabilitation for poor condition, and re-construction for very poor condition.

7. Determine the initial priorities for each road type by establishing a number of priority indices, between 0 and 100. In this case, the higher the number, the higher the relative priority.
8. Prioritize roads that need to be maintained based on the calculated priority Indices (RPI, SPI, CPI, and PPI). There are four priority categories: A (top priority) for $0 \leq PI \leq 30$, B (recommended) for $30 \leq PI \leq 50$, C (desirable) for $50 \leq PI \leq 70$, and D (possible) for $70 \leq PI \leq 100$.

Since the road maintenance prioritization procedures conducted in EMM involves value and weight criteria in calculating road indexes, it can be said that the municipality practices the prioritization methods called ranking based on parameters with scoring and/or weighting.

VI.3. Criteria Considered in Prioritization

There are some attributes considered in prioritizing road maintenance in EMM:

1. Regional goals and objectives. All planning, budgeting, management and decision making processes in EMM should refer to the Integrated Development Plan (IDP). IDP is a legislative requirement which has a legal status. It contains plans and programs that link planning to the municipal budget (directs the development and implementation of projects) such as development of an integrated transportation system. The planning process of IDP is preceded by considering national and provincial plans and guidelines, Ekurhuleni Government Development Strategies 2025 (such as high quality, integrated and well maintained transportation infrastructure), and ward priorities. Those

documents are the references in formulating 5-year IDP divided into annual budget and multiyear budget. It can be seen that the national and provincial programs and their respective targets are already covered in IDP.

2. Technical criteria include:

- Road type in which there are four road types: flexible road characterized by asphalt pavement, block road characterized by concrete pavement, gravel road characterized by gravel pavement, and earth road characterized by soil pavement.
- Surface type. There are two road types based on road surface in EMM: paved roads and unpaved roads.
- Traffic category. The traffic counted for classifying the roads is conducted for each link. It is aimed to determine the load for every road and simultaneously reflect the level of importance of each road.
- Road condition. There are five levels of road conditions for all road types. First, a very good road which has VCI > 85 and characterized by the road segment appears very good, and the ride is comfortable. Second, a good road which has VCI 70 – 85 and characterized by the road segment appears good and no discomfort is experienced. Third, fair road which has VCI 50 – 70 and characterized by the road segment still appears to be in a good condition. Fourth, poor road which has VCI 30 - 50 and characterized by the road segment appears in poor condition, the ride is becoming uncomfortable, and rehabilitation of these roads should be considered. Fifth, very poor road which has VCI < 30, and characterized by the road segment looks bad, the ride is uncomfortable, and these roads should be reconstructed soon. There are different specific descriptions used in measuring the road condition level for flexible roads and for segmented block roads, as described below.

Condition category	Specific Description for flexible roads	Specific Description for segmented block roads
Very good	No potholes, cracks or unevenness are visible.	No missing blocks, cracked blocks, block movement, sags and mounds or unevenness are visible, edge restraint is excellent.
Good	Very few cracks a unevenness are visible and only isolated patches.	Very few sags and mounds or unevenness are visible, little block movement, few cracked and missing blocks, jointing material is good, also edge restraint.

Fair	The closer examination will show cracks, potholes, and unevenness. The road users will experience slight discomfort. These roads should be considered for resealing.	The closer examination will show block movement and unevenness, cracked and missing blocks, also damage to edge restraint, loss of jointing material and some foreign patching. The road users will experience slight discomfort. These roads should be considered for light rehabilitation of distressed areas (equivalent to special maintenance).
Poor	Potholes, cracks, unevenness and patchwork commonly occur, indicating to structural failure.	Block movement, missing and cracked blocks, unevenness and foreign patchwork commonly occur, also damage to edge restraint, loss of jointing material and foreign patching, indicating to structural failure.
Very poor	Severe potholes, cracks, structural failures, and unevenness occur regularly and extensively.	Severe loss of blocks, cracked blocks, structural failures, unevenness, non-functional and broken edge restraints, total loss of jointing material and foreign patching occur regularly and extensively.

Source: Road condition and needs 2010/2011. The Government of Ekurhuleni Metropolitan Municipality

- Road classification based on the function of roads. Classifying the roads is conducted by identifying and highlighting the road classes starting from the highest class. Based on roads positions and their roles, roads can be classified into four categories:
 - ✓ Arterial roads are roads which serve relatively high mobility roads with lower levels of access for the movement of large volumes of people, raw materials, manufactured goods, and agricultural productions of regional importance in rural and urban areas.
 - ✓ Distributor roads are roads which serve moderate mobility with controlled higher levels of access for the movement of people, raw materials, manufactured goods, and agricultural productions of regional importance in rural and urban areas.
 - ✓ Collector roads are roads which serve high levels of access and lower levels of mobility for lower traffic volumes of people, raw materials, manufactured goods, and agricultural productions of local importance in rural and urban areas.
 - ✓ Access roads are roads which serve high access and very low mobility routes for the movement of people and goods in urban and rural areas.

- Riding quality is classified as one of performance variables.
3. Political criteria. This criterion can be seen in IDP which covers ward priorities. In generating ward priorities, the councilors meet with communities in order to discuss and decide program and projects that important for communities include which roads that are significant for them and their issues related to road maintenance. After that, councilors bring those ward priorities into planning process of IDP. They will use their power to include their voters' needs into IDP, compete with other councilors who also bring their voters' aspirations. In this process, all councilors put forward their constituent interests/issues rather than other public interests.
 4. Financial criteria related to budget availability. The number of local road maintenance projects approved by council to be constructed is depended on the amount of budget allocated for road maintenance. Therefore, budget availability influences the rank of roads that will be maintained.
 5. Social criteria related to the presence of delivery care center and suburbs in which road is situated. Those facilities are used to identify the level of importance of the roads to the community. This criterion is already covered in IDP. In this case, IDP covers ward priorities contained projects that gives many social benefits such as access to isolated areas and public places.

Since there are many criteria considered in local road maintenance prioritization, the prioritization in EMM uses multi criteria technique. Prioritization criteria considered in EMM are regional goals and objectives, technical criteria, political criteria, financial criteria, and social criteria.

VI.4. Actors involved in prioritization

Actors involved in road maintenance prioritization in EMM are related to budgeting provision. The budget process is started when the city manager submit the approved proposal to EMM Council. The local agency who manages the infrastructure assets should report the results to the city manager every year. (EMM, 2011)

In the Road Condition and Needs Report 2011 issued by the government of EMM, there is no information related to actors involved in road maintenance

prioritization. Therefore, the data used to identify actors involved in the prioritization are taken from correspondence and documents titled Local Government Budgets and Expenditure Review: 2006/07 – 2012/13 issued by Department: National Treasury – Republic of South Africa, the document issued by Department Provincial and Local Government – Republic of South Africa (2007) in which there are some actors involved in maintaining roads using Municipal Infrastructure Grant (MIG), and IDP document. Based on those documents, actors involved in road maintenance prioritization in EMM are listed below.

1. Authority or municipal manager. The proposed roads policies, and road maintenance plan will be prepared and submitted to the municipal manager for approval. Besides that, he or she assesses municipal roads in accordance with standards of legalized accounting practice, and evaluates road management policies. The municipal manager as an accounting officer is responsible for the effective management of capital funds. Therefore, this actor holds power, legitimacy, and urgency.
2. Politician (councilors). Council approves the proposal of road policies, road maintenance plan, and road maintenance budgeting plan submitted by municipal manager, and also issues IDP. Thus, this actor holds power and legitimacy.
3. The higher level of government. There are two departments of the higher level of government involved in local road maintenance prioritization, as explained below.
 - The Department of Provincial and Local Government (the dplg) that responsible for allocating budget, composing report for parliament, and monitoring the implementation of program. Thus, this actor has power.
 - Provincial departments is responsible for ensuring Integrated Development Plans (IDPs) are composed in line with the national and provincial guidelines, developing the capacity of municipal infrastructure asset management, monitoring and supporting municipalities, and providing technical advices. Based on those roles, this actor holds legitimacy.
4. Technical agency of local government. There are some technical agencies of local government involved in local road maintenance prioritization. First, municipalities are responsible for managing road infrastructure in South Africa

including road maintenance. Every municipality has municipal infrastructure departments which will carry out road maintenance through road authorities, known as The Department of Public Works (DPW). DPW conducts annual studies using the visual condition index (VCI) reflecting road condition for basic data in prioritizing road maintenance. In general, this agency is responsible for setting criteria in order to achieve the objectives of poverty alleviation and employment generation, giving training to municipalities related to road maintenance process, systems, techniques, and approaches, guiding the procurement process, and monitoring the process. Therefore, it can be said that this actor holds power and legitimacy. Second, the asset manager is the head of public works department. In conducting local road maintenance prioritization, he or she must have a deep understanding of the operational policies and budgets required to maintain assigned assets to the required level of performance. The asset manager need to participate in the development of asset-management policies and strategies and to provide budget input that optimizes the service life of their assets. (National Treasury, 2008). So that, this actor holds power and legitimacy. Third, in the case of road maintenance prioritization, EMM require a planning team consisted of:

- Planning manager which is the head of road planning section in DPW. He or she is responsible for integrating, coordinating, managing, and administering the project, ensuring project compliance with all applicable legislation, policies and conditions requested, liaising with the provincial and the senior manager, submitting the report to Department of Provincial and Local Government, and managing the team and the outputs. This actor holds power, legitimacy, and urgency.
- Engineer or technician is responsible for delivering technical support and evaluating the proposed projects in align with the respective municipal IDPs and the regional and provincial growth and development plans, ensuring compliance with all legal aspects and conditions, as required by the various spheres of government, conducting site visits/meetings to ensure compliance with business plan conditions, maintaining road performance data on a national database, and assisting with other related

municipal infrastructure programs. Based on those roles, this actor holds legitimacy and urgency.

- Financial personnel/legal staff is responsible for auditing compliance of all legal condition, required by the different spheres of government. Therefore, this actor holds legitimacy.
- Administrative personnel is responsible for supporting and assisting all administrative duties required, processing related correspondence, assisting with report generation, and performing register maintenance such as site-visit reports. This actor holds legitimacy.
- Data capturer/limited Information Technology (IT) personnel is responsible for managing and maintaining the national monitoring database, liaising with provincial and national IT specialists on related issues, providing data and information technology and quality control, and manipulating data for the preparation of all necessary reports to municipalities and the relevant provincial and national departments. This actor holds legitimacy.
- Community officer/communications personnel is responsible for designing and implementing a communication strategy in line with provincial and national objectives, preparing and implementing a MIG capacity-building business plan in align with the municipal business plan, facilitating community liaison linkages to ensure full community participation at all stages of a project's life cycle, conducting bi-annual socio-economic impact assessments on selected projects as required by the National MIG Unit, coordinating project-based capacity building, and monitoring and reporting the implementation of capacity building initiatives. This actor holds legitimacy.

5. Communities. EMM practices a mayoral executive and ward participatory system of local governance which ensures that governance is taken right down to community level and all citizens are represented in decision-making process. It will increase the citizens' sense of belonging for infrastructure, and community empowerment and involvement in dealing with municipality issues. In this case, ward councilors communicate the communities' desires to the council and deliver the council consideration to the communities, help

communities in identifying their needs and prioritizing the development areas. (Ekurhuleni IDP, Budget & SDBIP 2011/12-2013/14). Besides that, related to the planning process of IDP there is Community Based Planning (CPB) conducted in the level of wards as a basis for community to deliver their plan and to involve in decision making process interactively. It facilitates community, ward councilor and its elected ward committees should be involved actively in planning and implementation of development planning. The process will generate ward plans that will be submitted to councilors and will be included in the IDP. Besides that, IDP contains the list of road projects that need to be prioritized and other projects that need to be supported by road network. Therefore, this actor holds urgency.

6. Financial agency which is National Treasury. Related to funding source, municipalities can use local government equity share (unconditional grants) taken from intergovernmental transfers (National Treasury of Republic of South Africa, 2011). Furthermore, most municipalities use the municipal infrastructure grant (MIG) as a main source for road infrastructure funds in order to assist municipalities to deliver basic infrastructure to poor communities. Besides that, they can use public transport infrastructure and system grant (PTIS) which is a conditional grant. In this case, MIG is one of grants received by EMM for funding capital projects (EMM, 2011). In this case, financial agency is responsible for administering the related financial legislation, and guiding the municipalities' operation using the macroeconomic framework established by national government. Therefore, this actor embraces legitimacy.

Based on Table 7, it can be seen that there are fourteen actors involved in local road maintenance prioritization conducted in EMM. Those actors can be grouped into five types of actors: dominant, dormant, discretionary, definitive, and demanding actors. Council, engineer, and asset manager are holding power and legitimacy so that they are classified as dominant actors. The Department of Provincial and Local Government who only embrace power is the dormant actors. The provincial government, financial agencies, financial personnel/legal staff, administrative personnel, data capturer/limited IT personnel, and community officer/communications personnel who only have legitimacy are grouped as

discretionary actors. The Department of Public Works, planning manager, and municipal manager who hold all attributes are classified as definitive actors. Meanwhile, communities who only hold urgency are grouped as demanding actors. Furthermore, the scheme of actors involved in the prioritization in EMM can be seen in Figure 10. From that figure, it can be seen that the municipality has the parallel position with council. Therefore, those institutions should be supporting each other in conducting the prioritization. Meanwhile, the provincial government and The National Treasury as financial agency coordinate with the local agency. There are many actors that are included to be the part of technical agency. Therefore, the technical agency has the most active role in the prioritization.

Table 7. Types of Actors in Ekurhuleni Metropolitan Municipality

Actor		Power	Legitimacy	Urgency	Type of actor
Authorities	Municipal manager	√	√	√	Definitive
Technical agency of local government	Asset manager	√	√		Dominant
	The Department of Public Works	√	√	√	Definitive
	Planning manager	√	√	√	Definitive
	Engineer or technician	√	√		Dominant
	Financial personnel/legal staff		√		Discretionary
	Administrative personnel		√		Discretionary
	Data capturer/limited IT personnel		√		Discretionary
	Community officer/communications personnel		√		Discretionary
The higher level of government	The Department of Provincial and Local Government	√			Dormant
	Provincial departments		√		Discretionary
Political	Council	√	√		Dominant
Funding donors	Financial agencies		√		Discretionary
Communities	Communities			√	Demanding

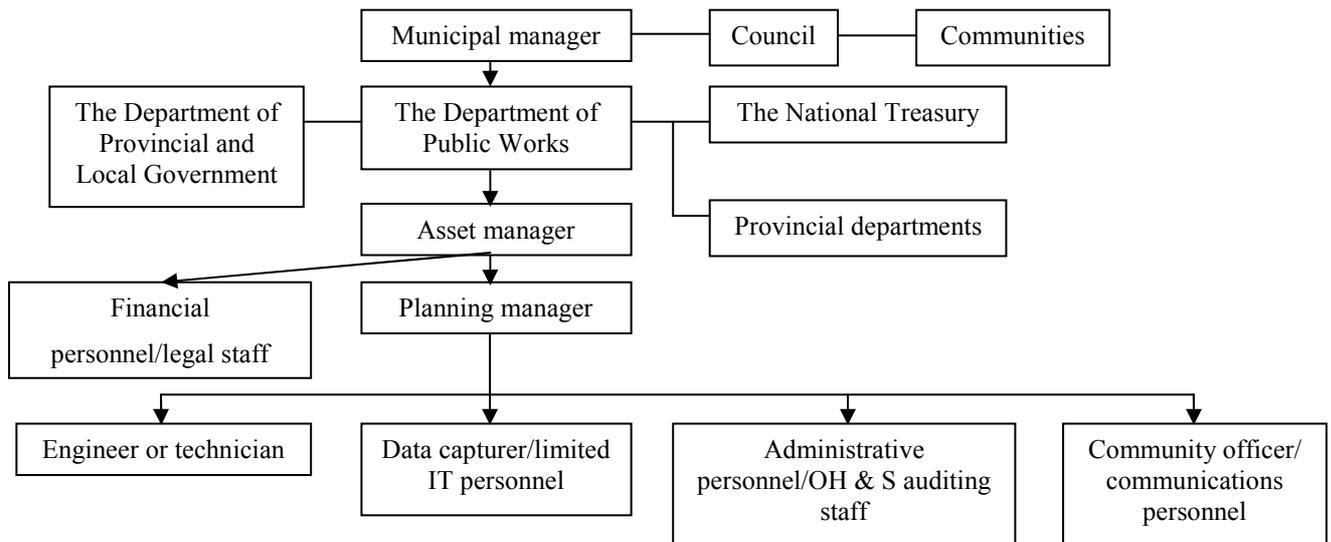


Figure 10. The Scheme of Actors Involved in The Prioritization in Ekurhuleni Metropolitan Municipality

Conclusion

The local road maintenance prioritization practiced in EMM uses ranking considering parameters with scoring and/or weighting. This prioritization considers local, provincial, and national goals and objectives, technical criteria, political criteria, financial criteria, and social criteria. There are five general actors involved in the prioritization. Based on the attributes that they embrace, they can be classified into five types. They are the higher level of government as dormant and discretionary actor, technical agency of local government as discretionary and dominant actor, communities as demanding actors, politician as dominant actors, and authorities as definitive actors.

CHAPTER VII

COMPARISON, LESSONS LEARNED, AND TRANSFER POSIBILITIES OF LOCAL ROAD MAINTENANCE PRIORITIZATION IN WEST LOMBOK REGENCY, THE CITY OF HAMILTON, AND EKURHULENI METROPOLITAN MUNICIPALITY

In order to identify lessons learned from the practices of local road maintenance prioritization carried out in the city of Hamilton and Ekurhuleni Metropolitan Municipality (EMM), the prioritization methods used, criteria considered, and actors involved in those two countries and West Lombok Regency (WLR) will be compared in this chapter. First, this chapter will discuss similarities and differences in local road maintenance prioritization discussed in chapter IV, V, and VI, and summarized in Table 1 and 2 (see Appendix). Those similarities and differences will cover procedures reflecting the prioritization method used, criteria considered, and actors involved in conducting local road maintenance prioritization in WLR, the City of Hamilton, and EMM. After that, the weaknesses of the prioritization in WLR, the strengths of the prioritization in the City of Hamilton, and EMM can be identified. In this case, not all good points from two reference countries can be adopted directly by WLR because those possibilities will need some adjustments. Finally, the requirements needed in adopting the proposed improvements will be explained in the last section of this chapter.

VII.1. Similarities

Based on the above exploration of the local road maintenance prioritization in WLR, the city of Hamilton, and EMM, there are some similarities found in the prioritization practices in those case studies, as listed below.

1. Basically, all prioritization methods used consist of establishing the existing condition, determining the suitable maintenance, conducting road ranking analysis, and budgeting. Those main steps are conducted in order to put the right maintenance treatment to the right road at the right time with the limited budget available so that the road quality can be maintained and improved efficiently and effectively.

2. All countries use multi criteria in prioritizing local road maintenance, both technical criteria and nontechnical criteria. It can be seen in the similar criteria considered in local road maintenance prioritization conducted in those three countries. Those criteria are road conditions representing technical criteria, and regional goals and objectives, political criteria, financial criteria, and social criteria representing non technical criteria. Technical criteria and non technical criteria are important since the former are related to road capacity and capability, and the later are related to the level of importance of those roads to communities and to the overall developments. The use of those criteria in local road maintenance prioritization can ensure the accuracy of measuring the level of importance of the roads so that the roads that will be maintained are the appropriate one. Furthermore, the prioritization becomes more comprehensive in addressing the issues through considering multi criteria.
3. There are authority (city manager), technical agency of local government, politician, and communities involved in road maintenance prioritization in all countries. They represent the owner, executors, licensors, and consumers of roads so that they have big interests in prioritization process. Furthermore, the involvement of those main actors is intended to ensure aspirations and transparency will be delivered well in the prioritization process so that the outputs are the best results of negotiation process among actors. The involvement of all important actors also can avoid conflict in the future execution of road maintenance projects. In those three countries, the technical agency of local government is the most active actor in local road maintenance prioritization since they are the single actor in the prioritization stage which only considers technical criteria, and they are consisted of some personnel who have different role causing technical agency can act as several types of actors.

VII.2. Differences

There are some differences which covers methods used, criteria considered, and actors involved in local road maintenance prioritization in WLR, the city of Hamilton, and EMM, as explained below.

1. The three countries use the different prioritization methods in which they sort the roads based on certain considerations. First, Hamilton city rank the roads by combining two methods: ranking based on parameters with scoring and/or weighting by considering technical criteria in order to calculate road indexes, and subjective ranking when the prioritization related to non technical criteria. Second, EMM uses Pavement Management System (PMS) which ranks the pavement conditions by valuing the conditions and classifying them into priority categories. Third, WLR also ranks the roads to be maintained by considering roads' condition subjectively. It can be seen that both Hamilton City and EMM involve scoring and weighting in their road maintenance prioritization procedures. In this case, the former uses computer software called Hanzen in storing their data, and uses excel spread sheet in calculating road indexes and then ranks the roads based on those indexes. The latter applies ranking with scoring and/or weighting by utilizing PMS. Meanwhile, WLR only ranks the roads based on the visual assessment of road condition, and the level of importance of roads without using any analytical tool. This difference is caused by the high cost required for utilizing software and the needs of high qualified human resources that expert in information technology to operate the analytical tool. Hamilton city and EMM can deal with those requirements, but the limited resources owned by the government of WLR hampers them in using the software because the limited budget owned by the local government, and the road planning section did not have any Information Technology engineers. The use of simple subjective ranking in WLR causes the lack of objectivity since this prioritization method only relies on engineering staff judgments and experiences. This situation leads to the not optimal prioritization output such as the abandonment of some local roads which is so important for WLR and the poor quality of local roads.
2. Hamilton city and EMM conduct the prioritization separately in two stages: prioritization considering technical criteria on the first stage and then followed by prioritization considering nontechnical criteria. Meanwhile, WLR combines technical criteria stage with non technical criteria stage within one phase prioritization. The reason for this situation is the used guidelines state that

procedure. For instance, Indonesian guidelines state that the level of importance of roads for community is processed simultaneously with technical criteria by technical agency before presenting the rank in the development planning consensus. Besides that, it can be seen when the region equity requirement and the roads significance revealed from communities' letters are put forward in prioritization process. These situations cause too much non technical criteria influence the rank produced by technical agency. Finally, roads that technically urgent to be maintained become neglected, and the road quality will be decrease.

3. Hamilton city involves more non technical criteria than two other countries since they manage more types of roads so that they should address more issues. Therefore, they try to consider all relevant criteria in order to handle those issues as much as possible through practicing the accurate prioritization. For example, they also consider environmental criteria, risk analyses, and economical criteria that did not consider by two other countries. The reason for this situation is Hamilton city is located in Canada which is a developed country that is very concerned about environment. Moreover, their concern is supported by the sufficient resources to realize the concern in actions. Besides that, the government of Hamilton city has a long analysis in determining public policies so that they use risk analyses in order to ensure the minimum shortcomings caused by road maintenance projects. Furthermore, as the business centre, Hamilton city consider all project economically. Since WLR did not consider environmental criteria, risk analyses and economical criteria, roads in WLR become easily deteriorated and less sustained. In this case, risk analyses are required for anticipating the side effects of developments in the future, and economical criteria can be beneficial for its multiplayer effects. Whereas, EMM and WLR more focus on technical criteria since it relatively more measurable and practical. Therefore, the less consideration to environmental, economical, and risks hampers the sustainability of road maintenance since the prioritization do not take into account some environmental effects.
4. Hamilton city conducts coordination with the higher level of government through involving them directly in the process of ranking the roads to be maintained. That coordination is conducted if there is mutual interest. This is because the

coordination among the different level of government which manages the different roads will create an integrated road network. WLR also conducts the consultation with the higher level of government, but the initiative comes from the higher level of government. This coordination is usually urgent and should be covered in the short term planning. On the other hand, the multiyear planning of local government is already prepared. This urgent requirement often changes the initial prioritization so that the target of local road quality cannot be achieved on time. Meanwhile, EMM considers the higher level of government interests indirectly. In this case, EMM takes into account IDP in road maintenance prioritization. This document covers other agencies' interests. The cause of this deference is that procedure is stated in those three countries' regulations.

5. EMM does not have the specific guideline about municipal road maintenance management both from national government and provincial government that explain the recommended prioritization conducted in South Africa. Besides that, the government of EMM also does not issue the road maintenance prioritization guideline for their practices. Meanwhile, Hamilton city has a complete road maintenance prioritization guideline graded from national, provincial, city, and technical agency guidelines. Those two countries give the responsibility for managing local roads to local roads agency. The national governments of Canada are particularly concern with road management in which they conduct many researches in road management include local road maintenance. The output is in the form of guidelines for municipal road maintenance. WLR also did not have specific guidelines issued by local government, just guidelines from national government since this regency does not have resources to compose their own guideline so that they rely on national guideline. Besides that, the funding donors or financial agency in WLR has certain requirements to be met by the recipients of their funds. Those requirements are still refer to the national guidelines. Therefore, it is more practical for WLR to refer to national guidelines so that no difference treatment for roads with local funds and roads with national funds. However, WLR which follows the national guidelines often neglect to maintain some roads that actually importance to be maintained since those roads did not match with the requirements in the guidelines. For instance, rural roads and/or

non status roads which are important cannot be maintained use national funds. This condition causes the decrease in road quality and the service cannot deliver well to the community. Meanwhile, in Canada there is no intervention from funding donor since local road management fully done by the local government so that they can maintain the roads appropriately.

6. The standard for road maintenance in Hamilton City and EMM is focused on the level of services (LOS). In this case, LOS reflects the services delivered to the communities especially road users. Meanwhile, in WLR the focus is on road condition since the prioritization by looking to road condition through visual survey is the easiest and cheapest way to access roads quality. However, it causes road deteriorate before their service life is over. The reason for this situation is regions are developing over the times causing the increase in traffic volume and the capacity of vehicles pass the roads.
7. In Hamilton city, the types of actors involved are more diverse than in EMM and WLR. The involvement of diverse actors in the prioritization process more represents all interests. In this case, Hamilton city involves non technical agency of local government and road users directly. However, WLR did not conduct coordination with non technical agency, just refer to the information from planning agency and also did not involve road users. EMM also did not conduct coordination with the other non technical agency but they already considered the other non technical agency interests by taking into account IDP. However, the current prioritization practice in EMM did not involve road users exclusively, they involve communities which also road users since there is no legal regulation that obligate projects related roads to be coordinated with road agency. The less coordination among agencies shortens the life time of roads. For instance, drinking water company, telecommunication company, electricity company which have their channel under roads often repair or build new channel without coordinating with roads agency. Their projects damage the roads and decrease the road quality.

VII.3. Lessons Learned

Through exploring the similarities and differences of local road maintenance prioritization in Hamilton city, EMM, and WLR, the strengths and the weaknesses of local road maintenance prioritization practiced in those three countries can be found. Those strengths and weaknesses found in Hamilton city and EMM can be used to improve the local roads maintenance prioritization in WLR. This process is called lessons learned. Lessons learned in this thesis will be explored below.

1. The use of analytical tool in ranking the level of the importance of the roads based on technical criteria in the first rank and then considers non technical criteria in the second rank by Hamilton city and EMM is much better than the use of simple subjective ranking method practiced in WLR. The reason for this statement is the calculation of road indexes in ranking roads to be maintained by Hamilton city and EMM is more objective in evaluating the level of importance of roads rather than subjectively based on visual assessment as done by WLR. In this case, the methods used by Hamilton city which are the combination of ranking based on parameters with scoring and/or weighting when related to technical criteria and simple subjective ranking when related to non technical criteria is better than ranking based on parameters with scoring and/or weighting used by EMM since the methods used by Hamilton city is more flexible and the information gained from considering non technical criteria directly in the prioritization process will be more reliable rather than considering non technical criteria through certain policy such as IDP. Besides that, Hamilton city that uses Hanzen to store the data and excel spread sheet to calculate road indexes has the simpler procedure than methods used by EMM, and also better than simple subjective ranking method used by WLR. Furthermore, the use of software by Hamilton city and EMM also simplify the process in updating the data.
2. The practice of prioritization in Hamilton city guided by national and local guidelines is better than the practices in EMM which does not have guidelines and WLR with the national guideline. In this case, EMM practices are still better than WLR since local road agency in EMM is capable in formulating their own procedures by using the available method which suit with their conditions. Besides that, WLR did not fully practice prioritization as stated in guideline since

they skip some surveys that need much time and money because the vast area, limited budget and time causing the output become less accurate.

3. The involvement of various criteria in local road maintenance prioritization by Hamilton city is better than WLR and EMM since those criteria are the parameters used in measuring the level of importance of roads. Through involving many criteria there will be more issues addressed.
4. Hamilton city and EMM consider integrated development in the prioritization reflected from the coordination among the local government agencies, and coordination between local government with provincial and national government which is better than WLR that has no regular coordination with provincial government. In this case, road agency in the city of Hamilton considers national, provincial, and municipal guidelines in conducting road maintenance prioritization. However, Hamilton city only conducts the coordination if there is any national or provincial project that will affect their residents or conduct in their areas. EMM is really concern to the integrated development since they issue the considerations of national and provincial goals and objectives legally in IDP so that it has law enforcement. Thus, the target of road quality achievement become more realistic, and measured. Finally, the road network can be optimal in delivering public services.
5. Hamilton city and EMM emphasize the level of services (LOS) owned by each road in prioritizing roads to be maintained which is more superior to WLR since LOS shows to what extent the roads can deliver the public services. Therefore, it is the reliable measurement of road function.
6. The involvement of road users in Hamilton city is a great practice in local road maintenance. This practice is better than EMM and WLR that only involve communities since the road users are the real consumers so that their information, assessment and issues are the significant parameters to be considered. The reason for this view is the funds used to finance road maintenance are sourced from their taxes such as through vehicle tax and fuel tax. It also shows that the transparency of Hamilton city in utilizing taxes paid by road users and their efforts to use those taxes as much as possible for the benefits of road users.

7. The involvement of councilors in local road maintenance in Hamilton city and EMM is better than in WLR. This is because they involve directly to the communities in collecting and then delivering their aspirations and issues. In turns, the communities' aspirations and issues will be more appreciated by the local technical agency since the councilors in Hamilton city are the definitive actor which is the most important actor. Therefore, if they carry out their task to deliver communities' aspiration well, road maintenance can give the optimal benefits to communities. At the end, it will make the sense of communities belonging to roads increase, and the road quality become more sustain since the communities will participate actively in maintaining the roads.
8. All countries consider political criteria, but in Hamilton and EMM political interest did not dominate prioritization. Whereas, in Indonesia political is dominant. For example, there should be the equity in the length of roads maintained for all regions, and the councilors will prioritize roads in their areas or their constituents' areas to be maintained first. In EMM the political can be said lightly influence the prioritization since it only covered in IDP process. IDP is divided into yearly and multi years planning. It is very clear, detail, and complete document which covers all development fields and government targets. Besides that, all prioritized projects are mentioned in IDP so there will not vague interpretations. It is intended to realize the integrated development. Moreover, it has law enforce since it is a legal document so all agencies should be refer to IDP. Furthermore, there are national and provincial goals, and wards priorities become the main considerations in the process of preparing IDP. Therefore, IDP will save much money and time for coordination with other actors every year.

VII.4. Transfer Possibilities

All lessons learned gain from exploring local road maintenance prioritization in Hamilton city and EMM cannot be transferred directly to WLR. There are some considerations taken in adopting the strengths of local road maintenance prioritization in Hamilton city and EMM, as listed below.

1. The better prioritization method practiced in Hamilton city and EMM which use analytical tools in scoring and/or weighing the parameters which cannot fully be adopted by WLR. This method only can be adopted if there is a strong willingness and effort from the technical agency to provide all requirements needed to operate analytical tools for assessing the level of importance of roads objectively. Since WLR did not have much budget to formulate their own analytical tool, they can use the suggested prioritization method stated in the national guideline called Regency Road Maintenance Guideline issued by Public Works Department of Indonesia (2005) which already adjusted to Indonesian conditions. In that guideline, the road maintenance prioritization is suggested to use matrixes. The requirements are in the form of the latest data regarding to traffic volume and road conditions, and also the capability of the technical staff. However, the latest data obtained from the complete surveys as required cannot be done yearly for all areas since the length of roads and the vast area covered will need much money and time to be surveyed.
2. The implementation of Regency Road Maintenance Guideline issued by Public Works Department of Indonesia (2005) in WLR can be realized only if that implementation obligated by the council. By that way, the executors in which the head of agency and the technical agency should conduct the guidelines for getting the approval from the council. This obligation is important since it accounts the characteristic of civil servants who will obey the written and legally regulations. Furthermore, it needs the willingness and effort from the local government in fully conducting the guidelines as long as they cannot produce their own guideline.
3. It is difficult to include other non technical criteria such as environmental criteria, risk analyses and economical criteria in the local road maintenance prioritization in WLR even though those criteria are important. Those criteria can be considered in the prioritization if there is a legal regulation setting the clear rules. In addition, it needs the capability of technical staff to utilize the criteria in prioritizing local road maintenance.
4. The coordination among local agencies and between local agency and the higher level of government in Hamilton city and EMM is very positive point of

prioritization practices in those two case studies. WLR can involve the non technical local agencies in prioritizing road maintenance with the help from the city manager. It can be done by obligating all agencies to reveal their programs each other, communicate projects affected local roads with road planning section in the beginning of budget year, and schedule the coordination with the higher level of government related to local roads. In this case, the head of the regency has power to force all agencies in coordinating their programs each other.

5. The consideration of the clear measurement of the level of services (LOS) of roads in the practices of local road maintenance in Hamilton city and EMM can be adopted by WLR. This adoption is possible only if there are data of the current LOS for all roads, a clear standard, and the clear guideline how to measure LOS. Those requirements should be stated in the prioritization procedures so that the target of LOS achievement can be determined.
6. The involvement of road users in prioritization process in WLR will be difficult since it needs a long time and clear procedure. Road users can be involved in the prioritization unless the local government wants to launch the program first to the communities, and conduct several pilot projects aimed to check the effectiveness. Besides that, the government needs to determine the best methods to involve them. This is because the road users in WLR have the various educational backgrounds in which most of them are less knowledgeable in road maintenance issues.
7. The direct and active involvement between communities and councilors can be improved in WLR only if communities are aware about their rights and councilors are aware about their responsibilities because the local government cannot force council to actively communicate with communities since their position in institutional structure are parallel.
8. The domination of political interest can be reduced only if the politicians are aware about the effects of their final decision to the prioritization output, and the negative effects of disproportional of political interest in prioritization process.

CHAPTER VIII

CONCLUSIONS, RECOMMENDATIONS, AND REFLECTIONS

This chapter will discuss conclusions, recommendations, and reflections as the results of this research. Conclusions will provide answers for the main research question and all research sub questions. Furthermore, recommendations present all the proposed actions to be taken in order to transfer lessons learned from the city of Hamilton and Ekurhuleni Metropolitan Municipality (EMM) into West Lombok Regency (WLR). These recommendations are aimed to improve the practices of local road maintenance prioritization in WLR. These adoptions eventually will maintain and improve road quality in WLR. Meanwhile, reflections are the author's contemplations after conducting this research in which it will come out with the strengths, weaknesses, and challenges of this research, and suggestions for the further research that in the similar topic.

VIII.1. Conclusions

In conclusion, the local road maintenance prioritization is a process to rank local roads to be maintained based on certain criteria. Through conducting the right prioritization, the quality of roads can both be maintained and be improved. Therefore, this thesis explores the prioritization practiced in WLR, The city of Hamilton, and EMM, and analyzes to what extent the prioritization in The city of Hamilton and EMM can be transferred to WLR.

Local road maintenance prioritization practiced in WLR uses Simple Subjective Ranking method. This method considers national and local goals and objectives, technical criteria, political criteria, financial criteria, social criteria, and legal criteria. There are five actors involved in this prioritization which can be grouped into four types of actors. They are authority as dominant actor; technical agency of local government that can be acted as discretionary actor, demanding actor, and dominant actor; politician as dominant actor; communities as demanding actor; and financial agencies as dominant actor. Meanwhile, Hamilton city combines two prioritization methods in prioritizing local road maintenance: ranking

considering parameters with scoring and/or weighting method, and subjective ranking method. In this case, this city considers regional goals and objectives, technical criteria, political criteria, financial criteria, social criteria, economical criteria, environmental criteria, and risk analyses. Furthermore, there are seven actors involved in this prioritization which can be divided into five types. They are authority act as definitive actor, technical agency of local government act as dominant and dependent actor, non technical agency of local government act as dominant actor, the higher level of government act as demanding actor, politician act as definitive actor, communities and road user act as demanding actor. The prioritization practiced in EMM uses a method called ranking considering parameters with scoring and/or weighting. This prioritization considers local, provincial and national goals and objectives, technical criteria, political criteria, financial criteria, and social criteria. There are five actors involved in this prioritization. Based on the attributes that they embrace, they can be classified into five types of actors. They are the higher level of government as dormant and discretionary actor, technical agency of local government as discretionary and dominant actor, communities as demanding actors, politician as dominant actors, and authorities as definitive actors.

Based on those explanations, it can be said that the prioritization practiced in Hamilton city and EMM is better than the prioritization practiced in WLR in the form of using more objective methods and clear guideline, aware of integrated development, considering diverse criteria and actors, and using level of services (LOS) as standard measurement in road maintenance prioritization. In order to improve the prioritization practiced in WLR, those strengths can be adopted. However, those strengths cannot be directly adopted by WLR. It will need some adjustments such as strong willingness and efforts from technical agency to operate analytical tools for improving the objectivity, the legal regulations that force the implementation of prioritization guidelines, the rules setting the main prioritization criteria, and coordination among all local agencies discussing projects affected local roads. Besides that, the local government should provide the current LOS data and the clear LOS standards, conduct the suitable prioritization program involving road

users, give communities education related to their rights in the prioritization, and manage the proportional intervention from politicians.

VIII.2. Recommendations

Lessons learned from local road maintenance prioritization practiced in Hamilton city and EMM, and the adjustments needed to adopt those lessons can be used to formulate some recommendations in order to improve the current prioritization practiced in WLR:

1. West Lombok Regency can adopt ranking considering parameters with scoring and/or weighting method practiced in Hamilton city and EMM. First, the Regency can implement a prioritization method stated in the Local Roads Maintenance Guideline year 2005. Because of that guideline was issued by Public Works Department of Indonesia, it is already both tested technically and matched with the condition in Indonesia. Therefore, the output will be more reliable. After that, WLR can try to apply an analytical tool as used by EMM if the qualification of human resources and funds are sufficient. The reason is the use of analytical tool in prioritization can ensure the objectivity.
2. The succeed practice of local road maintenance prioritization guidelines in Hamilton city and EMM can be seen in the good quality of local road. In order to achieve the same results, WLR can implement the Local Roads Maintenance Guideline issued by Public Works Department of Indonesia year 2005. This recommendation requires the complete data of traffic volume, and road condition. Those data can be completed through surveys. However, surveys will cost a lot of money and need much time. The regency can deal with this situation by encouraging the active involvement of road observers and their staffs in every district. In this case, the road agency can give them training about how to conduct the surveys. Therefore, they can submit the required road data in the beginning, and in the end of budget year. Road agency can use those data both for data base planning and for planning evaluation. Since the civil servants only conduct the legal instruction, these responsibilities should be stated clearly and legally to road observers and their staffs. After that, those data will be used in

prioritization method suggested by the national government. The capable technical staff is needed to operate that method. For that reason, the local government can send their staff to the research center of national public works to gain knowledge and skill related to the operational of local road maintenance prioritization method. Besides that, the local government can conduct training by inviting the experts to give the course in the regency. Furthermore, these efforts need the willingness and enforcement from the local government. Therefore, all local agencies will fully implement the national guideline. Finally, the skilled engineering staff can formulate the local guideline based on the national guideline. That local guideline should be adjusted with the current conditions of WLR. The guideline should clearly explain the procedures conducted, and criteria considered in the prioritization so that there will be no miss interpretation.

3. The local road maintenance practiced in WLR did not consider environmental criteria, economical criteria, and risk analyses although these criteria are important for the sustainable development. Since the implementation of those criteria for all roads' assessment is relatively expensive, the regency can require those criteria only for every proposed road maintenance project to the council for approval. Therefore, the bad effects from the project to the environment, social, and economy can be minimized.
4. Since the decentralization era, there is no coordination between WLR government and provincial government in the process of local road maintenance prioritization. This coordination is important in supporting integrated development aimed to optimize the development both in the provincial territory, and in the regency territory. For that reason, the mandatory meeting among the local government, the provincial government, and the national government in prioritizing local road maintenance should be scheduled. The coordination should cover all projects affected local roads located in WLR for the integrated development. Furthermore, the coordination should also emphasize the long term planning so that the local future prioritization can be adjusted, and the target of road quality can be more realistic.

5. Recall to the importance of LOS in local road maintenance prioritization, there should be an evaluation for minimum once in five years in WLR. Besides that, the status of roads should also be evaluated in order to adjust with the current requirements of roads. Thus, the funds can be allocated appropriately.
6. The suggested involvement of road users, and other relevant agencies should be stated in the legal regulations of road maintenance prioritization in WLR for the law enforcement. For example, those actors should be involved in the development planning consensus. Besides that, the involvement of road users in the prioritization can be conducted by spreading questionnaire to the random road users regularly. For example, it can be done once in five years in order to obtain road users' views.
7. Local council in WLR, Hamilton city, and EMM has the significant roles in prioritizing roads to be maintained so that it is important to increase the knowledge of road maintenance prioritization in that institution. Therefore, they can perform their job in delivering and guiding residents' mandates for addressing road maintenance issues in the appropriate manner.
8. In order to put political interest proportionally, the government should educate the communities related to their rights in local road maintenance prioritization. Therefore, they can convey all their issues, and initiatives regarding to local road maintenance as stated in legal regulations. Since there is much political interest intervene the local road maintenance prioritization in WLR, the regency can adopt the use of IDP in EMM as one criterion considered in prioritization. In this case, the planning process of IDP in WLR should be as transparent as possible, and the political portion should be ensured to be as proportional as possible since the importance role of IDP in the prioritization. For that reason, it will need community building planning (CBP). Fortunately, there is CBP in Indonesia namely development planning consensus. The outputs of CBP will be stated in the document of IDP which will be legalized by council. Therefore, the prioritization process considered IDP can be accommodated all parties proportionally.

VIII.3. Reflections

The choice of research methods used in this thesis is appropriate since it can explain clearly local road maintenance prioritization practiced in WLR, the city of Hamilton, and EMM by applying comparative analysis and case study research. Furthermore, the systematic structure of this thesis can help the researcher to answer all research questions, and achieve the goals. In this case, this research is started by the explanation of local road maintenance prioritization practiced in case studies. After that, the similarities and differences are explored in order to generate lessons from those practices. Furthermore, taking into account the WLR background in transferring the lessons is essential in generating the adjustments needed to adopt those lessons learned. Besides that, the selection of different countries with different background as reference countries results in the different perspectives that enable the researcher to generate the realistic recommendations.

However, there are some weaknesses found in the case studies selection. Firstly, Hamilton city also manages the expressway causing the different scope of roads to be managed. It causes the road maintenance prioritization in the city considers more criteria, and involves more actors than EMM and WLR in order to address more issues. Therefore, it is better for case studies in the further research to have similar types of roads managed in order to gain the comparable road maintenance issues addressed. Secondly, the exploration of road maintenance prioritization in South Africa faces some challenges such as the limited published documents related to local road maintenance prioritization. Thus, all aspects of local road maintenance prioritization in South Africa cannot fully be revealed. For that reason, it is important to include the completeness of data in the case study selection criteria. Furthermore, the recommendations proposed in this thesis can be suggested to other regions in Indonesia since principally they refer to the same guidelines with the similar physically condition, and have the same institutional structure. However, those recommendations cannot be suggested to other developing countries since there will be the different current practices of different prioritization methods, and also different institutional, political structure, and financial policy.

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Appendix

Table 1. The Summaries of Comparison of Methods used, Criteria considered and Actors involved in conducting Local Road Maintenance Prioritization

Country	Prioritization Procedure	Prioritization Method				Criteria	Actors
		Simple Subjective Ranking	Ranking Parameters with scoring and weighting	Ranking based on parameters by economic analysis	Optimization		
West Lombok Regency-Indonesia	<ul style="list-style-type: none"> List the proposed roads to be maintained taken from proposal sent by village and sub-district government and communities. Survey road conditions. Classify roads based on their condition. Determine the type of road maintenance activity needed for each condition. Rank based on road condition, class of roads, and the level of importance for communities, region equity, the requirements from funding donor organizations, and then calculate the budget required. (1st rank) Conduct public meeting in planning and development consensus. Rank based on public meeting. (final rank) 	√		Ranking based on parameters by economic analysis		<ul style="list-style-type: none"> Technical criteria (road condition, the surface type of roads) National goals and objectives Political criteria Financial criteria Social criteria Legal criteria 	<ul style="list-style-type: none"> Authorities (Regent) Technical agency (public works agency, local planning agency) Politician (local council) Communities Funding donors (Financial Agency)
The City of Hamilton-Canada	<ul style="list-style-type: none"> Determine the level of services. Identify road maintenance needs Rank road maintenance needs <ul style="list-style-type: none"> Utilize Hanzen Pavement Management System (PMS) as a tool for storing, analyzing and updating the city's road network by using road attributes to create report of network inventory Calculate road indexes by using Pavement inspection data for analyzing distress measurements, their extents and severities, and distress weightings → Surface Condition Index (SCI). after that, roughness inspection data → Roughness Index (SCI). finally, SCI and RI to produce Overall Condition Index (OCI) Classify the roads based on condition 	√	√			<ul style="list-style-type: none"> Technical criteria (road attributes, road condition, traffic volume) Regional goals and objectives Political criteria Financial criteria Social criteria Economical criteria Environmental 	<ul style="list-style-type: none"> Authorities (city manager) Technical agency (senior management, the leader of planning team, finance staff, team members) Non technical agency of local government Higher level of government Politician (council)

<p>Ekurhuleni Metropolitan Municipality-South Africa</p>	<ul style="list-style-type: none"> ✓ Classify the roads based on capacity and funding ✓ Rank the roads based on other non technical criteria (final list) • Conduct budgeting including the budget allocation for road maintenance. • Collect the data of roads through examining data base • Classify the road network based on strategic function • Classify the road network based on traffic • Survey the current condition of the network • Calculate unit costs of every proposed treatment • Determine treatments that are suitable for every road • Calculate Visual Condition Index (VCI) • Categorize the VCI into five pavement condition categories • Calculate Reseal Condition Index (RCI) and weight the various defects • Categorize the RCI into five reseal condition categories • Calculate a surface need category indicating the surfacing need of the segment • Calculate a structure need category • Calculate a crack seal index (CCI) • Calculate patching index (PCI) • Recommend the treatment • Determine the initial priorities for each road type • Prioritize roads that need to be maintained based on the calculated priority Indices (RPI, SPI, CPI, and PPI). • Formulate the final rank by considering IDP • Submit to the council for approval and budgeting 				<ul style="list-style-type: none"> ➤ Risk analyses 	<ul style="list-style-type: none"> • Communities • Road users
				<p>v</p>	<ul style="list-style-type: none"> ➤ Local, provincial, and national goals and objectives ➤ Technical criteria (road types, Surface type, Traffic category, road condition, road classification, riding quality) ➤ Political criteria ➤ Financial criteria ➤ Social criteria (delivery care center and suburb) 	<ul style="list-style-type: none"> • Authorities (municipal manager) • Politician • The higher level of government (The Department of Provincial and Local Government (the dplg), Provincial departments) • Technical agency of local government. (Department of Public Works, asset manager, Planning manager, Engineer or technician, Financial personnel, Administrative personnel/OH & S auditing, Data capturer/limited IT personnel, Community officer/communications personnel) • Funding donors (Financial Agency: The National Treasury (NT)) • Communities

Table 2. The Summaries of Comparison of The types of Actors involved in conducting Local Road Maintenance Prioritization

Country	Dormant Actor	Discretionary Actor	Demanding Actor	Dominant Actor	Dangerous Actor	Dependent Actor	Definitive Actor	Non actor
West Lombok Regency-Indonesia		- Technical agency (Local Planning Agency)	- Technical agency (traffic survey) - Communities	- Technical agency (the head of public works, planner engineer)) - Authorities (Regent) - Financial Agency - Politician (Council)			- Technical (Team Coordinator, and Transport Planner)	
The City of Hamilton-Canada		- Technical agency (finance staff)	- Non technical agency of local government - Higher level of government - Communities - Road users	- Technical agency (senior management)		- Technical agency (team members and team leader)	- Authorities (city manager) - Technical agency (the leader of planning team) - Politician (council)	
Ekurhuleni Metropolitan Municipality-South Africa	- The higher level of government (The Department of Provincial and Local Government)	- Technical agency of local government. (Financial personnel, Administrative personnel, Data capturer/limited IT officer/communications personnel) - The higher level of government (Provincial government) - Funding donor (Financial Agency) (The National Treasury (NT))	- Communities	- Politician - Technical agency of local government. (asset manager, Engineer or technician)			- Authorities (municipal manager) Technical agency of local government. (Department of Public Works, Planning manager)	

