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Research topic:

A life-cycle approach for managing road infrastructures in developing countries based on *Asset Management*

Case study: Highway Durres-Kukes-Morine (Albania-Kosovo)

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CONTENTS

1. INTRODUCTION

> "We need to stop thinking about infrastructure as an economic stimulant and start thinking about it as a strategy. Economic stimulants produce Bridges to Nowhere. Strategic investment in infrastructure produces a foundation for long-term growth".
> -Roger McNamee-

> "Moving into asset management is all about changing organizational culture."
> -Local government official, United Kingdom-

> "Roads remain the essential network of the non-virtual world. They are the infrastructure upon which almost all other infrastructure depends. They are the paths of human endeavor."
> -Ted Conover-

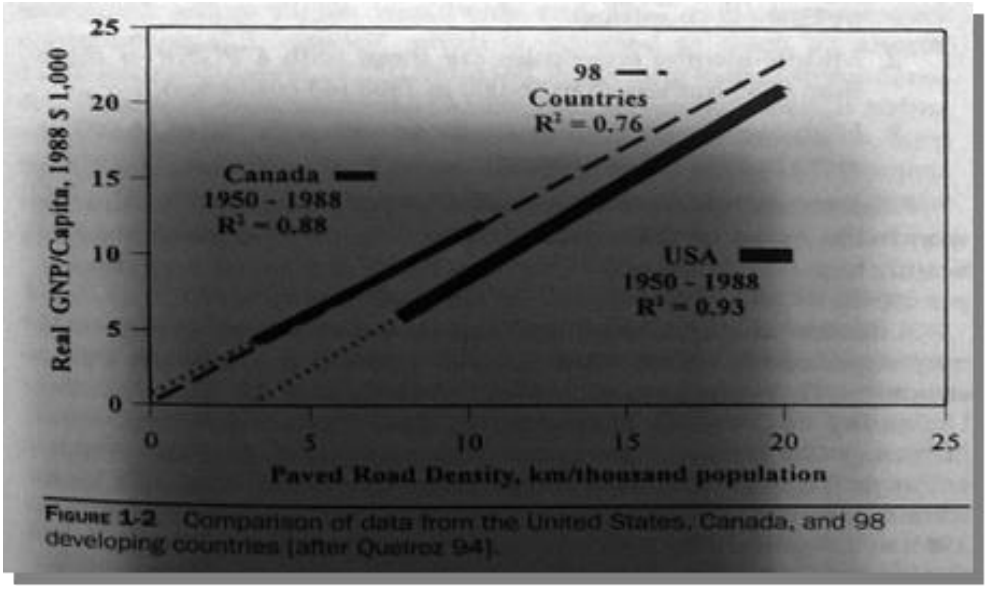
All modern economies are sustained by extensive infrastructure networks of roads and other transport systems, water supply, waste disposal, energy, telecommunication networks and recreational facilities.

The success and progress of human society relies on physical infrastructure which is extremely important to strengthening the economy, creating jobs and building strong communities. It is essential for distributing resources and essential services to the public. The quality and efficiency of infrastructure affects the quality of life, environment, health of the social system, and the continuity of economic and business activity. A nation's strength relies on its infrastructure assets and many examples from history can be cited, such as Roman Empire, which built a strong empire by constructing all-weather roads throughout Europe, North Africa and Middle East to move people and goods. The most recent example is the heavy investments of infrastructure network in East Germany after the reunification with West Germany in 1990. Historical Development of the economic and social systems closely parallels phases of road infrastructure development and Urban Growth and raises the standard of living and public services.

Economic growth leads to a gradual increase in the demand for mobility and expectations from commuters in terms of quality of service, safety, reliability, environmental impact. As a result, authorities face the challenge of preserving existing road assets and, at the same time, raising sufficient funds for new infrastructure investments.

Quieroz in his world Bank study[1] provides a clear relationship between investments in infrastructure and economic growth

Figure 1.1 Relationship between economic development and paved road density like Canada and USA.



Sources: Uddin/Hudson/Hass (2011) Public Infrastructure Asset Management Second edition 2011

Figure 1.1 shows a very strong association between economic development, in terms of per capita gross national product (GNP) and Paved Road density in countries like Canada and Usa for a period from 1950 to 1988.

One of the most important features of infrastructure networks is the degree of inter-dependency, not only within a particular asset network, but also from one network to another. The failure of one component within a network may undermine the ability of other networks to perform. Therefore, it becomes fundamental to plan and manage this complex network in an efficient and effective way and introduce the term "Infrastructure asset management".

“Infrastructure asset management”, combining strategic planning different from country to country and engineering principles with well-established management practices and with economic theory, replaces an old conduct based on corrective actions, with a life-cycle management of assets monitoring capital goods (assets), managing them efficiently and effectively by planning their

[1] Queiroz, C. and S. Gautam, 1992, *“Road Infrastructure and Economic Development- Some development indicators”,* Working Papers WPS 921, *Western African Department and Infrastructure and Urban Development,* The World Bank, Washington, DC, June 1992

construction, the interventions for their maintenance, upgrade and replacement, and also by optimizing the processes of resource allocation.

Today, in the road sector, with the term “road asset management” is intended a logical and continuous evaluation process to plan and build new road infrastructure, measure its conditions and performance and consequently define optimal intervention strategies, in terms of social, environmental technical and economic profitability.

Unlike in developed countries in which infrastructure represents a huge societal investment and have introduced the principles of asset management in road sector, developing countries, as the case of Albania, still do not acknowledge that infrastructural assets are composed of economic goods, which have a useful life characterized by stages, each of which involves environmental, social and economic costs (and eventually benefits). These determine the overall cost of their cycle and life-span. Considering infrastructural assets as composed of goods which have value over time and produce income, would result in fundamental changes in the decision-making models for identifying strategic decisions to be taken for planning and preserving these assets.

The problematic situation of infrastructure in developing countries, (case study Albania), where systems to strategically plan and manage infrastructure assets are immature or non-existent and which show obvious deterioration, scarcity of resources available for road administrations, requires not only urgent maintenance of the existing road network, but also the development of a new way of planning and managing their assets, which does not produce the inefficiency and ineffectiveness of the past but reduces the adverse consequences that arise from an attitude that so far has seen emergency logic prevailing over programming.

While the developed countries, from the 1980s, have started to make major reforms of all sectors in the economy which affected the efficiency of the management of essential infrastructure services, developing countries are in an ongoing process of legislative and internal transformation of their public institutions to pave the way for the implementation of asset management processes. Therefore, is essential to take into consideration and analyze these challenging social, political, legislative and business environments when proposing solutions for the implementation of Asset management processes in developing countries.

Asset management (AM) practices, ***if implemented effectively in the challenging social, political, legislative and business environments of developing countries, hold the potential for heightened performance and major cost savings of the assets throughout their entire life.***

Therefore, organizations in these countries undertaking this strategic approach to plan and manage their Infrastructures must have a clear understanding of the external factors that influence the successful implementation of the AM processes, as well as their organizational behavior to improve their asset management planning.

1.1 Thesis Objectives and content

The main objective of this dissertation is to understand the patterns that influence the strategic planning of road infrastructures and the successful implementation of the practices of asset management in the regulatory environment and structure of the responsible authorities in the developing countries. These patterns (external drivers), different in each country, if not researched and understood correctly, may affect the outcome of the results for the upcoming decades and jeopardize the entire implementation of asset management processes within the organizational structures of the developing countries.

This dissertation will analyze and take examples from Top Asset Management Countries for this purpose. It will analyze how the lack of taking in consideration these patterns (external drivers), in planning and management of the assets on a strategic phase may affect the outcome of the results for the upcoming decades and create problems on the technical level. It will also analyze the relationship that exist between these patterns and current and future traffic loads on primary road infrastructures, asset management processes such as capacity/demand patterns and maintenance.

This dissertation will raise awareness of the benefits "road asset management" has by describing and analyzing its processes, investigate the challenges that developing countries face in implementing "Road asset management" processes in their public authority structure, and propose solutions to a case study by taking in consideration external factors such as social, political, legislative and business environments.

It will review and analyze the National regulatory environment and practices in Top Asset management countries (Canada, Australia, New Zealand, Uk, Usa) and current social and political

situation in the western Balkans region (developing countries region), which is influencing the successful management of primary infrastructures in this region.

A significant Case study from Albania (Highway Durres- Kukes - Morine, segment of European route 7 between Albania and Serbia), is introduced and actual physical Conditions, value and performance of the Highway are taken in consideration. Description of Problems this highway experiences because of lack of life-cycle panning and management are presented and how the mismanagement of the assets on a strategic level leads to tangible problems on the technical level.

Transport impacts on the highway in terms of displacement, traffic flows and forecast, historical traffic data are analyzed in order to analyze capacity/demand patterns and future demand, the influence it has on Road asset management and relate this with different strategies of maintenance.

1.2 Motivation

Road transport is important to economic activity, especially in developing countries where it plays an essential role in marketing agricultural products and providing access to health, education, and other services. These countries, in decreasing order of economic growth or size of the capital market, are classified by IMF[2] (International Monetary Fund), as: Newly industrialized countries (Brazil, China, India, Turkey), Emerging markets (Albania, Argentina, Russia) Frontier markets (Kenya, Vietnam), Least developed countries (Afghanistan, Namibia).

The majority of these countries are experiencing a rapid economic growth and today the majority possesses a wide variety of modes of transport by land, water and air. Overall, road transport is the primary and preferred mode of transportation for most of the population. They have become increasingly automobile-dominated and less environmentally and economically sustainable. Their road transport systems are among the most heavily utilized in comparison to other forms of transport.

While economic growth and the investments in road transport have increased heavily in developing countries, the public sector responsible for their life-cycle planning, management and maintenance is struggling to make the necessary reforms to keep up with the pace. Road transport is still considered unreliable and inadequate and a major impediment for further economic growth.

[2] https://www.imf.org/external/index.htm

The World Bank (2005) lists several reasons why this is happening such as inadequate planning, cost recovery, corruption, insufficient competition, and low credibility of institutions. It claims that unsatisfactory public-sector performance is due to the lack of long-term planning and coordination for infrastructure and the lack of a healthy framework for suitable financing opportunities.

Almost the same reasons are listed by the European commission in its Review of Albanian National Transport Plan (ANTP)[3] for Albania, considered an Emerging Market, where the case study is located and will be the particular focus of this dissertation.

ANTP lists the following strategies to be followed by Albanian Public Sector regarding the transport sector and specifically road network:

- ✓ Define, streamline and consolidate the management of the sector;
- ✓ Improve the coordination and cooperation between stakeholders;
- ✓ Improve and rehabilitate transport infrastructure and, where possible, encourage the private sector to participate in this through PPP agreements;
- ✓ Secure the provision of necessary financial resources for development of the transport system by involving users of the infrastructure who can make a fair contribution to investment and maintenance costs.

Regarding the road transport ANTP states:
"Considerable progress has been achieved in building the necessary road infrastructure required to transport people and goods within Albania and in providing the main corridors connecting its road system with that of its neighbors. The most notable one is the new main artery from **Milot to Kukes and Morine**, the case study taken in consideration in this dissertation, which has been constructed at a substantial cost to connect Albania with Kosovo".

"The GRD, an old-style government road construction and maintenance organization, is being transformed and streamlined into an independent service provider and asset manager, the **Albanian Road Authority** which is to be the principal asset manager of the national road network and will operate on the basis of a performance type contract with the Ministry".

[3]EUROPEAN COMMISSION EuropeAid/127468/C/SER/AL (2010, June), *First Five-Year review of Albanian National Transport Plan*

"Emphasis needs to now be placed on **conservation** of the new infrastructure on a sustainable basis which will become of greater importance over the longer term for Albania"

"Road safety is considered an important issue going forward. A poor accident record is costing Albania millions".

From these considerations and statements arises **the motivation** to conduct this research and write this dissertation. This motivation derives from the wish to collaborate with Albanian Authorities to help them conduct this process of legislative reforms and their internal institutional transformation, by investigating the best practices of leading countries in infrastructure asset management. By taking in consideration an important case study from a developing country such as Albania and analyzing the benefits and problematics, the goal is to understand the importance of adequate road infrastructure long-term planning for these countries and the influence of the external drivers, such as demographic, social, political, legislative, business environments in the positive outcome of asset management processes and how the neglection of this drivers on the strategic planning phase can lead to problems in technical phases, such as operation and maintenance.

1.3 What is this dissertation about

1.3.1 Introduction to Road Asset Management

The fundamental question to pose is what is Infrastructure Asset Management? Why developing countries should undertake essential political, legislative, territorial, business environment reforms to pave the way for its implementation in their Public governing institutions and business environments? Why do they have to follow the path of top leading countries? Why is it so essential to the sustainable development of infrastructures and specifically Road infrastructure?

International Infrastructure Management Manual (INGENIUM, 2011)[4] defines the objective of AM as *'the combination of management, financial, economic, engineering and other practices applied to physical assets with the objective of providing the required level of service in the most cost-effective manner'.* and lifecycle Asset management as "*the combination of all the above practices*

[4] NEW ZEALAND ASSET MANAGEMENT SUPPORT (2011), *International Infrastructure Management Manual Version 4, Retrieved from http://www.nams.org.nz/*

with considering the management strategies as part of asset lifecycle, looking at the lowest long-term cost (rather than short-term savings) when making decisions".

While BSI PAS 55 by the British Institute of Asset Management (BSI, 2008a)[5], defines asset management as *'the systematic and coordinated activities and practices through which an organization optimally and sustainably manages its assets and asset systems, their associated performance, risks and expenditures over their lifecycles for the purpose of achieving its organizational strategic plan'*

Analyzing more in detail these two definitions some of the key concepts of the discipline come out:

Multi – disciplinary nature: Involves different actors like Governments, Public officials, regulators, Investors/Stakeholders, contractors, public communities, customers, researchers and various technical disciplines like engineers, architects, accountants, operators, executives, meaning that "soft skills" like Communication, interpersonal people skills, social skills, team-work, data management are essential elements to the success of the process.

Life-cycle management: a visionary approach of planning and managing the physical assets like roads and other facilities. This approach covers their management from the design-planning phase, construction, operation, renewal rehabilitation, maintenance and ends when the asset is not considered anymore an asset but a burden for the owner or stakeholders. It means 80 years life-span or more for some infrastructures like roads, bridges, sewer etc.

Optimal and Sustainable management: treat infrastructures as an asset that is environmentally respectful, socially useful, and economically viable and manage them in a way that current generations and future generations can benefit. Sustainable management is essential to successfully maintain the quality of our life without compromising the quality of environment.

Cost effective manner: enable measures, find new strategies and improve the existing ones, to achieve maximum environmental and social benefits with the minimum economical cost for the public institutions and private businesses. It means minimization of planning design, construction, repair, rehabilitation, life-cycle maintenance cost of infrastructures, meeting the current needs in a

[5] The Institute of Asset Management & British Standards Institution (2008), *PAS 55*

responsible and endured way, without compromising the ability of future generations to meet their needs.

Level of service: Maintain a certain performance of the asset which depends on external factors and social needs and is different from country to country. It is measured by key performance indicators (KPI) which evaluate the minimum quality requirement needed from an asset and are regularly monitored and changed depending on environmental, social and economic needs.

From the above key statements, we can recognize the importance of asset management for every developed and developing country, organization, investor, which undertake this process and realize that with the financial difficulties, increasing social needs, limited environmental resources every modern economy, in a way is obligated to follow this path.

1.3.2 Top asset management countries overview

Top leading countries in Infrastructure asset management are New Zealand, Australia, United Kingdom, United States and Canada, from which best practices are analyzed and taken in consideration in this dissertation.

These countries, from the '60s, began to consider the management of their infrastructural assets within an approach that can be described as "visionary and managerial". Initially, this approach involved only the maintenance of existing road pavements and structural calculations of the new pavements. With "pavement management" term, Usa and Canadian research programs, launched in 1966, defined the process of sizing, evaluation and analysis of the behavior of road pavements. Subsequently, these research programs were extended to bridges ("bridge management") then to the concept of planned development and management of the entire road network (or even, of the entire infrastructural assets), using the Anglo-Saxon terminology " asset management ", initiated in the business sector and then used in relation to physical assets.

The region's major road agencies of New Zealand and Australia began reporting the financial value of their road infrastructure assets in the late 1980s and since 1997 all major road agencies had recognized road assets in annual financial statements. For more than a decade, the two countries have collaborated to advance their asset management programs.

New Zealand was among the first countries to make major reforms of all sectors in the economy starting in the 1980s, which affected the efficiency of the management of essential infrastructure services. The measures resulted in and overview of state and local government sector operations, with increasing involvement of the private sector in infrastructure through sales and contracting arrangements. The New Zealand Transport agency[6], a crown Entity, created on 1 August 2008, merging Transit New Zealand with Land Transport New Zealand delivers the State Highway network and produces annual Asset Management plans. It determines road programmes and funding levels. The establishment of The National Asset Management Support[7] (NAMS) group in June 1995 to develop and promote infrastructure AM practices, policies and systems in New Zealand, was further important step.

Introduction and use of AM information systems Road Maintenance management system "RAMM" improved data storage and processes flow, in addition facilitated professional connectivity among various disciplines. Long-term infrastructure planning was first legislated through the Local Government Amendment Act (No.3) 1996[8]. It required the local authorities to prepare and adopt long-term (10 year plus) financial strategies every 3 years and asset creation/ realization and loss of asset service potential. The local Government Act 2002[9] had significant legislative changes and for the first time "asset /activity management" was embodied in the legislation through requirements such as capital expenditures, meetings of additional demand for and activity, levels of service and replace existing assets.

In Australia an important step was the introduction of New Accounting Standards and the first National Asset Management Committee in 1993, which subsequently partnered with the NAMS Group[10] in New Zealand and published the IIMM (International Infrastructure Asset Management Manual). Until recent years there has been little regulation and legislation driving AM practice, apart from Financial Reporting Requirements under various Australian Accounting Standards which are made by Australian Accounting Standards Board [11](AASB) and serve to address the financial reporting needs of the public sector.

[6] https://www.nzta.govt.nz/

[7] http://www.nams.org.nz/

[8] Local Government Amendment Act (No 3) (1996 No 83) *Retrieved from www.legislation.govt.nz*

[9] "Local Government Act 2002 No 84 (as at 01 March 2017), Public Act – New Zealand Legislation", *www.legislation.govt.nz*, 24 December 2002, retrieved 6 April 2017

[10] http://www.nams.org.nz/

[11] https://www.aasb.gov.au/

In 2006, the Local Government Association (ALGA)[12], established in 1947 the principal organization representing Local Government bodies in Australia, and acting as the independent interest body for Australian local mayors, councilors and local government employees commissioned PricewaterhouseCoopers to undertake the first national study of the financial sustainability of local government. The outcomes of the report led to the Local Government and planning Ministers Council (LGPMC)[13] across Australia and New Zealand. This led the debate and decision making on key strategic policy matters for Local Government and planning in Australia and New Zealand that can be addressed at the national level and implement frameworks to improve financial sustainability, AM and financial reporting of local government

In United Kingdom since the 1980's many of the utility and strategic transport networks (with the exception of roads) have moved to private regulated ownership. Parliament and the Government, at a national level, are responsible for a number of different forms of framework, from legislation and statutory requirements to the appointment of regulators, or simply the promotion of best practices. The Highways England formerly known as the Highways Agency[14] is responsible for the road network (Almost 7,800 km) and sets performance levels coherently with the goals defined at national level. An important step was the publication of PAS 55 in 2004 by the British Standards Institute which described the requirements for an integrated and optimized asset management system and provided guidelines and generic examples.

In United States a structured body of practices in AM, first entered the US state and local government arena in the transportation sector in the late '60s and early '70s. Systematic inventory, condition assessment, service level determination and optimized renewal techniques have been taught for 3 decades culminating in the creation of the US department of Transportation's Office of asset management in 1999. In the same year the Government Accounting Standards Board (GASB)[15]adopted a new accounting principle that required the valuation, depreciation and reporting of all assets, including infrastructure. The overall leadership on transportation asset management is the purview of the Federal Highway Administration (FHWA)[16], the American Association of State Highway and Transportation Officials (AASHTO)[17] and the Transportation Research Board (TRB).

[12] https://alga.asn.au/
[13] http://www.lgam.info/local-government-and-planning-ministers-council
[14] www.gov.uk/government/organisations/highways-england
[15] https://www.gasb.org/
[16] https://www.fhwa.dot.gov/
[17] https://www.transportation.org/

Unlike in the previous countries which have a federal authority responsible for the management of national infrastructures, **Canada** does not have a central federal authority. Provincial, territorial and municipal governments are responsible for a significant portion of the assets in Canada. Approximately 80 percent of the public roadways in Canada are maintained by municipal governments. In 2008, the Canadian Public-Sector Accounting Board (PSAB)[18] introduced Regulation 3150. The PSAB 3150 was approved by the Canadian provincial governments and required all municipal governments in Canada to record and include all tangible capital assets in financial statements under the care and control of the municipality. Since 2009, all public sector municipal agencies in Canada are required to comply with PSAB 3150. They are responsible for the preparation of AM plans.

In 2014, ISO[19] the International Organization for Standardization, a worldwide federation of national standards bodies published 55000:2014, Asset Management – Overview, Principles and Terminology which outlines specific processes and procedures that are recommended for the successful implementation of an asset management program. The ISO 55000 series comprises three standards:
ISO 55000 provides an overview of the subject of asset management and the standard terms and definitions.
ISO 55001 is the requirements specification for an integrated, effective management system for asset management.
ISO 55002 provides guidance for the implementation of such a management system.

1.3.3 Challenges to Implementation

Asset management, as will be described in the following chapter is composed of a series of internal processes influenced by external inputs like political, legislative, natural, economic, social environment, which influence the choices made by Asset Managers within the governmental agencies in the three levels, strategic, tactical and operational. Considering the complexity of such intertwined processes both developed and developing countries face challenges to implement them in their public institutional structure and private sector.

[18] www.frascanada.ca/public-sector-accounting-board
[19] www.iso.org

U.S. Department of Transportation, Federal highway Administration lists in its website the following challenges that road governmental agencies might face and must overcome to be successful in the Transportation Asset Management environment. These challenges are Strategic Institutional, Measurement, Integration, and Analytic.

Asset management is guided by **strategic objectives** the outcome of which influences various customers of different interests like road users, owners, transport companies, emergency services, and various divisions within the agency. They have different beliefs, expectations and different missions, agendas and values. This diversity leads to different objectives which are often in competition. For example, pavement division's focus is on preservation, while the operations division may be focusing on construction. All these competing ideas have to be solved though constructive top-down and down-top communication within different teams of different levels in the governmental agencies, and consensus building. Strategic objectives and policies have to take in consideration all these factors, while developing the life-cycle approach.

Challenges are faced to address the different personal needs, interests and goals of the various teams **(human resources)** within the governmental agencies. Helping people within the organization to understand and appreciate the benefits of the Transportation Asset Management process from the perspective of the entire governmental agency rather than the viewpoint of their individual units.

Measuring the right things is the key to develop effective asset management plans. Governmental agencies can have gigabyte of data from various sources available on their information systems, but the challenge is to recover the useful data in order to identify the appropriate levels of services and performance indicators. Inventory data should be reviewed and evaluated from experts within different divisions in the agency depending on the setting of strategic goals and objectives, so that agencies con produce fact-based information needed to make sound business decisions.

Integration data challenges are faced within the organizations when developing asset management. Heterogeneous data from different disciplines within the organization like finance, engineering, environment need simple software interface and a main framework to incorporate and access them. The challenge is to create an easy and ready accessible software interface which includes all the necessary data, addresses disparities in data sources and formats and responds flexibly to changing data requirements when new strategic decisions are taken or when existing processes are modified.

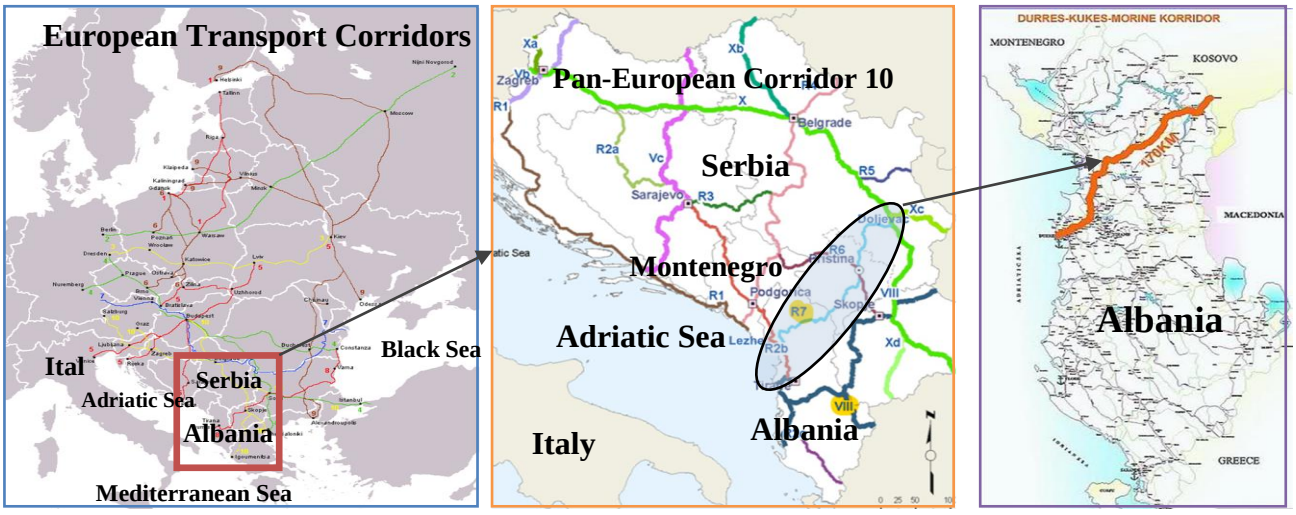
Analytical challenges include models, methods and tools to construct and analyze economic benefits which are still being developed and experimented. Common, consistent definitions and formats of data across systems in a linked or shared database environment are also still under development. A challenge for most agencies in developing and implementing data standards and in converting existing data to these standards is coming up with suitable data formats, models, and protocols when existing databases are extremely diverse.

Besides the previous common challenges all the countries face when trying to implement asset management processes in their institutions, developing countries like Albania should overcome other major obstacles when trying to implement it. Governments of developing countries should create the right political legal environment to support the implementation of Road asset management in agencies. They should make accountability reforms to increase transparency, control corruption, regulate management sector and improve government effectiveness by training human resources. Stakeholders involvement should take priority and be reflected in AM plans Strategy and Policy. Investments in Technological environment like Asset management systems should increase to assure process flow and decision making.

1.3.4 Introduction to Case study

The case study taken in consideration in this dissertation **(Figure 1.2),** is the 170 km long segment connecting the port of Durres, with Albania-Kosovo Morine border, the most important infrastructure investment in Albania, also highlighted in European commission reports for Albania.

Figure 1.2. Highway Durres -Morine



This segment is part of the European Route 7 between Albania and Serbia, including in perspective the connection with the Pan European 10 corridor to Nish in Serbia, continuing in Romania, Bulgaria and beyond. In this thesis, it is divided into four further segments, for study purposes, each one differing from the other in terms of length, width, traffic capacity, function and safety. This further division is essential to describe and analyze the benefits and problematics of this case study, as well as the problems afflicting developing countries in road infrastructure.

The four segments which compose the 170 km long highway from Durres to Kosovo border are:

- ✓ **Durres - Vore**, dual carriageway (22 km), segment of the Albanian State Road 2 (SH2) which connects Durres to the capital of Albania, Tirana. This main Interurban road was the first to be constructed, during years 1997-2002 and is one of the busiest roads in Albania.
- ✓ **Vore - Mamurras**, single carriageway (20 km), segment of the Albanian State Road 1 (numbered SH1), which connects Durres to Shkoder, the main city in north Albania, and continues to Montenegro.
- ✓ **Mamurras - Milot**, dual carriageway (13.4 km segment of the Albanian State Road 1 (numbered SH1), which connects Durres to Shkoder, the main city in north Albania, and continues to Montenegro.
- ✓ The newly constructed **Milot - Morine**, dual carriageway (110 km), which connects Milot to Morine border with Kosovo, and continues to Nish where it meets the Pan European Corridor 10.

1.3.4.1. Historical Background of case study

The first proposal to connect Kosovo with Albania was presented at the office of the former Albanian Prime Minister in 1990's, including the section Durres - Kukes – Morine. Specialists took into serious consideration the possibility to have this link after the NATO intervention in Kosovo in 1999. Maps and other topographic materials were reviewed, and specialists conceived and developed the idea of a more detailed project, defining the costs and distances in question, their plans, longitudinal profiles, etc.

In 2000, in a meeting with Kosovo Road Department, the Albanian group asked what could be done with the road, but it seemed that funding was not easy. However, the project was very important for the future of both countries and the financial means were the last preoccupation. Although there was no official request, the design of the highway project started. In 2001, the General Albanian

Directorate of the Roads started preparing the terms of reference for the feasibility of the Corridor Durres - Kukes - Morine, which was funded by the World Bank.

In 2002, a National Conference for Durres – Pristina, was held in Tirana, under the leadership of Albanian Prime Minister Pandeli Majko, with the participation of former President Meidani. Many Kosovo authorities were also invited. The technical project of the road and building costs were presented. A similar conference was held in Pristina (Kosovo) and preliminary studies were presented to defend the feasibility of the project in the mountainous territory of Albania.

In August 2003, the foreign consultant (Technic and Mott MC Donald), charged with the task of studying the feasibility of the project, presented a draft study to the Ministry of Transport and the General Roads directorate. The Minor Fan and Thirr tunnel alternatives were neglected and conclusions were drawn in favor of the rehabilitation of the existing roads. This did not converge with the interests of Albania and the conclusions of the Albanian experts determined it. The foreign consultant group did not realize that the idea was to connect Albania with Kosovo and not just Durres with Northeast regions of Albania through the simple rehabilitation of existing roads. They were asked to review the entire study, including the Minor Fan Valley alternative with a dual carriageway instead of single carriageway tunnel. A meeting of the Technical Board of the General Directorate of Roads with foreign consultant group that developed the feasibility study was organized and ideas of both variants, Fan Minor valley and Durres - Kukes – Morine, were compared. Later, the alternative passing through Minor Fan valley was defined as a definitive project. This alternative was of fundamental importance for its credibility and funding being drafted by the World Bank, the funding institution meaning that it could not be changed later.

In October 2003, the General Roads Directorate, led by the Prime Minister of Albania approved the feasibility study of Durres – Kukes - Morine, deciding in favor of the dual carriageway alternative passing through the Minor Fan Valley.

The Albanian association of constructors brought up the idea of the design and construction of Durres – Kukes - Morine highway from local construction companies. In the presence of the media, the consortium of the three best companies in the field of road design, Infra-Transproject ltd., DSC ltd. and ICP ltd., was created at that time. The consortium, led by Infra-Transproject Srl, unfortunately missed the mission due to legal impossibility of implementation and operation. The work continued in any case.

In June 2004, the General Roads Directorate called a competition for the design of the last two most difficult sections of Durazzo - Morine Highway, namely the segments Kalimash - Rexhepaj (Kukes) and Rexhepaj – Morine,12 and 17 kilometers respectively. Approximately 55 km of the 110 Km of Milot - Morine highway, composed of Milot – Rreshen, a 26 km section and Kalimash – Morine, a 29 km section, were designed and approved.

In July 2006, the Design team started to prepare the reference terms of the most difficult 55 km long section from Rreshen to Kalimash, which included the 5 km Thirre tunnel, composed of 4 lanes. In September 2006, at the request of the Ministry of Public Works and Transport, the constructive project version was to be completed in March 2007.

The actual highway is yet to be completed, resulting today in consecutive detached sections of two to four lanes with uncompleted bridges in the Kukes region. The financing method, scary and unrealistic expenses, and inaugurations for electoral effects seem to have reduced the Albanians' expectations for the highway. The truth is that this highway has exceeded too much the cost per km unit compared to regional highway unit costs and is costing too much to the poor Albanian taxpayers. Accounting experts, contracted by Albanian Attorney General to analyze the cost of this infrastructure, found that to build the highway from Rreshen to Kalimash, the Albanian government spent approximately 1 billion euros or 22 million euros for 1 km. If compared to Croatia where the same company, in similar conditions built the highway with 4-5 million euro / km, some questions could raise about the efficiency of the investment.

1.3.5 Transport Impacts

Transport impacts on Durres-Kukes axis in terms of historical traffic data, actual traffic volume and forecast as well as differentiation between Albanian- foreign vehicle entries and exits are very important to understand the use and utility of the axis and analyze actual capacity/demand and future demand patterns. Analyzing transport impacts on this axis will help understand the importance of initial planning phase when investing in such important infrastructure and the influence it has on the life-cycle management after construction.

Quantifying it, current traffic load in Durres-Kukes varies in the 4 different sections of the Axis ranging from more than 45.000 AADT on Durres-Vore to less than 7.000 AADT on the new built section Kalimash - Morine. Although the major investment was made for this sections and expectations were high, investments should have been directed in other sections with a major traffic

load and as a result major returns of investment such as Vore- Milot section, which is still single carriage way and bears all traffic volume headed toward north Albania and Montenegro.

1.4 Contributions

This dissertation can be a guide, based on analysis of a real case study, for governments of developing countries trying to improve planning stages and implement road asset management in their institutions. The analysis of benefits and drawbacks of the case study, as well as the transport impacts will help understand the positive and negative impacts that capital investments in road infrastructure might have in the economic development of a developing country. The impact of research will be crucial not only for the context area taken in consideration, but also for the rest of Albanian national territory, and can be used as a real reference benchmark for other cases in developing countries. Research conducted for this dissertation, can present interesting results for the governments of Western Balkans region and international landscape, which supports the need to develop an integrated life-cycle vision for Road Infrastructures.

1.5 How to read this dissertation

This dissertation is organized as follows. Chapter 1 outlines the major topics of this dissertation, chapter 2 raises awareness of the benefits of road asset management by describing its processes, chapter 3 examines the external environment of top asset management countries, that of developing countries, political and economic situation in Western Balkans regions in order to investigate the patterns that influence the successful implementation of Road Asset Management at Strategic level and the outcomes after decades of operational activity, chapter 4 introduces case study, technical details and analysis benefits and problematics to explain relation between strategic-technical level, chapter 5 examines transport impacts and their influence on Road Asset management, chapter 7 gives conclusions and future work.

2 ASSET MANAGEMENT

The first chapter presented an overview of the major subjects of this dissertation. The aim of this chapter is to describe and analyze in detail the processes composing "road asset management" in order to raise awareness of the benefits it has for the organizations. It does not add anything to what is already present in the literature and specifically in the IIMM (International Infrastructure Management Manual), 2011[20].

2.1 Drivers of AM

Asset management integration into a public or private organization within a country which can be the owner of the asset or the asset manager involves three different levels of planning, applied not only in road infrastructure but also in a wide range of disciplines: 1. Strategic planning 2. Tactical planning 3. Operational planning. **Figure 2.1** developed from IIMM (International Infrastructure Management Manual), 2011 shows the Levels of planning within an organization and their interdependency from each-other.

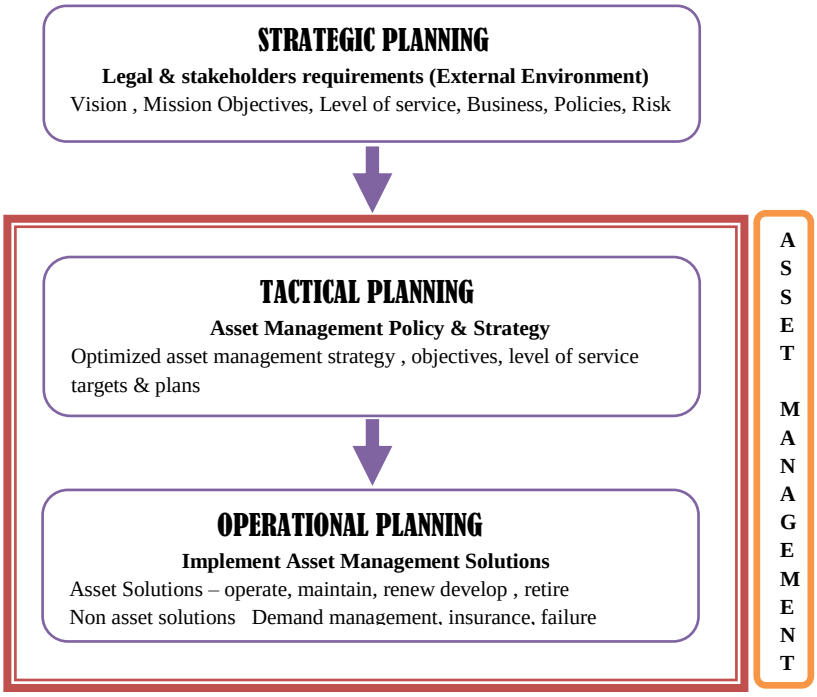
Strategic planning within the organization/public sector links Asset management policy and processes to the external factors like legislative, regulatory, commercial, financial, social and environmental different from country to country. By weighting each of these factors differently public sector strategic plans develop the vision, mission and values of the long-term position of the organization to achieve the prefixed outcomes. For example, in Canada, strategic plans usually have a 10-25 years horizon for financial planning purposes, asset management strategies, but asset managers usually look beyond this period and consider the life-cycle management of the road infrastructures.

Tactical planning involves the establishment of the organization's policies which translate its strategic direction into specific objectives, targets and plans to achieve the defined levels of services. It involves the application of detailed asset management processes, procedures and standards like managing information systems, risk identification, decision-making, asset performance and condition monitoring to achieve strategic goals through meeting defined levels of services.

[20]NEW ZEALAND ASSET MANAGEMENT SUPPORT, *IIMM (International Infrastructure Management Manual), 2011 edition*

Operation planning generally comprises detailed implementation plans and information with a short look (1-3 years) and emphasize practical rather than visionary elements. They outline the operational control of the road infrastructures and define the operational activities like planning, maintenance, renewal, performance measures, training and competence of staff, emergency plans, information and data control to deliver the defined levels of service, in the most efficient and effective way.

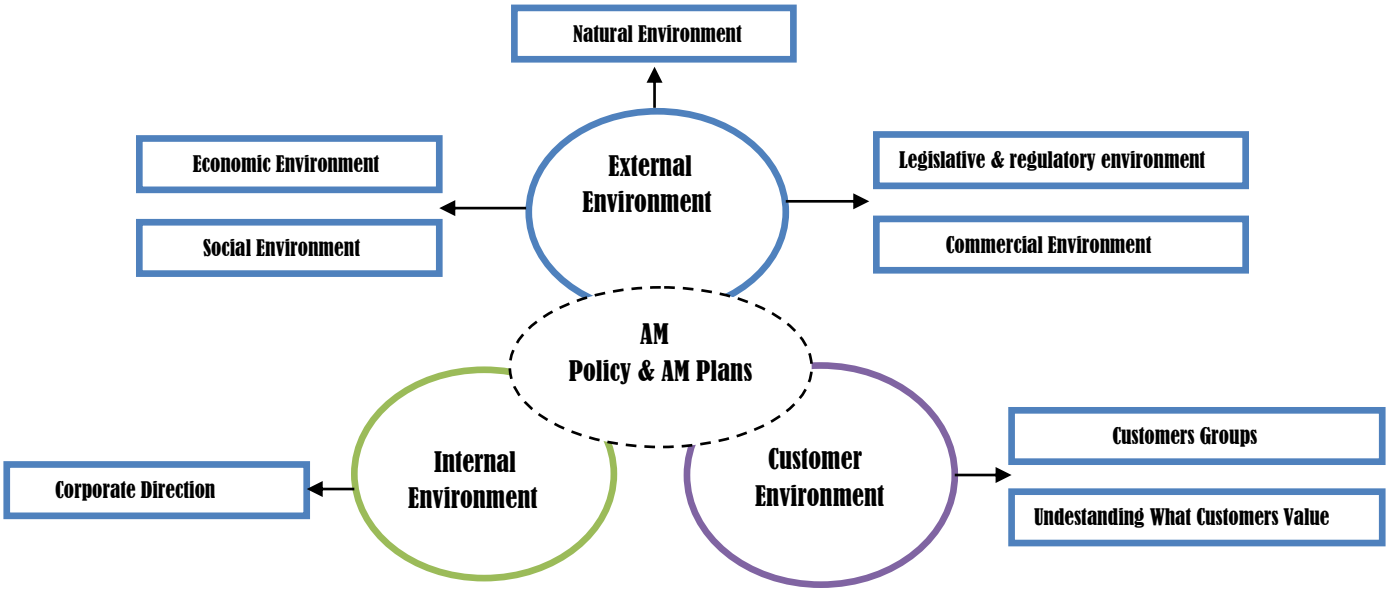
Figure 2.1 Levels of Planning of Agency



Sources: Developed from IIMM (International Infrastructure Management Manual), 2011;

Asset management is composed of a series of processes linked together and depending on changing social, political, legislative and business environments. **Figure 2.2,** developed from IIMM International Infrastructure Management Manual, 2011, shows the relations of the external and internal drivers that influence AM Policy & Strategy to deliver and improve the processes included in AM plans. Effective Asset Management plans should take in consideration these rapidly changing factors. Traditional infrastructure management methods which have been based on corrective and operational activities are unlikely to meet 21st century needs. A description of the internal and external drivers will provide a clear picture of the work flow to successfully prepare the Asset Management plans.

Figure 2.2 Drivers of the AM Policy



Sources: Developed from IIMM (International Infrastructure Management Manual), 2011;

External environment is a very important external driver to take in consideration when preparing the Road AM plans. The legislation in several Top management countries requires an AM approach for one or more infrastructures such as road infrastructures. Practices and the AM policy should identify how the AM processes will respond to these legislative requirements. For example, in Canada, the Province of Ontario requires the municipalities to measure and define levels of service and take in consideration customer and stakeholder requirements in defining these, define links between levels of service and expenditure, long term planning, use of decision making frameworks and recognition of the decline in service potential of the assets. Legislation also may define minimum requirements for AM service levels, customer requirements and other drivers. These requirements are than incorporated into the organization's agreed levels of services. For example, there is an increasing emphasis in many countries on service standards such as quality of road pavements, frequency of inspections, bridge capacity and conditions, galleries safety measures. All these increased requirements need new capital investment that may be difficult to provide.

As a result of the difficulties to provide new capital investment, **Commercial environment** and arrangement of funding mechanisms are essential and can affect the scope of AM and the influence it has on customers. Accountability and reporting mechanisms vary considerably and affect the way in which AM is implemented and how performance is measured. Service delivery and procurement processes for works and services on roads may be mandated though legislation or at the organization's discretion. When AM processes like maintenance are outsourced, aspects of

monitoring are fundamental and should be defined in AM responsibilities. The quality of services depends on funds through taxation or other governmental levies to maintain the required levels of services as well as charging the customers. The AM framework should explain how the organization will provide a cost-effective service and ensure value for money for its' customers taking into account economic environment, affordability and fiscal restraints. An example is taken from IIMM 2011, where New Zealand government clarifies its main goal "to grow New Zealand economy to deliver prosperity, security, and opportunity for all New Zealanders" and sets long term outcomes for New Zealand Transport Agency (Crown Entity), manager of Country's 11.000 km highways to work towards this goal. It states the following: "an efficient transport system that supports high levels of economic productivity, provides strong international connections for freight business and tourism, and meets international obligations"[21]. In response NZTA identifies strategic priorities that affect these outcomes like "Delivering the roads of national significance" and "Improving freight movement efficiency"[22].

Social environment should be taken in consideration when preparing AM plans and policies. This environment is referred to the balancing of business benefits and long-term impacts across socio-demographic groups and input from different interest groups. Road assets are provided to meet social needs. However, they can have negative effects on parts of society. For example, a roadway expansion which passes through a neighborhood should be evaluated for its present and future effects it has on the quality of life of the affected communities. Although social sustainability, a term used to ensure that future generations have the same access to social resources as present generations, are difficult to quantify Asset Managers should keep in mind these effects and take a multidisciplinary approach when evaluating AM objectives and activities by seeking input from a range of other professionals that can offer a different social perspective.

Natural environment is gaining significant importance in recent years as e result of warnings from scientists of the effects of climate change on human well-being. Economic development, the main reason for investments in road infrastructures, should be sustainable and ensured without harming environment. Examples can be taken from around the world where highway infrastructure investments have harmed the environment through the release of vehicles exhaust gases, building construction sites etc. However, road infrastructure can also deliver real environmental benefits. A right integration of road infrastructures with the environment, like planting trees alongside or in

[21] The government's strategic direction, Statement of Intent 2010 – 2013, retrieved from *https://www.transport.govt.nz/*
[22] Retrieved from *www.nzta.govt.nz/roads-and-rail/state-highway-projects/roads-of-national-significance-rons/*

central part separating carriageways, or considering local construction materials, which mitigate the effects of carbon footprint are essential to the sustainability of road infrastructures.

Internal environment

The previous overview of the external factors which should be kept in mind when undertaking the AM processes are intrinsically intertwined with the internal environment within the organization. The organization's direction goals and objectives, (corporate direction) which describe to stakeholders the organization's commitment to deliver the services it provides, may align with these external factors such as environmental, sustainability and economic growth. The AM policy reflects these goals and objectives. Instead of the approach "Top Down" where management level of the organization influences the importance of different AM processes in relation to each other, another approach called "Down Top" should be taken in consideration. This approach consists in gathering information and creating a wide database which is the basis for the management decisions.

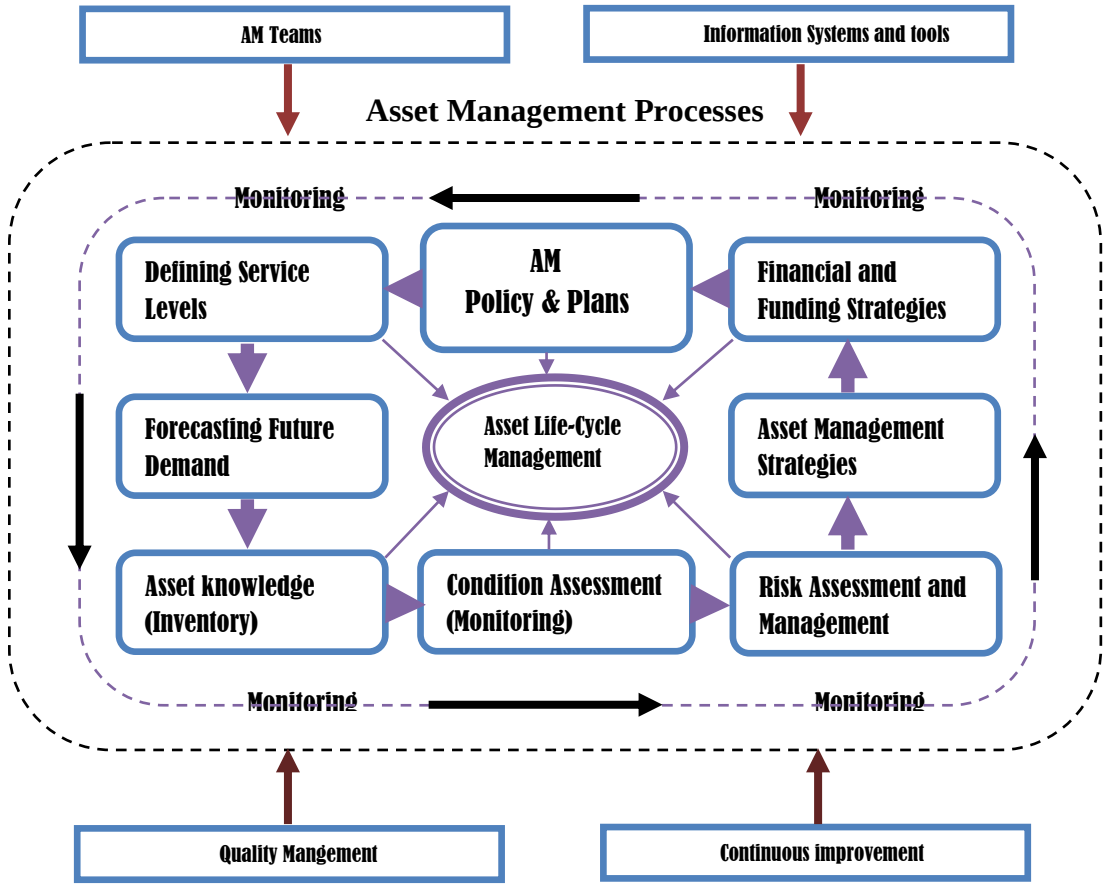
Organizations should understand the **customer environment** when developing AM policies. Customers (stakeholders) are different and have different needs in different environments. For example: key stakeholders such as operators or owners of interconnected networks with roads such as water supply and waste water have different needs and more specific interests in the AM Policy and processes than residents of the communities. "Funding partners" have another relationship with the organization and can impose different rules which direct organization's choices or options. Users such as transport truck companies and private users can judge the performance of the roads differently based on their needs and expectations. The best thing the organizations could do in this case, is grouping customers with similar needs and expectations when developing AM framework, such as residents that reside near areas influenced by the highway, specific users of the highway such as transport operators, emergency companies, business and commercial users, private users that drive from Albania to Kosovo. IIMM states that customers of all groups generally see the value provided by the service as "Value = Benefits – Costs". Understanding how different customer groups describe the service can provide useful indications to the levels of services that should be provided when developing AM policies and performance measures that should be used. Another factor that should be taken in consideration is the "willingness to pay" of these customers, how much can they financially contribute to improve the levels of services.

2.2 Enablers and processes involved in Road Asset Management

But, which are the enablers and processes of AM plans and their flow? Who is involved in their development and what systems and continuous processes make them possible?

Figure 2.3, developed from IIMM (International Infrastructure Management Manual), 2011, gives an overview of overall Enablers and Processes. Enablers include AM teams, such as Human resources within the institutions, Information Systems and Tools such as hardware and software, used for collecting data, Quality Management systems and continuous Improvement systems which control the internal performance of the organization.

Figure 2.3 Asset Management Enablers and Processes



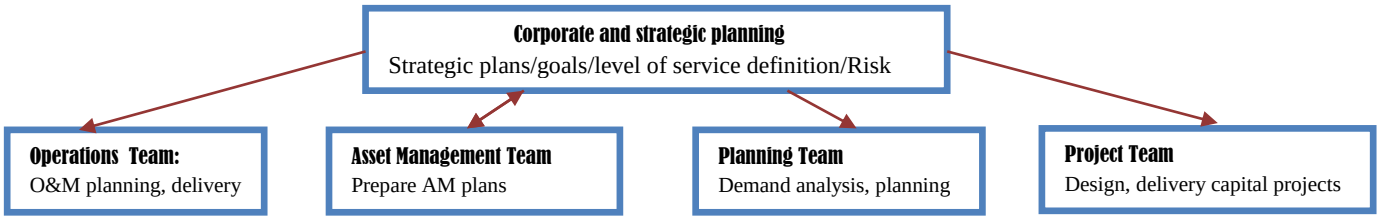
Sources: Developed from IIMM (International Infrastructure Management Manual), 2011

2.2.1 Asset Management Enablers

AM teams include Human resources within the agency like asset managers, economists, civil engineers, architects. The number AM teams within an organization depends on the size of the

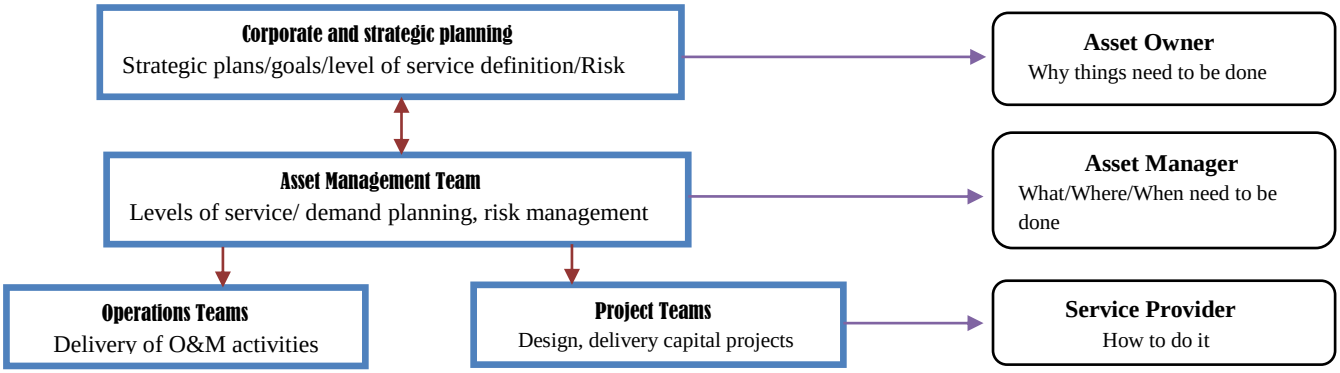
agency. For small sized owners of assets like Roads (small size agencies) asset management team is intended a person or team that writes the AM plan. For larger organizations "asset management" is everything that infrastructure-based organization does. Roles and responsibilities of asset management department can be allocated in different ways within the structure of the agency. According to IIMM, AM team may be allocated in de-centralized or centralized **(Figure 2.4** and **2.5)** position depending on the size of the organization, levels of specialization of the function and types of structural decisions.

Figure 2.4 Asset Management Team location (small agencies)



Sources: Developed from IIMM (International Infrastructure Management Manual), 2011

Figure 2.5 Asset Management Team location (large agencies)



Sources: Developed from IIMM (International Infrastructure Management Manual), 2011;

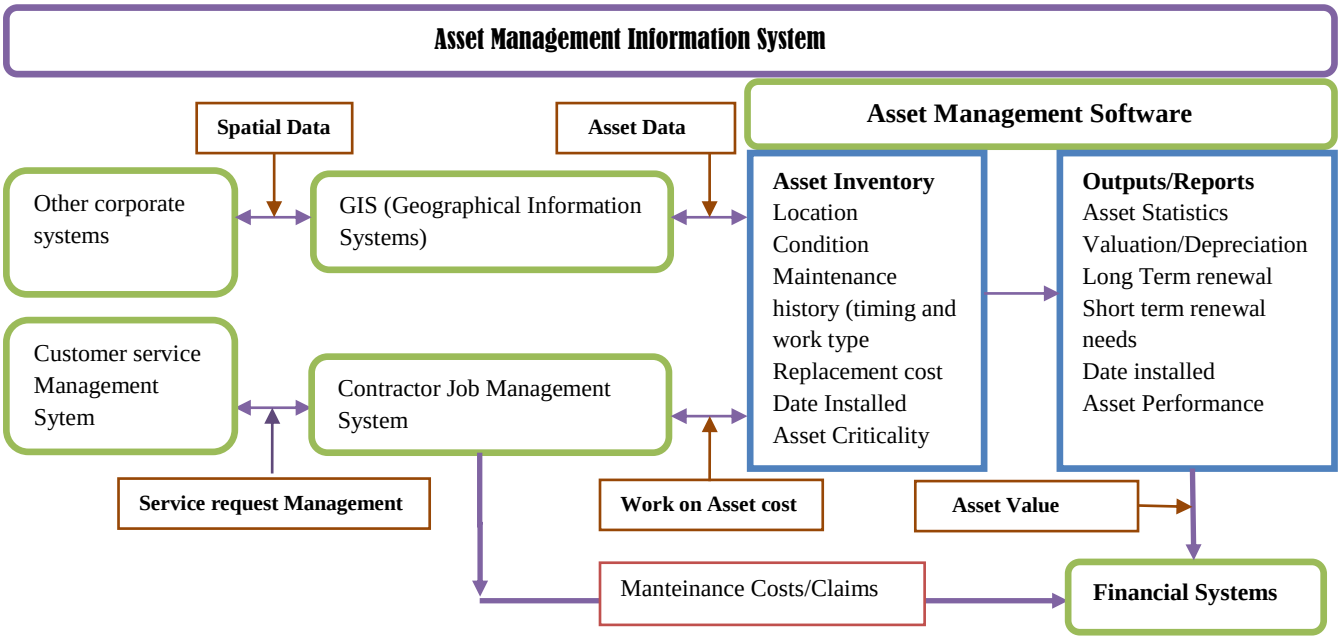
The advantage in the **Figure 2.5** (larger organizations) is that it places Asset Management Team in a core position, giving responsibility for asset planning across the lifecycle, making communication within the team much easier and enabling asset management team to control every aspect of AM. Decisions are taken and communicated to Operations and Project teams who deliver the services. This allocation is challenging to implement in small organizations. In this case, Asset management teams, controlling every aspect of Asset Management, and including various technical disciplines,

make decision making process much more difficult because of lack specialization of human resources. Organization may separate asset owner, manager and service provider either internally or by outsourcing some roles (like service provider, through performance-based contracts). These three entities correspond to Corporate and strategic planning team, Asset management planning team and Operations and project teams.

Asset Management Information systems are defined in IIMM as " a combination of processes, data, software and hardware applied to provide the essential outputs for effective AM such as reduced risk and optimum infrastructure investment" Considering the Increasing size, standards and complexity of road infrastructures and the increasing maturity of AM practices such as optimization, and transparency of renewal and capital investment plans, information systems are placed in a core position to enable the management of infrastructure assets and communication among various departments within the agency. These Computer-Based information systems which include Hardware, Software, Data, Procedure/Standards and people are used to store and analyze significant quantities of asset data collected for AM purposes. The power of current computing technology enables a comprehensive and cost–effective approach to asset identification, analysis and management.

Figure 2.6 shows the relations among different systems within a typical road asset manager which has given in outsourcing the maintenance services of the road.

Figure 2.6 AMIS Relations with other systems



Sources: Developed from IIMM (International Infrastructure Management Manual), 2011;

Geographical asset data recovered from GIS (Geographical Information Systems) or other agency's systems serve as a data input for the Asset Management Software in order to have a cost-effective management of the physical assets.

These data are essential to have an asset inventory regarding the construction date of the road, location, condition, maintenance history, replacement cost. This data is registered in the Asset management software (for example some municipalities in Canada use Work-Tech Asset Management Software[23] or MDW[24]) and it is used for risk prioritization of road network and to define asset management strategies. Once asset management teams have evaluated the conditions and decided the management strategies to follow in terms of maintenance, renewal, rehabilitation etc, an asset lifecycle value is assigned to the asset and passed to the financial systems to decide the Financial/Funding strategies.

Financial Systems receive input from private contractors as well. Every installment required by contractors from the public agency, for the job done in maintaining the road serves as an input for financial systems, so that both financial data from agency and contractor comply and payments are made in time. Both agency's Asset Management Software and Contractors Management System rely on data from various groups of interests, such as customers to deliver the best required levels of services required and improve the quality.

The continuous improvement of the organizations performance which influences the outcomes of the AM processes in terms of efficiency and efficacy is assured through **Quality Management Systems.** This enabler is strategic and has a focus on long-term success of the organization. Its framework aims to integrate quality as part of a comprehensive management system that is focused on the continuous improvement of internal management quality and focused on maximizing value to the customer (Montgomery, 2010). ISO 9001 specifies the requirements for Quality Management Systems as a: "structured, measured set of activities designed to produce a specific output". ISO 9001:2008 requires an organization to "Establish, document, implement and maintain Quality Management System and continually improve its effectiveness" defining it as: "A system to establish policy and objectives though coordinated activities to direct and control an organization"
The successful implementation of Quality Management Systems within the organization requires the full commitment of Senior Management to monitor, control and improve quality through a

[23] www.worktech.ca
[24] http://www.municipaldataworks.ca

strong integration of the systems with the AM practices and a focus on continuous process improvement.

2.2.2 Processes involved in Road Asset Management

The previous section of this dissertation tried to describe the factors and enablers that influence the processes and decision-making of the Asset Managers within an organization. It dealt mainly with the relationship among the components that make Asset Management decision-making efficient and effective to deliver the established levels of service and manage the physical assets like roads with a visionary approach (life-cycle management). This section will describe the flow of the processes in an AM plan and analyze the influence they have on each-other.

Referring to **Figure 2.1,** the first step Asset Managers should do is to establish an asset management policy and strategy which translates the organization's broad strategies and plans into more specific objectives, targets and plans relevant to a particular portion of the organization, like roads division.

Being AM a continuous improvement and monitoring process it's policy and strategy can be modified based on data inputs taken from the other processes like, levels of services, demand forecasting, risk management, asset management and financial analysis techniques, so the cycle starts with the organization's establishment of levels of service and existing asset information base (roads inventory).

2.2.2.1 Levels of Service and Performance measures

What are the levels of service and why their comprehension is essential to AM?
Levels of service are key business drivers which influence all AM decisions. They are defined by IIMM as "an output the organization intends to deliver to the customers" and related to service attributes such as quality, reliability, responsiveness, sustainability, accessibility and cost. They are positioned between the higher level of organization's objectives, influence the operational objectives and are measured numerically by key performance indicators (KPI), which define the performance measures taken at tactical and operational levels to achieve the levels of service. For example the Upper-Tier Niagara Regional Municipality in Ontario, Canada, through the Transportation Master Planning process has identified four key themes to provide the proper level of service for the Region's Transportation department; 1.Transportation infrastructure influences people's feelings about where they live, work and play; 2.Transportation infrastructure influences

employment, the economy and goods movement; 3.Transportation influences tourism, 4. Transportation needs to be accessible to all.

Levels of service statements typically focus on describing organization's output (provision of high quality road pavement) rather than an outcome (happy drivers) and should be clearly defined. For example, level of service "the agency delivers operational activities "effectively" and "efficiently"" is not well defined, as it does not specify the needs to be measured and therefore it is impossible to set standards and targets.

Figure 2.7 Link of Level of service with performance measures

Service attributes	Level of service	Performance measures
Tangibles	Extent of Potholes Clarity of signage Sustainability of lightning levels	Nr of complaints about potholes Road users satisfied with street signs (%) Residents satisfied with street lightning (%)
Reliability	Levels of Congestion Nr of signals Breakdown	Average duration of rush hour trip from A to B Nr of complaints about signal outages

Sources: Developed from IIMM (International Infrastructure Management Manual), 2011

Fig 2.7 developed from IIMM shows a link between levels of service and performance measures where the level of service focuses on broader attributes such as reliability (Levels of Congestion) while the performance measures focus on the numerical indicator which assess the level of service.

Performance Measures provide an indication of the organization's performance against goals and levels of service and should be "SMART":
Specific – target a specific area for improvement.
Measurable – quantify or at least suggest an indicator of progress.
Assignable – specify who will do it.
Realistic – state what results can realistically be achieved, given available resources.
Time-related – specify when the result(s) can be achieved.

They are divided into two categories by IIMM: 1. Customer performance measures which is the outcome the stakeholders receive. 2. "technical performance Measures" which is the measure of

how the organization provides the service and are focused more on technical criteria that demonstrate effective organizational performance.

For example, in **Figure 2.8** "Less than (x) % loss of control of vehicle accidents per year" is a customer focused performance measure which gives information about the % of road users who lost control of their vehicle, where "(x) % compliance with skid resistance standards "takes in consideration the skid resistance of the road pavement to explain the reason, and make investments to improve road safety.

Figure 2.8. Example of Customer and technical Performance Measures

Service Attribute (Customer Value)	Customer Performance Measures	Technical Performance Measures
Safety	Less than (x) loss of control of vehicle accidents per year	(x) % compliance with skid resistance standards

Sources: Developed from IIMM (International Infrastructure Management Manual), 2011;

It is important to always try and develop performance measures that are clearly and directly linked to levels of service. For example: The level of service "To provide uncongested travel around the city outside peak hours" has a strong relationship with a performance measure relating to "time delays at uncontrolled intersections".

Another key point to consider when establishing performance indicators is to understand the control that the organization has over them. For example, respond to service request within (x) days, is something that the organization can clearly influence through provision of adequate resourcing, training etc. However, "the number of fatalities on roads" cannot totally be influenced by road management, but driver behaviors, police enforcement and a number of other factors which contribute to the overall outcomes.

The more control an organization has over the measure, the more robust the measure is an indicator of organizational performance.

2.2.2.2 Stakeholders involvement

The most challenging issue for organizations in defining the levels of service and performance measures is to match them with customer expectations, considering the cost of the service

(price/quality relationship), external conditions which may impose minimum standards, and internal conditions including availability of resources and financial constraints.

Customer consultation is an essential process to deliver the right level of service and define performance measures. Before determining the desired levels of service and setting performance measures organizations should segment road customers in groups **(Fig 2.9)** who may have different needs and expectations and make sure to involve every representative group of customers and discuss with them the associated cost impacts that the increase of level of service has. **For example,** cyclists may judge the road performance based on preferential lanes for bicycle, their standards and safety while for private drivers, driving comfort may be the most important aspect.

Figure 2.9 Customer Group Segmentation

Roads	**Associated service providers**	**Users**	**The wider community**
Roads	Contractors Transport operators Emergency services	Private Drivers Drivers of public and other transport services Pedestrians Cyclists	Tourists Event Organizers Residents who live beside the roads/Highways

Sources: Developed from IIMM (International Infrastructure Management Manual), 2011;

There are many areas in which the expectations of different users converge and others where they are quite different. Those that appear frequently and those that are potential conflicts are areas where special effort should be given to development of levels of service and performance measures. In this context it is also important to separate, or at least differentiate between needs and wants. The latter often fail to be truly valued when their full cost is included in the "Customer value equation" above.

Consultation provides the service provider with an opportunity to enter into dialogue with service users which fosters good relationships and encourages feedback as an early warning system of any developing problems. It communicates the benefits of services provided and ensures that performance measures are focused on factors which are important to customers; identifies levels of service which are currently too high or too low relative to customer expectations and where there is

customer desire for change; enables an understanding of customer willingness to pay well before an option is selected; demonstrates good stewardship of public funds.

Customer consultation process should begin **from internal research.** This existing internal research is likely to provide good indicators of general areas of customer value, if it considers all the customer groups. Internal information sources relating to customer values include: previous customer research and public submissions processes; front-line staff who have a good understanding of what customer "problems" are; complaints records; nearby or similar type of organizations.

Where internal research provides insufficient information on customer values, the first phase of consultation is aimed at consulting directly with customer groups to determine **what they value** and how much value they place on one aspect of the service provided over another. This type of consultation is commonly based around focus groups and user surveys. Important questions the organization should ask to customers are: what do we do well /poorly? What else could we be doing to help you? What problems do you have that we are not addressing? By asking these type of questions, the organization acknowledges the best performing sectors and those to improve. While customers may not be ideally suited for developing the solutions to their problems they can call the organization how well the solution works for them. The results collected from consultation process provide the organization with valuable information to establish levels of service framework which are important to the customers and define the key outputs for the activity which will be the subject of a detailed levels of service review. This consultation phase explores specific level of service issues and options in more detail with customers to quantify both current level of service being provided and the level of service sought by customers ("level of service gap"). Then, the organization develops the options based on their knowledge of the nature and size of the identified level of service gap. Viable options will be limited by

- ✓ Minimum levels of service, based on the minimum technical, environmental and legal requirements applicable to the service.
- ✓ Maximum levels of service, based on best practice and taking into account the condition and capability of the assets to deliver the service, the availability of the resources, the defined levels of service and the ability to measure and monitor the levels of service.

2.2.2.3 Future demand

Future demand forecast is the ability to predict future demand for services and enables asset managers plan in advance and identify the best way of meeting that demand. Asset managers should analyze factors and trends influencing demand like population change, economic growth, political relationship between countries for assets, understand the key drivers of demand, and prepare demand projections. Mathematical modeling processes, like linear relationship with one variable, or analysis of historical data through regression models, although rarely 100% correct, are used to model future demand based on past trends. Change of these factors can strongly influence demand change and asset management planning and processes. Poor demand forecasting can lead to over-investment or under-investment in infrastructure, resulting in an under-utilized or over-utilized infrastructure which in turn can result in lack of financial means to maintain the established levels of services or infrastructure unable to meet the unexpected demand.

Some factors influencing demand for roads and transport are shown in **figure 2.10**. A Core AM Plan should attempt to understand and describe these demands changing factors and how they might affect future demand quantities. Population growth or decline, and other social changes, land-use changes (urban and rural), economic development or decline and political factors are high-level demand drivers and often are the basis for strategic planning studies (e.g.in Canada a provincial transport study which influences municipal authority transport plans), urban development strategies, growth strategies or structure plans. Good AM practice is for these high-level factors to be common and agreed within an organization.

Population growth or decline in rural towns or even cities can have very significant impacts on the need for road assets and how they are managed. Many “western” towns and cities grew rapidly in the early 20th century. Now with increased competition from Asiatic countries like China, India ecc some of these cities are in decline. Due to this decline funding base collected from taxation is reduced, delaying asset maintenance and renewal costs and making it more difficult for Asset managers to balance social, economic, and environmental needs.

Land-use changes (urban and rural), such as from dry – land to intensive horticulture, are another factor which can have a significant effect on infrastructure and AM practice. For example, roads and bridges previously carrying light traffic may need to be strengthened to carry high volumes of milk tankers or unsealed gravel roads may need to be resurfaced to control dust effects on sensitive crops.

Figure 2.10 Factors influencing demand

Roads and Transportation
Population Growth/Decline
Modes of transport
Vehicle ownership
Alternative Transport
Location of commercial areas
Gross Domestic Product
Land use/development patterns
Customer preferences
Government policy/regulation
Political and historical Relationship among countries

Sources: Developed from IIMM (International Infrastructure Management Manual), 2011;

Urban development planning also involves infrastructure planning, together with consideration of transport connections, proximity to other towns or cities major nodes, and the relationship between urban and surrounding rural land uses. Many authorities produce growth strategies or structure plans to coordinate long term urban development with the provision of infrastructure. This provides an opportunity for asset managers to work alongside strategic planners to develop the most appropriate urban form, coordinating the sequencing of land development with infrastructure while also achieving the desired social, environmental and economic long-term outcomes for communities.

There are both **quantitative and qualitative demand forecasting techniques**. Quantitative demand forecasting usually requires records of historical demand data. These are quantified by regression analysis model which is a common form of quantitative forecasting. A relationship between demand variables is established using historical demand data and used to project future demand. Qualitative forecasting is based on research or discussion amongst experts to reach a consensus on future demand. Best results arise from doing both and comparing the results.

With an understanding of growth and future demand trends like population density, age profile, ethnicity, income, employment and the impacts on levels of services, decisions on how to address future deficiencies or shortfalls in service can be made. This may require capital investment in new assets, or a range of “non-asset solutions” (demand management), or changes in the allocation of budgets to operations, maintenance or renewal of assets.

Influences on demand, such as changes in governmental policy, technological advance, environmental awareness and consumer preferences, cannot be predicted with certainty over long periods. As a consequence, in the development of forecasts, assumptions are made about how these factors may change and results of forecasts should be treated with some caution and taken as possible future outcomes rather than definitive statements. In the selection of forecasting methods, careful consideration needs to be given to the consequences should the actual outcome vary considerably from the forecast outcome. A factor of safety may need to be built into forecasts to provide a buffer against this eventuality. The frequency of updates to forecasts and the type of forecasting methods used also may need to be considered if forecasts have a high degree of sensitivity. If the service is based on user charges, what is the impact of variance in income (is there aqeduate cashflow to cover lower than expected demand.) What flexibility is there to change pricing structures to correct for inaccurate demand projections?

Once the above factors are identified and demand forecasts are made through quantitative and qualitative methods, also taking in consideration political relationship among countries, economic, environmental constraints and social pressures, demand management process starts. The objective of this process is to actively seek to modify customer demands for services in order to:

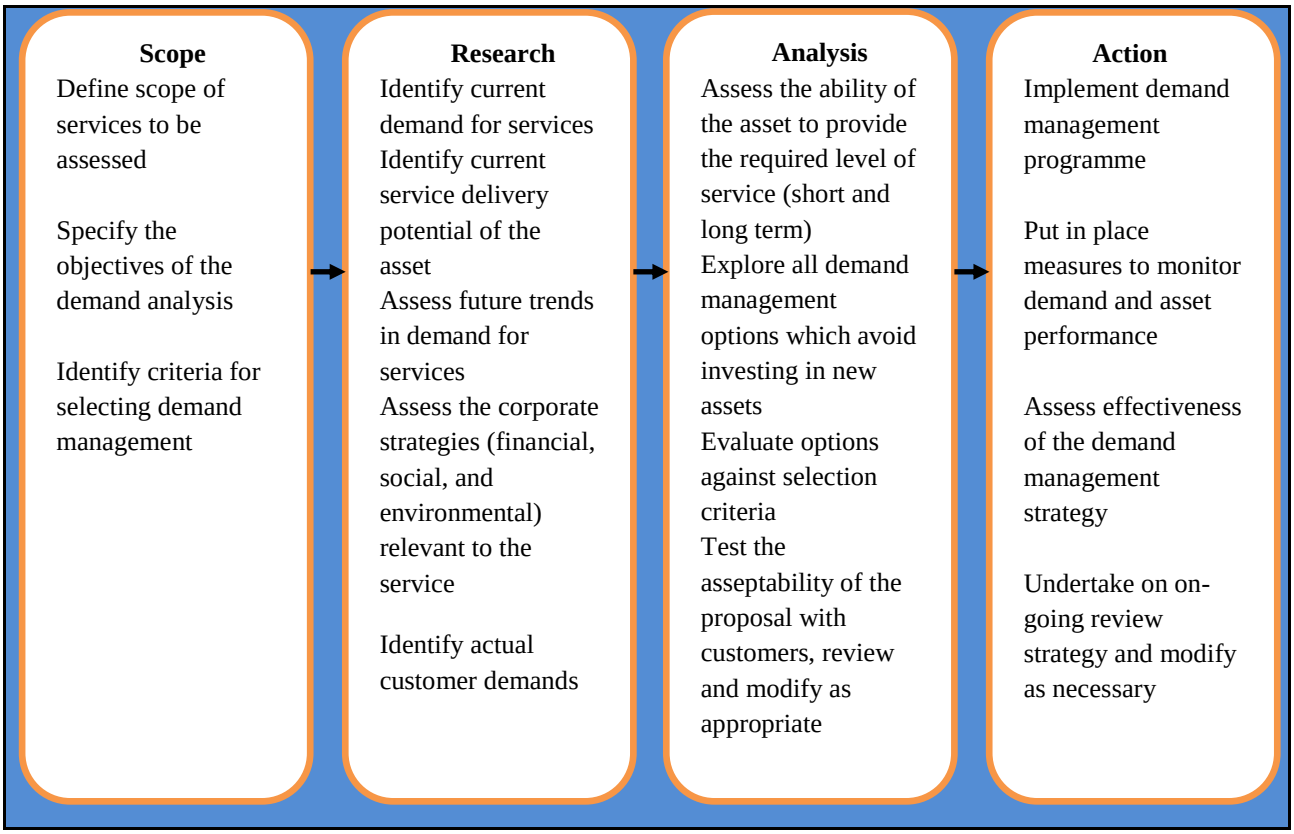
- ✓ Optimize utilization/performance of existing assets
- ✓ Reduce or defer the need for new assets
- ✓ Meet organization's strategic objectives (including social, environmental and political)
- ✓ Deliver a more sustainable service
- ✓ Respond to customer needs.

According to IIMM a typical flow chart for evaluating demand management options shown in **figure 2.11** involves 4 steps; scope, research, analyze and action.

The focus of demand management strategies is to:

- ✓ Reduce peak demand, which is the major factor related to the ultimate capacity of the network. This can be achieved by reducing overall demand or shifting demand to non-peak times. An example is variable road pricing to encourage motorists to travel at off-peak times.
- ✓ Reduce average demand, seeking to modify both peak and base flows in order to reduce operating costs, for example programmes and initiatives to encourage alternative means of transport to the private car.

Figure 2.11 Assessing demand management options



Sources: Developed from IIMM (International Infrastructure Management Manual), 2006;

Historically, most core service providers have attempted, with varying degrees of success, to meet demand for services without attempting to question or modify demand. This approach tends to raise customer expectations and invariably leads to even further demand. Increasing focus on strategic planning, fiscal responsibility, user pays principles, and core services reviews has created greater awareness of the need to consider demand management techniques.

Demand management should consider, and balance both supply-side and demand-side measures. Supply-side measures focus on the analysis and management of factors which result in capacity loss. Demand-side measures may be considered as having up to five major components (depending on the particular activity, with each having a number of implementation options:

The components are:

Operation – Control Access, ingress, egress, etc.

Regulation – Restrict time of use and type of use

Incentives – pricing structures, metered use, subsidies etc.

Educational – change habits, increased understanding, promote alternatives.

Demand substitution –provide alternatives.

Their interactive nature, when promoted as a package or strategy rather than in isolation, can dramatically reduce the demand on the infrastructure network involved. **Figure 2.12** provides an example of how a demand management strategy may be applied to components of different asset groups.

Figure 2.12 Demand Management Strategy

Roads and Transportation		
Operation	Traffic signal controls Local area management	Ration use of road space at intersections Encourage use of arterial rather than local roads Restrict heavy vehicle entry to residential areas
Regulation	Road use restrictions Speed controls Parking restrictions	Control speed of traffic in certain areas Ration use of road space by parked vehicles
Incentives	Provide subsidies of free travel on public transport Parking levies	Encourage use of public transport Discourage car use for travel to certain areas (e.g. Central business district)
Education	Travel blending Change public attitude to using cars at peak hours	Encourage voluntary combining of trips to minimize total travel Promote car-pooling, changes to hours of travel, use of other modes
Demand substitution	Provide/promote alternative transport modes Working at home Freight substitution	Special lanes for buses/car-pooling/cycles Promote acceptance of working from home Shift freight to off-road modes

Sources: Developed from IIMM (International Infrastructure Management Manual), 2006;

2.2.2.4 Asset description and Inventory

Having identified service requirements like levels of service and future demand, asset managers need to be able to assess existing asset capability to meet those requirements now or in the future. Physical information of assets along with key supporting information such as value and age, location, size, type, hierarchy, work history, cost, condition, performance is a starting point for many AM practice.

A full inventory of road facilities generally refers to the data related to the physical features, including structural components, physical dimensions, material proprieties, and construction details (including date of original construction). For existing facilities, it is essential to determine and

record in the database a history of all construction, rehabilitation, capital improvement and other physical changes in the structure, drainage, and so forth. The maintenance, rehabilitation work and cost history, as well as the historical record of usage, are also important data attributes.

Seeking 100% accuracy and coverage is often difficult and not justified for small organization which do not have the necessary funds and human resources, so a staged approach is the best solution, starting off by identifying minimum data required for legislative compliance and reporting requirements. Detail of data collected, in increased order should be able to value the asset and identify replacement programmes, support maintenance management or allow risk management and optimized lifecycle analysis depending on risk prioritization of assets.

The following **Figure 2.13** describes the typical range of data that may be captured in an AM database or system starting from Asset locations and ending at Optimized lifecycle data, depending on the size of the organization. Basic physical information can be recorded on spreadsheet while advanced approaches need Asset Management Information Systems, which allow asset managers to measure the asset's physical integrity or **asset condition**, reliability and management, essential to the accuracy of outcomes that can be achieved through use of the data.

Figure 2.13 Examples of Data Requirements for an Asset Management System

Parameters	**Description**	**Recommended Fields**
Asset Identifiers, Location and Descriptors	Data used to identify, describe and locate the asset. Will also define in terms of position in asset hierarchy.	Asset No., Parent Asset, Description, Location, Asset Group, Asset Class
Detailed technical data	Data which will help individualize this asset from similar assets	Dependent on the asset groups involved and the needs of staff
Valuation Data	Data that allows the organization to value the assets, record and track depreciation, and get an understanding of the actual lives of the assets.	Year Constructed, Asset Life, Remaining Life, Year End, Construction Cost, Replacement Value, Annual Depreciation Rate, Annual Depreciation Charge
Maintenance Data	Data that identifies the work to be completed and work completed against an asset.	Region, Asset No., Owner of Asset, Site Name, Work order No., Date work order Created, Task title, Task Details, Date on Site, Time on Site, Date Completed, Time Completed, Work Order status, Priority, Work Details, Frequency of Work ,Scheduled Period

Condition Data	Data used to prepare decay curves, revision of effective life and current valuation.	Condition, Condition Category, Condition – Based Remaining Life, Condition – Based Written Down Value, Data Assessed, Assessor
Predictive Data	Data used to prepare decay curves, revision of effective life and current valuation.	Decay Curve Type, Future Year 1,2… Future Remaining Life 1,2 …., Predicted Future Condition Year 1,2…
Performance Data	Data recording demand and capacity performance. Unplanned maintenance activity is recorded against asset including cause and costs. Planned maintenance procedures adopted for critical assets.	Target performance Indicators, Year of Assessment, Actual Performance Indicators
Risk data	Data used to analyze an asset's failure and determine the risk to organizations if the asset were to fail.	Failure Mode, Probability of Failure, Consequences of Failure 1,2… etc, Criticality Rating, Cost of Consequence of Failure 1,2 etc. Risk Cost, Date of Analysis
Lifecycle Data	Data used to plan future asset strategies, and determine future costs associated with operations maintenance, creation, renewal, disposal of assets. The current cost of any strategy should also be determined.	Work Description, Cost of Works, Work Code, Year to Start, Date to Start, Resources to Use, Work Period, Safety Criticality Rating, Function Criticality Rating, Cost Criticality Rating, Discount Factor
Optimised Lifecycle Data	Data used in the optimization analysis of works taking into account the following factors: risk, maintenance, operations, life extension, age and condition of asset, asset decay, treatment options and cost.	Treatment, Treatment Type, Cost of Treatment, Frequency of Treatment, Asset Life, Replacement Cost, Planned Maintenance Costs before and after Treatment, Unplanned Maintenance Costs before and After Treatment, Operations Cost before and after Treatment, Consequence of Failure Costs, Risk Costs before and after Treatment.

Sources: Developed from IIMM (International Infrastructure Management Manual), 2006;

Road Infrastructure assets generally have a clear hierarchical relationship, which provides the business with the framework in which data is collected, information is reported and decisions are made. Considering the quantity of possible physical inventory data, it is essential to prioritize the data and/or collect the primary data elements that are required for M, R&R analysis first. **Figure 2.14** suggests mandatory inventory data elements for highways and roads.

Figure 2.14 Mandatory inventory data elements for highways and roads

Facility	Indentification/Location	Construction/Geometry/Material/Structure	Cost and Usage History
Highways, Roads, Streets, parking areas	Agency, state, county, city, name and number, section number, reference longitude and latitude, use, functional class	Construction Number type and date, lanes, pavement width and length, surface type, material types and thickness, shoulder, sidewalk, drainage, safety, appurtenance, traffic, control and lightning.	Total/Annual construction and M, R&R costs, unit costs, annual traffic and percent vehicle type.

Sources: Developed from IIMM (International Infrastructure Management Manual), 2006;

As noticed in the figure, identification and location of the facility are the first step. This data is collected from maps and recorded at GIS through a numbering system which provides a unique identifier for each asset assigning and retrieving information. Then for each asset historical information is added such Construction/Geometry/ Material/ Structure, in order to make it easy to keep record of the data. At the end information about Cost and Usage history are recorded to be used for management and financial purposes.

Use of advanced technologies are used for the acquisition of large quantities of data such as road infrastructure inventory items.

1. Transcription from “as built” or “as constructed” project records. The historical project record is the least expensive source of inventory information.
2. Pedestrian observer visual survey, usually on a sampling basis. This is feasible for small-size facilities.
3. Photo or video logging has an advantage of permanent records. This method can be used for roads, airports, railroad tracks. Subsequent data reduction by either manual or automated image-processing techniques is, however, required but it is costly.
4. Automated measurements of geometrical and structural characteristics can be done efficiently on roads, railroad tracks.
5. Weather records, which can provide simple, inexpensive environmental data.
6. Nondestructive testing, such as ground – penetrating radar, magnetic resonance, acoustic emission, and wave – propagation methods, are sometimes useful.
7. Terrestrial and kinematic laser-scanning (LIDAR- aerial Light Detection and Ranging), for surface-defect mapping and three-dimensional (3D) visualization of assets at local level.

8. Airborne laser scanning and digital imagery (LIDAR- aerial Light Detection and Ranging), aerial radar imaging, and spaceborne remote-sensing satellite imagery for mesoscale mapping and regional applications.

2.2.2.5 Condition assessment

Once asset inventory is completed Roads/Highways are ranked based on their condition and performance. Asset condition reflects the physical state of the asset, whereas asset performance measures whether the asset is delivering level of service requirements. It is critical that service organizations have a clear knowledge of the condition of their road assets and how they are performing. All management decisions regarding maintenance, rehabilitation, and renewal revolve around these two aspects.

Condition and performance information supports decision making and is critical to the management of risks and performance in achieving service standards. It is critical to risk asset management because it is linked to the likelihood and consequences of asset's physical failure. Age (more likely to fail) and criticality (higher consequence of failure) are 2 key factors in ranking assets, usually based on a 1-5 rating scale, and define the frequency of asset inspections **(Figure 2.15).**

Organizations typically start with a more basic approach prioritizing assets based on their importance and criticality and collect data for them (risk-based approach). Generally, they look at those assets that are going to be critical to the organization in the next ten to twenty years and to look at a sufficient sample of the range of asset ages and materials to be able to assess asset remaining lives across the network.

Risk-based approach applies engineering judgement to assign likelihood and consequence of failure indicators and an overall level of risk for each asset. For example, age and material may be indicators of likelihood to failure. Consequence of failure indicators may include cost to repair, number and type of customers affected, environmental impacts, service interruption ect. Important highways or national roads are given more importance as their failure can have major impacts on a country's economic growth and transport.

Condition assessment techniques range from simple visual to detailed mechanical inspections and are selected based on the importance of the asset, likelihood of asset physical failure, so basically, they depend on cost and benefit analysis of applying the technique.

Condition information is then used in analytical models, methods and tools to predict the asset failure now and in future years and identify the timing of future asset preventive treatments, such as maintenance, rehabilitation and renewal.

Figure 2.15 Mandatory inventory data elements for highways and roads

Rating	Description of condition
1	Very good condition: Only cyclic mainteinance required
2	Good Condition: Minor maintenance required plus cyclic maintenance
3	Moderate condition: Significant maintenance required
4	Poor condition: Significant renewal/upgrade required
5	Very poor condition: Unservicable

A basic approach to Condition assessment for non-critical assets for valuation and renewals forecasting can be undertaken by using a “Top down” approach based on the knowledge of staff and maintenance records. The condition grading standards adopted will tend to be simple (i.e 1-5 rating scale, Figure 2.15).

An advanced approach to condition assessment and performance monitoring will be undertaken at a greater component level (making use of sampling techniques where appropriate) to support predictive modeling and decision-making. More sophisticated grading standards may be used to manage multiple asset failure modes. Asset performance will be monitored using a greater number of customer and technical performance measures to enhance decision-making focused on achieving strategic objectives and network optimization.

An example of asset condition with information regarding the components of road assets, quantity, expected service life, historical cost and replacement value is taken from Niagara Region Asset Management Plan. Pavement network age distribution and Bridges General Overall Condition. As shown in the charts **(Figure 2.16),** Niagara Region has created an inventory of the transportation assets under its jurisdiction classifying them based on a number of different factors like quantity,

expected service life, historical cost and replacement value. Road pavement network age distribution is recorded and asset/bridge condition is classified to make appropriate decisions on their maintenance, renewal or replacement

Figure 2.16 Example of Condition Assessment of Niagara Region Asset Management Plan

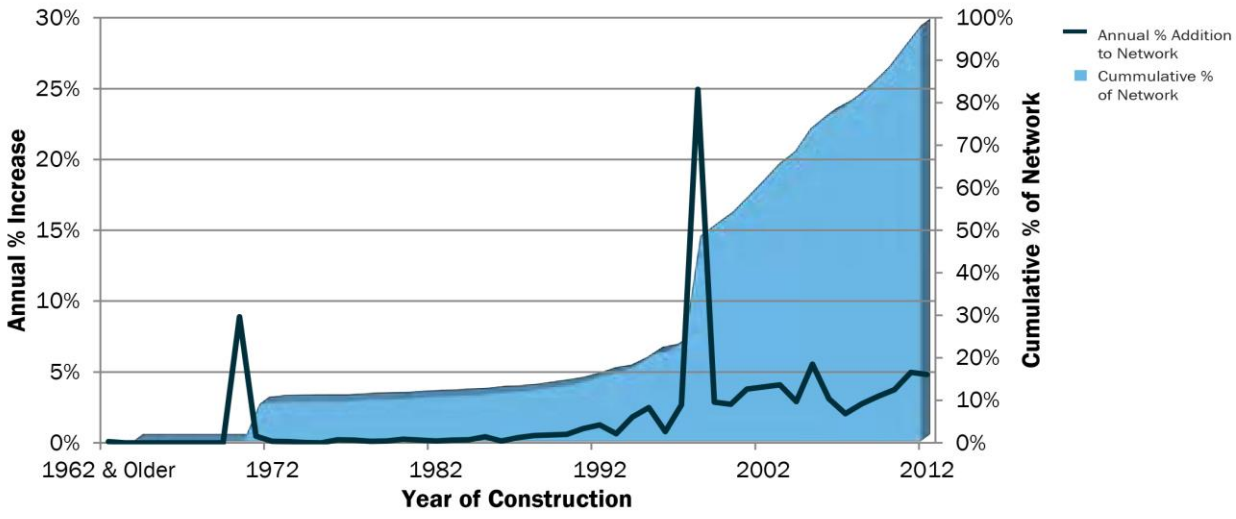
Figure 2.25– Bridges General Overall Condition

PRIORITY RATING	EXCELLENT	GOOD	FAIR	POOR	TOTAL
ADEQUATE	4%	27%	0%	0%	31%
6-10 YEARS	0%	1%	11%	0%	12%
1-5 YEARS	0%	5%	22%	7%	33%
NOW	0%	15%	7%	2%	23%
TOTAL	4%	48%	40%	9%	100%

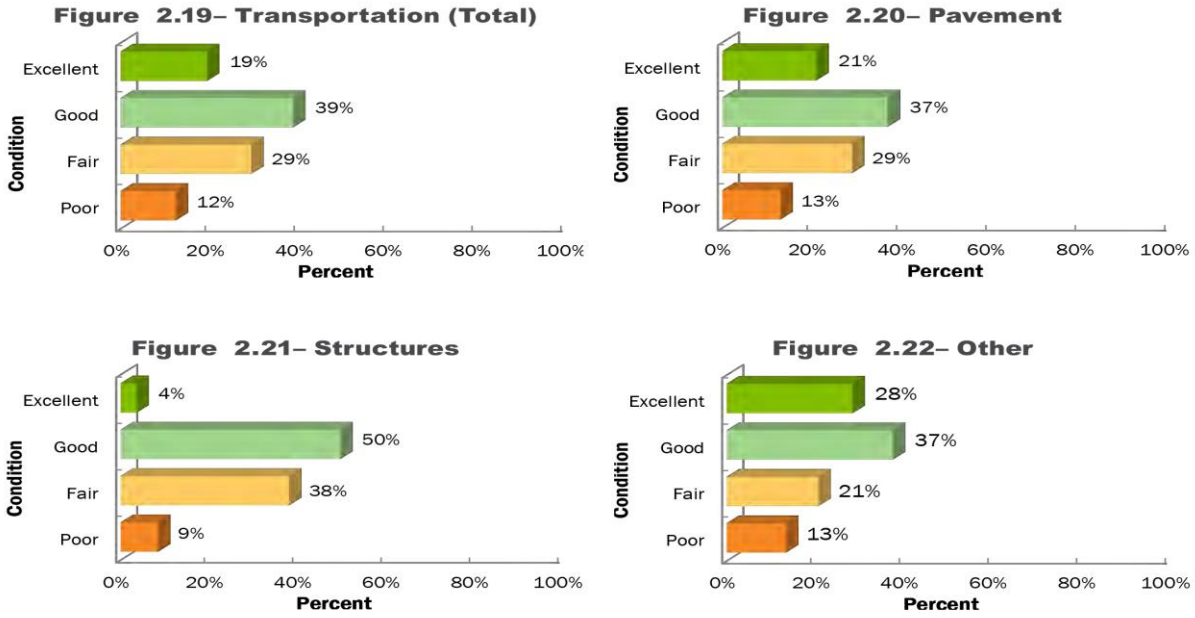
Figure 2.15– Transportation Assets

ITEM	QUANTITY	EXPECTED SERVICE LIFE (YEARS)	HISTORICAL COST	REPLACEMENT VALUE
Paved Roads	758 of centre line km	40	$538M	$1,247M
Structures (Bridges & Culverts)	128 bridges, 55 large culverts	75	$95M	$221M
Signals & Illumination	269 signals, 1019 luminaires	5 to 40	$36M	$84M
Other	5 patrol yards, guide rails, cross culverts, retaining walls	5 to 40	$21M	$48M
Fleet	193 vehicles, 275 pieces of equipment	4 to 20	$17M	$19M
Total			**$707M**	**$1,619M**

Figure 2.16– Pavement Network Age Distribution



ASSET CONDITION



Sources: Developed Niagara Region, Ontario, Canada, Asset Management plan 2014

In conclusion, the benefits of knowing the current condition and performance level of an asset are:

- ✓ Ability to plan for and manage the delivery of the required level of service
- ✓ Avoidance of premature asset failure, leaving open the option of cost-effective renovation.
- ✓ Risk management associated with asset failures
- ✓ Accurate prediction of future expenditure requirements through understanding remaining asset life and capital investment needs.
- ✓ Refinement of maintenance and rehabilitation strategies.

From these considerations we can deduce that Condition Assessment Programme is designed to achieve the following objectives:

- ✓ Identify those assets which are underperforming
- ✓ Predict when asset failure to deliver the required level of service is likely to occur
- ✓ Ascertain the reason for performance deficiencies
- ✓ Determine what corrective action is required and when (maintenance, rehabilitation, renewal)
- ✓ Record asset failures for use in advanced AM techniques

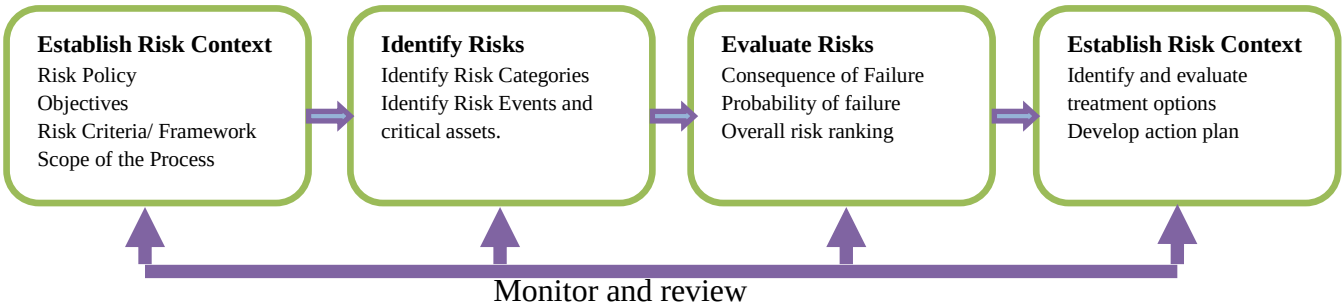
2.2.2.6 Risk Assessment and Management

Once assets are ranked, **Risk Identification, Understanding and Management** are key processes which influence and may compromise the delivery of organization's strategic objectives. AS/NZS ISO 31000 defines risk in terms of the effect of uncertainty of objectives. In other words, risks are events that may cause failure to achieve objectives. Objectives are commonly described in terms of the triple bottom line aspects of social, environmental and economic goals.

According to IIMM, organizations should establish a risk management framework identifying the criteria against which risk can be evaluated and the responsibilities for managing the risk. Risks may relate to business planning, management service delivery, physical asset failure and organization's risk policy should define risk objectives, scope and strategies, including the definition of "Unacceptable" risk.

Once the criteria in the risk framework are set, the next step is to assess the risks, and, if appropriate, to then examine these in more detail. The assessment looks at both the probability and consequence of the risk occurring and combines this into overall risk score. Once the risks are identified and assets prioritized options for risk mitigation should be identified and evaluated taking into account the costs of doing so. Successful implementation of risk management relies on sustained commitment by management, appropriate framework design, communication and ongoing monitoring review.

Figure 2.17 Risk Management Processes



Sources: Developed from IIMM (International Infrastructure Management Manual), 2011;

Figure 2.17 developed from IIMM, ranks the processes involved in Risk Management Context. The first step for an organization is to establish a consistent risk framework applied within the organization across the corporate, outlining the risk policy, objectives, and risk framework. Based on Risk objectives, risk categories, events and assets are identified classified based on their

probability and consequence of failure and measures are taken to evaluate treatment options and develop action plans.

In deciding the scope and level of advancement of the risk management process (core-advanced) an organization needs to consider: The nature of the service provided, for example organizations providing essential community services, such as water supply or power typically have minimization of risk as a core business driver; Legislation, risk management processes may be mandated by government and provinces, typically to protect public health and safety of the environment. Costs, the effort put into assessing and managing the risk needs should be to be proportional to the risk exposure, to avoid implementing risk processes where the benefits gained are likely to be lower than costs incurred. Some organizations focus on risk relating to the business success, but organizations managing public infrastructure like roads, commonly broaden their risk context to include “community risk” or “environmental risk”.

Risks can be assessed at different levels of detail. For example, a risk event defined as “structural failure of a bridge due to deterioration” may be an acceptable level of detail for some organizations, while others may wish to individually assess this risk for each bridge. Others may wish to undertake a specialist assessment of each failure mode for each component of each bridge. The level of detail to be captured depends on the scope of the risk process. Critical assets, critical failure modes and high-risk areas can then be defined and analyzed in greater detail. A risk event can be defined as an occurrence with a cause and a chain of possible impacts. The cause itself can often be defined as an impact of a precursor event. Once risks are identified, they are generally recorded in a risk register. Usually there will be formal monthly or annual review of the risk register. There should also be processes for recording other risk as they are identified.

Critical Assets are those which are the most important of delivering the required service, and/or have the highest consequence of failure, but not necessarily a high probability of failure. (for example for highways a bridge, a tunnel) Therefore risks associated with them should be separately identified and assessed in more detail. Depending on the criticality of the assets, the level of risk management adopted by the organization and the overall risk profile, risks may be recorded at individual asset or component level considering extensive failure modes. Similarly, critical failure modes are those which have the highest consequences. By identifying critical assets and critical failure modes, organizations can target and refine investigative activities, maintenance plans and capital expenditure plans at the critical areas.

Organizations can assess the criticality of their assets by applying broad assumptions about the implications of failure. For example, assuming that higher trafficked roads have a larger consequence of failure. While this type of criteria can be a good starting point, additional complicating factors get ignored in these simple approaches. For example, a secondary road can be main connector for an energy production plant. In this case GIS provides a powerful analysis tool to assist with the identification of critical assets through the application of geospatially linked rules.

Once Critical Assets are identified, risk evaluation allows the identified risks to be analyzed in a systematic manner to identify which risks are the most severe and which are unacceptably high. The organization can then determine its level of exposure to the risk and the actions necessary to minimize that risk. The overall risk depends on both the probability and consequence of the event. To estimate the level of risk, organizations should determine: the consequences of "failure" for the identified risk events (noting that "failure" refers to failure to achieve objectives and is not necessarily limited to structural failure); and the probability of "failure". This can be done referring to subjective assessment based on experience, professional judgement and data from asset inventory such as:

- ✓ Asset attribute data, location and operating context, commonly held in asset management information systems, GIS and, in the case of linear assets, network models;
- ✓ Data sets capturing and analyzing natural events, such as rainfall, tides, temperature, earthquakes, tsunamis etc;
- ✓ Specific studies into asset or service issues such as analysis of past failure events to identify causes, consequences and likelihoods; and
- ✓ Outcomes from user or community consultation into expectations and perceptions.

The progression from core to advanced risk management would typically see decreasing reliance on subjective experience and increasing reference to data.

Probability of failure can be assessed in a qualitative way (A to F scale) feed into the risk matrix approach or a quantitative way (e.g. probability of 0.02) required for those quantifying risk in monetary terms **(Figure 2.18).** The probability of physical failure of an asset is related directly to the current condition of the asset, hence the importance of realistic and accurate condition assessment. Factors such as redundancy of systems should be accounted for when developing probabilities of failure of assets or systems.

Figure 2.18 Probability of failure.

Code	Likelihood of occurrence	Current probability of condition-based occurrence	Equivalent statistical probability
A	Rare	>20 years	0.02
B	Unlikely	Within 10 –20 years	0.05
C	Possible	Within 6 – 10 years	0.1
D	Moderate	Within 3-5 years	0.3
E	Likely	Within 2 years	0.7
F	Almost Certain	Within 1 Year	0.9

The probability of natural or external events is determined less easily but scientific studies are usually available. These probabilities can be determined from fault tree and event tree analyses, expert opinion and computer modeling. A risk event can be described as a core initiating event, which may lead to a number of different consequences, each with its own probability.

Consequences of a risk event occurring leading to "failure" extend beyond the immediate financial implications. Organizations managing community infrastructure like roads should recognize effects to the community like: such as loss of life, injury or health impacts, loss of service, environmental consequences, and economic consequences such as the community costs associated with damage to property or other third party losses, which may include business impacts, traffic delays, etc. as well as economic consequences, such as repair costs, fines or litigation costs and loss of income, or income potential **(Figure 2.19).**

Figure 2.19 Consequence of failure.

CONSEQUENCE							
TBL Aspect	**Description**	**Weight**	**2 Insignificant (< $ 2000)**	**3 Minor (< $ 2000 - $ 20,000)**	**4 Severe (< $ 20,000 - $ 100,000)**	**4 Major (< $ 0.2 M - $ 2 M)**	**5 Catastrophic (>$ 2 M)**
Social	Safety & Health	5	Negligible injury	Medical Injury	Serious injury	Loss of Life	Multiple loss of life
	Loss of Service-Extent/Duration	4	Minor service disruption affecting	Significant service disruption affecting small	Significant localized disruption over extended	Major localized disruption over	Major long term city wide service disruption

			small number of customers	number of customers	period	extended period	
Environmetal	Environment	5	Negligible Impact Reversible within 1 week	Material damage of local importance. Prosecution possible. Impact fully reversible within 3 months	Serious damage of local importance. Prosecution probable. Impact fully reversible within 1 yr.	Serious damage of national importance. Prosecution expected. Impact fully reversible within 5 yrs.	Serious damage of national importance. Prosecution expected. Long term study Impact not fully reversible.
Economic	Business Costs	3	Total direct revenue loss & cost to restore service	Total direct revenue loss & cost to restore service	Total direct revenue loss & cost to restore service	Total direct revenue loss & cost to restore service	Total direct revenue loss & cost to restore service

Sources: Developed from IIMM (International Infrastructure Management Manual), 2011;

Treatment options should be identified for all risks assessed to be unacceptable to the organization, as defined in the risk management policy and several strategies to manage the total activity should be available, such as:

- ✓ reduce the risk by capital or maintenance expenditure, for example, reduce the probability of asset failure;
- ✓ reduce the risk by implementing operational and management initiatives;
- ✓ reduce the impact of failure by actions such as preparing emergency response plans, a common approach for high consequence, low probability events;
- ✓ accepts some risk and carry the consequential costs;
- ✓ insure against the consequential costs and a combination of the above.

Many organizations choose to adopt a progressive approach to implementing risk management. Such a progression would aim to steadily introduce sophistication and increase the level of analysis within the risk management process to move from core to, if appropriate, advanced risk management. Typically, this is achieved in the following steps:

- ✓ Asset managers subjectively identify key risks and critical assets.
- ✓ Asset managers, together with corporate staff, develop a risk management policy and risk management framework to be applied across the organization.

- ✓ Asset managers and other appropriate representatives from the organization systematically identify risks and qualitatively assess them using the risk management framework. Other representatives may include those responsible for operating, maintaining, renewing and developing the assets, as well as corporate services personnel such as finance representatives. High risks are identified and options selected for risk reduction.
- ✓ Sophistication is introduced to the assessment considering the overall risk exposure and extent/nature of the assets. This may include use of formalized criticality frameworks and GIS analysis, as well as quantitative assessments and systematic options analysis as discussed later in.
- ✓ Risk is integrated in all key decision- making and is not seen as a stand- alone process.

2.2.2.7 Asset Management Strategies

Once assets are registered in Spreadsheets or Information systems, demand is forecasted and prioritized, based on risk they represent to the organization, **Asset management strategies (Optimized decision making),** through decision making techniques like Benefit-Cost Analysis, Multi-Criteria Analysis (consider cost and benefits) are utilized to determine the best future solution for an asset (road), and decide the actions and best time to take them, for example is better to maintain the asset, renew or replace it at a given month/year. ODM is a format process to identify and prioritize all potential solutions with consideration of financial viability, social and environmental responsibility and cultural outcomes. These four "outcomes or "wellbeings" are referred to as the "quadruple bottom line (QBL) outcomes. These are the social, cultural, economic and environmental factors we will need to trade- off when optimizing a decision. The most critical issue with respect to all these factors is how they are analyzed, integrated and presented to decision-makers and stakeholders.

Two of the methods used in ODM are: Benefit Cost Analysis (BCA) which involves quantifying and comparing benefits and/or costs over a period of time and Multi – Criteria Analysis, (MCA) which is used where intangible impacts are significant, possible to rank without applying dollar values. MCA is a technique that takes into consideration more than one criterion when evaluating alternative projects. This methodology is widely used when the benefits and costs of each project vary across a wide range of criterion, are sometimes difficult to accurately define and are both quantitative and qualitative in nature. With a MCA a number of different criteria or indicators are chosen to represent the different areas of the project, such as cultural, social, financial, institutional and environmental. The project, or projects are then "scored" against each of the indicators. The

scores are generally given on a scale of 1 to 5 or 1 to 7 (1=poor,3 or 4 = medium, and 5 or 7 = good). Weights can be assigned to the different indicators to reflect the importance of the impact to the organization, and the resultant "weighted score" of each indicator in the score given to each indicator, multiplied by the weighting. Scoring can be either quantitative (e.g. number of road closures per year), or qualitative (e.g community acceptability/agreement based on qualitative words such as 1= strongly disagree, 2 = slightly disagree, 3 = indifferent, 4 = slightly agree, 5 = strongly agree). While it is generally recognized that MCA is the most practical way of logically, a range of criteria is chosen to represent the different outcomes or aspects of each option being considered. The criteria, such as environmental benefits, may be weighted to reflect a business's community's objectives and an overall score is given to each project option.

Which assets should be evaluated? Using the standard benefits-based techniques the key drivers for such a filtering or prioritization process are:

- ✓ those assets with a high consequence of failure
- ✓ those assets with high utilization
- ✓ those assets whose total value represents the greatest net value to the organization
- ✓ those asset groups with the highest average age
- ✓ those asset groups that are identified in the AM plan as key cost factors in the long- term business plan.

Which options should be considered? Asset related treatment options are:

- ✓ Do nothing: The do – nothing option should be considered fully and the associated risk cost to the organization assessed against this base. This option will tend to accelerate the decay of the asset.
- ✓ Operational procedures: Operational management changes such as modifying supply and rerouting can be implemented to reduce peak demand or stresses on the asset.
- ✓ Maintenance procedures (more or less status quo): consider a different maintenance regime to make the asset more reliable or to extend its life.
- ✓ Asset renewal: depending on where an asset is in its lifecycle, rehabilitation can be an economic treatment to maintain service levels. Where rehabilitation options are impractical or uneconomic it may be necessary to replace the asset.
- ✓ New work: where lower cost options are impractical, investment may be required to create a new asset or augment the existing asset.

- ✓ Asset disposal / rationalization, divestment of assets surplus to needs because a service is determined to be a non- core activity, or assets can be reconfigured to meet business needs better.

Non-asset treatment options are:

- ✓ Reduce demand for the service
- ✓ Reduce the level of service (e.g a pavement surface can be allowed to deteriorate to a condition below a current level of service to achieve a lower lifecycle cost or cash flow).
- ✓ Improve contingency planning, support systems, training and response times, to achieve an acceptable recovery time for re-establishment of service after an asset failure
- ✓ Educate customers to accept appropriate asset failures.

The best solution may be to upgrade or provide new assets, however non- asset solutions such as "do nothing "or "reduce/increase demand" should always be considered in the decision-making process.

Asset Utilization and Demand management are key processes which asset managers should carefully analyze to ensure the full utilization of the road assets, so that they meet the needs of community over the long –term. Road assets should be fully operational before decisions to create new assets are made. Asset managers should consider strategies to influence customer demand or organizations supply for existing assets that are under-utilized or over-utilized for example through pricing, regulation, education and incentives. Emergency response strategies and plans to minimize the disruption of services from event such as key staff absences, critical asset failure or widespread disasters should clearly allocate roles, responsibilities, communication lines and response priorities as incidents evolve.

Asset management strategies include the **development of maintenance strategies** and plans like time of intervention to maintain the required levels of services, maintenance roles and responsibilities, objectives. Maintenance is defined in IIMM manual as *"All actions necessary for retaining an asset as near as practicable to its original condition, but excluding rehabilitation or renewal"* From this statement maintenance is intended as an operational measure taken to slow down deterioration and delay more expensive operational measures like rehabilitation of replacement.

2.2.2.8 Financial Strategies

Once asset management strategies are defined taking in consideration attributes like levels of service, asset utilization, demand management, and cost-benefit options are analyzed, the last issue is how to fulfill the requirements financially. Development of transparent maintenance and capital investment strategies and plans to maintain, renew and rehabilitate assets provides time to make good decisions and coordinate activities in an effective and efficient manner.

Capital investments in new roads typically include the upgrade, creation or purchase of new assets to address growth in demand or upgrade of levels of services, renewal of existing assets to prevent existing assets from failing service and investment in assets that are held as an investment in their own right to provide financial return for future opportunity value.

Development of capital investment programs typically involves the following steps:

- ✓ Identifying potential projects. It is a good practice to collate all projects recommendation from the wide variety of sources available into a single repository. This enables all potential projects to be compared and prioritized for inclusion in the capital work programme.
- ✓ Developing options for each project. Non-Asset and operational options should be considered alongside potential asset upgrade or new build projects.
- ✓ Evaluate options and prioritize projects. Decision techniques discussed in the previous section can be used to identify the optimal solution for each project, and to prioritize which projects to carry out where works lists exceed budget availability.
- ✓ Project scoping. A project scoping report or business case should be prepared for capital investment projects in the annual works programme. The scoping report should outline objectives, benefits costs, assumptions risks, timeframes and options considered.

Renewal programmes may be based on the following methods:

- ✓ Forward projection of historic expenditure, possibly combined with some level of judgement to make broad parametric adjustments.
- ✓ Broad estimates based on replacing the asset at the end of its useful life. (methodologies for estimating useful life for valuation purposes.
- ✓ Predictive modeling of varying degrees of complexity (from a forward works programme based on staff judgment, through to advanced mathematical techniques that have a complex relationships between models)

- ✓ Bottom-up approaches where needs are identified via observation of defects in the existing and compiled into a work bank of projects. Projects within the work bank are prioritized and then funding allocated until the budget is reached.

3. IMPLEMENT ASSET MANAGEMENT IN DEVELOPING COUNTRIES

(Strategic level)

While the previous chapter described and analyzed the drivers and processes involved in Infrastructure Asset Management in order to raise awareness of the benefits governments and organizations in developing countries can have by implementing asset management in their organizational structure this chapter will describe the National regulatory environment in developed countries, such as Uk, New Zealand Canada, Australia, Uk, Usa, which pioneered the implementation of asset management in their governmental, provincial and organizational structures. By taking in example these countries and describing the situation in the national regulatory environment of developing countries, such as Albania, approaches on how to implement the practices in this environment will be analyzed.

3.1 International regulatory environment and Asset Management Practices in Uk, New Zealand Canada, Australia, Uk, Usa

In 2014, ISO[25] the International Organization for Standardization, a worldwide federation of national standards bodies published 55000:2014, Asset Management – Overview, Principles and Terminology which outlines specific processes and procedures that are recommended for the successful implementation of an asset management program.

The ISO 55000 series comprises three standards:

- ✓ ISO 55000 provides an overview of the subject of asset management and the standard terms and definitions.
  ISO 55001 is the requirements specification for an integrated, effective management system for asset management.
  ISO 55002 provides guidance for the implementation of such a management system.

In United Kingdom since the 1980's many of the utility and strategic transport networks (with the exception of roads) have moved to private regulated ownership. Parliament and the Government, at a national level, are responsible for number of different forms of framework, from legislation and statutory requirements to the appointment of regulators, or simply the promotion of best practices.

[25] www.iso.org

Department of transport[26] works with agencies and partners to support the transport network that helps the UK's businesses and gets people and goods travelling around the country.

Highways England [27]**,** a government agency, from April 2015, (Formerly the Highways Agency), is responsible for operating, maintaining and improving England's motorways and major roads and setting performance levels coherently with the goals defined at national level. It manages a total road network of around 4,300 miles, comprising only 2 per cent of all roads in England by length, but carrying a third of all traffic by mileage and two thirds of all heavy goods traffic. The mileage for which the Highway Agency is responsible has decreased each year over the past decade because the agency has been turning roads and bridges back to local governments (referred to as "detrunking") and agencies like Transport for London, Welsh Assembly, Transport Scotland and local authorities.

Although England has initiated important processes and procedures for **asset management**, it still has important challenges in improving the condition of the road network. One reason for this state of affairs is that local governments (of which there are 150 in England) are responsible for a large portion of the road network, but the funds they receive from the national government ostensibly for transportation purposes can be used for any governmental purpose. Not surprisingly, given strong public pressures for quality education and social services, some of this funding is allocated to non-transportation activities.

One of the most important drivers for asset management in England has been governmental directives on transport policy and accounting procedures. A tradition of managing road assets began in 1825 when Parliament stated that it was government's "duty to maintain" infrastructure built with public funds.

The more recent evolution in asset management is best explained by examining governmental policies and procedures occurring over the past 10 years. The national government published a white paper in 1998 entitled A New Deal for Transport, better for everyone and a report called A New Deal for Trunk Roads[28] in England. Three major investment areas were identified in these reports—maintenance, operations, and capital improvement—along with investment criteria on safety, envi-

[26] www.gov.uk/government/organisations/department-for-transport
[27] www.gov.uk/government/organisations/highways-england
[28] United Kingdom Government's Department for Transport, *A New Deal for Transport: Better for everyone*, retrieved from *http://webarchive.nationalarchives.gov.uk/, March 2010*

ronment, economy, accessibility, and network integration. They also identified new directions for the Highways Agency, one of which was to "give priority to the maintenance of trunk roads and bridges with the broad objective of minimizing whole life costs."

The **Local Government Act of 1999** [29] defined governmental responsibility as stewards of public funds as being a "general duty of best value." A best-value authority must "make arrangements to secure continuous improvement in the way its functions are exercised, having regard to a combination of economy, efficiency and effectiveness."

This act was preceded by a **Compulsory Competitive Tendering (CCT)** policy, which required local authorities to follow certain processes when delivering its services, thus leading to increased privatization of service delivery. This also changed the bid selection process from low bid to best value.

The Transport Act of 2000 [30] gave local authorities a statutory requirement to produce local transport plans (LTPs) covering the timeframe of 2001/2002 to 2005/2006. A national program provided money (£1.6 billion/US$3.2 billion) for local governments to hire private contractors to manage the condition of the network and reduce their maintenance backlog, with agreement that the governments would fund this responsibility after 5 years. So far, 20 local authorities have participated in this program. The most recent Transport Act requires another round of LTPs covering the years 2006/2007 to 2010/2011.

Another law, the **Traffic Management Act of 2004** [31], gave local authorities responsibilities for traffic management on local roads. All local authorities are required to appoint a traffic manager and this appointment gives the local authority the ability to take over traffic enforcement from the local police. This act has provided the Highways Agency with improved liaison with local governments on transport matters.

Legislation and government policies relating to **procurement** have also influenced asset management procedures. Several major studies during the 1990s highlighted problems with traditional methods of procuring and managing major projects, especially the awarding of contracts solely on the basis of lowest price.

[29] Local Government Act 1999, retrieved from *www.legislation.gov.uk*
[30] Transport Act 2000, retrieved from *www.legislation.gov.uk*
[31] Traffic management Act 2004, retrieved from *www.legislation.gov.uk*

The 1999 Gershon Report entitled Efficiency in Civil Government Procurement emphasized the benefits of privatized service delivery. The 2001 report of the National Audit Office entitled Modernizing Construction made recommendations on how to achieve sustainable improvements in construction performance, resulting in better value for the taxpayers' money. Recommendations were also made to government departments to develop more sophisticated performance measures and to measure improvements in construction performance.

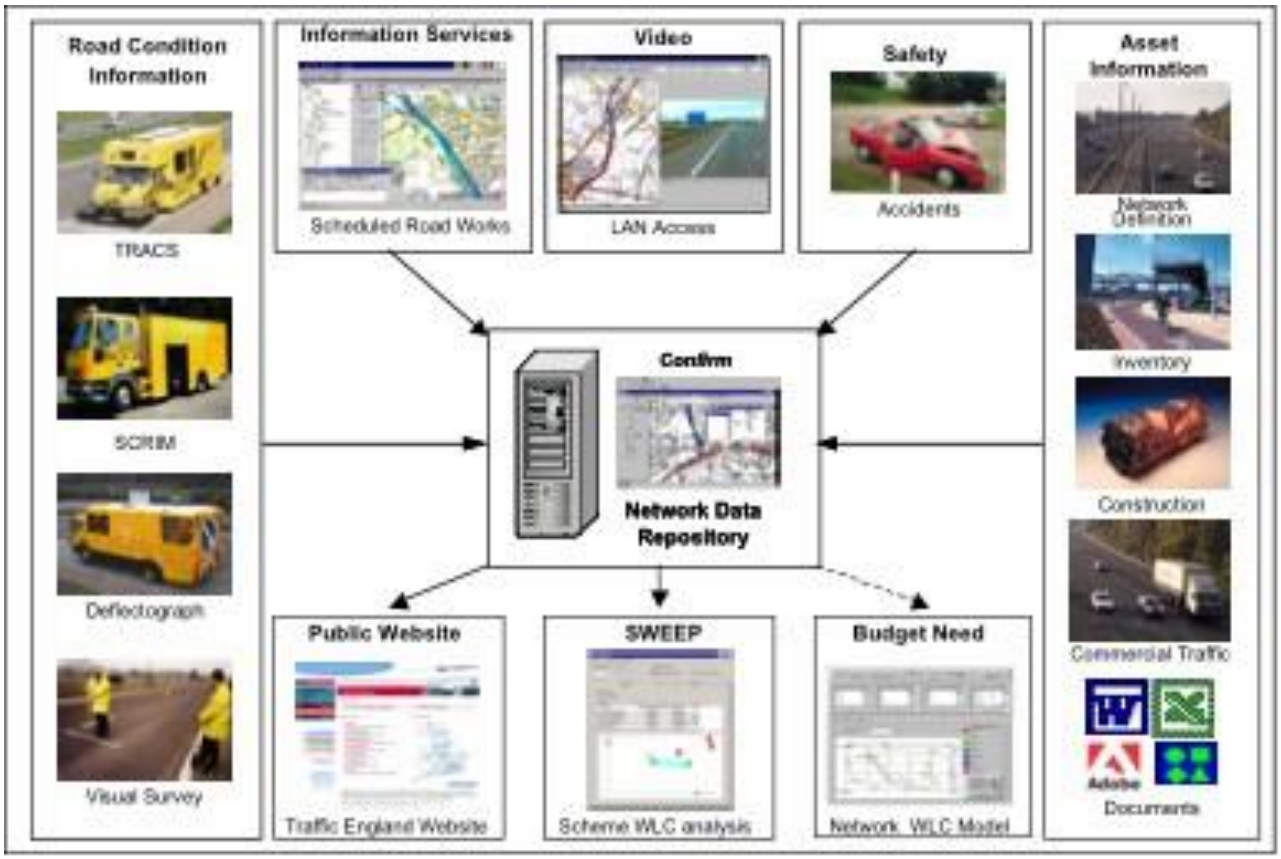
Perhaps even more important in encouraging greater attention to asset management were Treasury guidelines on resource allocation and budgeting (RAB). **RAB** is a system of planning, controlling, and reporting on public spending. Issued in 1993, the guidelines were followed by a 1995 government white paper that committed to the use of resource accounting as the basis of public expenditure planning and control. Asset remaining useful life must be used to arrive at a current asset value, usually determined through straight-line depreciation. All local authorities have until 2006 to report their asset accounts in this format; the Highways Agency has already done so for 5 years. In addition to the RAB requirements, the Treasury has adopted financial reporting requirements for local authorities wanting to debt finance infrastructure improvements, something that until recently has not been allowed.

Another important step towards asset management in UK was the publication of **PAS 55** in 2004 by the British Standards Institute which described the requirements for an integrated and optimized asset management system and provided guidelines and generic examples. It provides objectivity across 28 aspects of good asset management, from lifecycle strategy to everyday maintenance (cost/risk/performance). It enables the integration of all aspects of the asset lifecycle: from the first recognition of a need to design, acquisition, construction, commissioning, utilization or operation, maintenance, renewal, modification and/or ultimate disposal. PAS 55 also provides a common language for cross-functional discussion and provides the framework for understanding how individual parts fit together, and how the many mutual interdependencies can be handled and optimized.

Asset Management Information Systems in the UK have been developed independently for all assets. Although not developed solely by the department for transportation purposes, a United Kingdom Pavement Management System (UKPMS) has been evolving over the past 15 to 18 years for use on local roads. Department for Transport has been strongly encouraging local authorities to adopt UKPMS as the framework for their pavement management systems.

The Highways Agency Pavement Management System (HAPMS) **(Figure 3.1)** has been under development since 1998, and has cost about US$3.5 million per year (not including data collection) to develop. As figure 3.1 shows, HAPMS receives data from a variety of sources and provides outputs to a public Web site, a program investment development tool, and budget analysis. The Highways Agency also has a Structures Management Information System (SMIS). Other asset management systems that provide information to the decision-making process include HAGDMS, a geotechnical/ slopes database; HATRIS, a traffic information system; HA-ES, an environmental management system; and NOMAD, a technology equipment database.

Figure 3.1 Highways Agency Pavement Management System in UK



New Zealand has been a world leader in many aspects of road network management. In asset management, New Zealand has implemented innovative performance-based maintenance contracts, established a performance-oriented asset management decision-making structure, and is the home of one of the most active local government and professional association-supported programs for furthering asset management goals.

The New Zealand Transport Agency (a crown Entity) created on 1 August 2008, merging Transit New Zealand with Land Transport New Zealand delivers the State Highway network and produces annual Asset Management plans. **Transit New Zealand** (Transit NZ) managed a 10,836-km (6,733-mi) national road network, constituting 11.5 percent of the length of New Zealand's roads and about 50 percent of the total vehicle-kilometers traveled each year in the country while **Land Transport New Zealand** (Land Transport NZ) funded police, safety programs, and public transportation. Transfund, part of Land Transport NZ, was the major source of funds for highway investment and a critical player in establishing transport priorities.

The Agency is organized into four major groups/divisions, an organizational structure replicated in the regional offices— transport planning, network operations (where the asset management responsibility lies), capital projects, and organizational support. About 50 people nationwide have responsibility for asset management, including those in Agency's regional offices. It outsources maintenance service delivery and overall the human resources required to deliver the total package has been significantly reduced. Contractors are required to maintain their own performance audit systems (open to review by the agency); It audits about 5 percent of the network to assure quality performance.

The human resource element is another important aspect of organizing for asset management. The agency conducts an annual asset management workshop, holds training seminars when new approaches or policies occur, supports conferences and technology seminars, and participates in local asset management forums with 72 local authorities. It is also a major participant in the research efforts of Austroads, the association of Australian and New Zealand road transport and traffic authorities, as they relate to asset management. This research focuses on pavement failures, levels of service, and cost models.

Overall, asset management in New Zealand, is part of the strategic planning, performance monitoring, and accountability structure established in all levels of government, more than any other country, and shows a much higher level of integration of asset management concepts and principles into the day-to-day activities of the transportation organizations. It is important to note that the transportation agencies in New Zealand compete with other non-governmental programs for resources (except for revenues dedicated to transportation). This whole-of-government context places even greater importance on transportation agencies to justify their funding requests.

T**he most important drivers for asset management** in New Zealand have been governmental directives and acts on transport agency, transport policy and accounting procedures.

Government Road Powers Act 1989 [32] provided the necessary powers for the Transport Agency and ministers to build, maintain and manage roads. It was originally passed as the Transit New Zealand Act 1989.

Land Transport Act 1998 [33] promotes safe road user behavior and vehicle safety; provides for a system of rules governing road user behavior, the licensing of drivers and technical aspects of land transport; recognizes reciprocal obligations of persons involved; consolidates and amends various enactments relating to road safety and land transport; and enables New Zealand to implement international agreements relating to road safety and land transport. It now includes the registration and licensing of motor vehicles and the regulation of commercial transport services and the limits on driving hours.

Land Transport Management Act 2003[34] sets out the requirements and processes for local authorities to obtain funding for road construction and maintenance, and for the funding of NZ Police on-road enforcement. As amended in 2013, it sets out the requirements for regional councils to contract for the provision of public transport services. As amended in 2008, it is also the act that establishes the NZ Transport Agency. Its responsibility set out in the Land Transport Management Act 2003 (amended 2008), is to contribute to an efficient, effective and safe land transport system in the public interest, investigate and review accidents manage the state highway system, including planning, funding, design, supervision, construction and maintenance operations, manage regulatory requirements ,cooperate with, and assist any government agency or local government agency at the request of the Minister of Transport, provide the Minister of Transport with advice on our functions.

The Land Transportation Management Act of 2004 [35]has also added a new twist to this stewardship role. By adding sustainability to Transit NZ's objectives, asset management takes on an environmental quality element as well.

This and other legislation, such as the **Land Transport Act 1998**, determines its roles and provides the authority for the agency to act as an asset manager. Other forms of legislation – regulations and

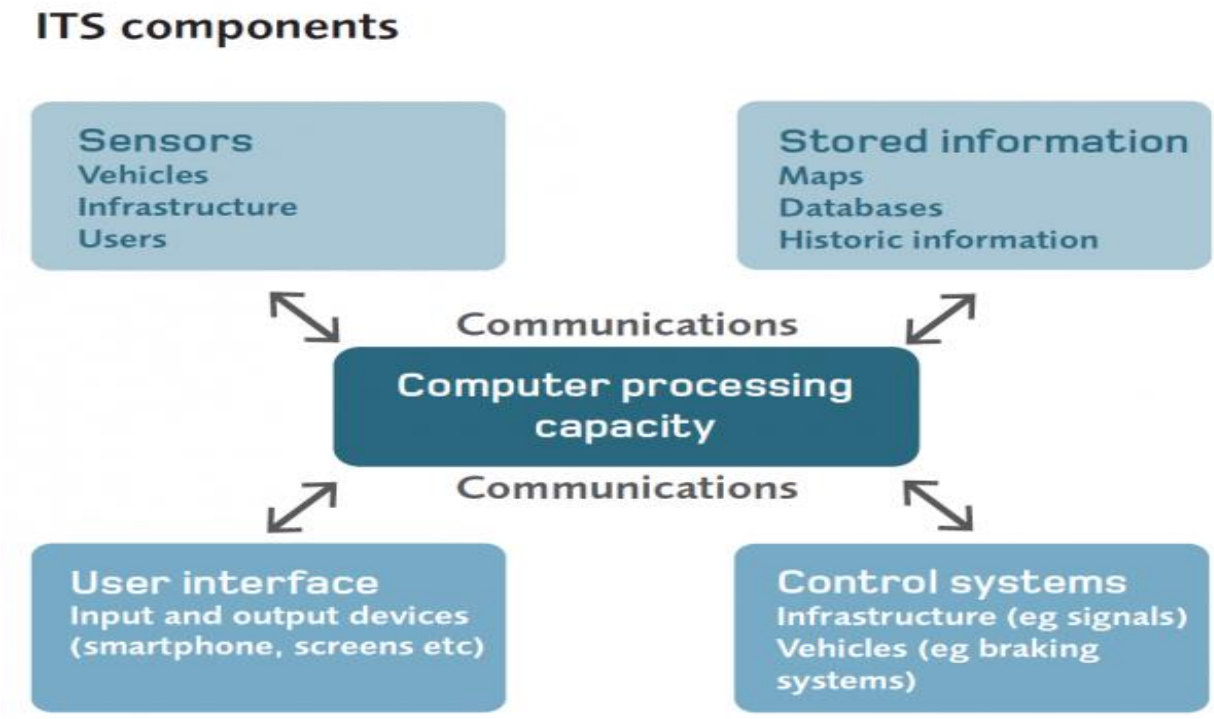
[32] Government Roading Powers Act 1989, retrieved from *http://www.legislation.govt.nz*
[33] Land Transport Act 1998, No 110, retrieved from *http://www.legislation.govt.nz*
[34] Land Transport Management Act 2003, retrieved from *http://www.legislation.govt.nz*
[35] Land Transportation Management Act of 2004, retrieved from *http://www.legislation.govt.nz*

rules – set out its powers for a range of activities, from establishing toll roads to implementing driver and vehicle requirements.

Another important driver for asset management was the establishment of the **National Asset Management Support and Steering committee (NAMS)**[36] group in June 1995. This was the result of a proposal developed by INGENIUM (organization that represents all those people who manage, maintain and operate public infrastructure in New Zealand, focused on asset management and engineering for public infrastructure) and supported by Local Government NZ, the Society of Local Government Managers, the Office of the Auditor-General, the NZ Water and Wastes Association and the NZ Recreation Association. This group has played an important role in fostering improvements to asset management practice in New Zealand and through its publications in other parts of the world.

Intelligent transport systems of The New Zealand Transport Agency[37] provide information to the decision making and prioritization process (Fig. 3.2).

Figure 3.2 Intelligent transport systems of The New Zealand Transport Agency



[36] http://www.nams.org.nz/

[37] Intelligent Transportation Systems New Zealand, retrieved *from https://www.transport.govt.nz*

The Road Asset Maintenance Management[38] (RAMM) includes the primary road inventory, condition data, and treatment selections and interfaces with the pavement design system. It is used by the agency's staff, consultants, and can be used as a distributed system. Seventy-two local authorities also use this system. The National Optimization of Maintenance Allocation by Decade (NOMAD), a module of RAMM, develops a 10-year program of investments by treatment type. A pavement modeling tool, dTIMS[39], uses deterioration modeling to predict future pavement condition (there are 85 dTIMS licenses in New Zealand, but not all license holders use the software). In this application, the road network is segmented into like-performing roads and appropriate treatments are identified for different performance levels.

Transport Agency'**s** Traffic Monitoring System[40] (TMS) includes five weigh-in-motion sites (dial up and non-continuous), 70 continuous traffic count sites, and 1,000 non-continuous traffic count sites. TMS is used primarily for reporting traffic volumes and trends in growth and weight, and for enforcing truck weight restrictions. A bridge information system is available, but it is not as developed as RAMM. It consists simply of an asset register of bridge structures (BDI), a bridge structural index (BSI), and an overweight vehicle management system (Transit Overweight Permitting System (TOPS)).

The agency is implementing a Location Referencing Management System with spatial capabilities designed to provide a more integrated database approach to future asset management activities.

In **Canada and Australia** the federal government is not a major player in asset management, providing much less funding than the United States for transportation infrastructure. In Australia, for example, the federal government is proposing to remove itself even more from funding transportation systems. Thus, the provinces and states have a great deal of autonomy in developing asset management programs in ways that met their own needs. Provincial, territorial and municipal governments are responsible for a significant portion of the assets in **Canada**. Approximately 80 percent of the public roadways in Canada are maintained by municipal governments.

In 2008, the Canadian public-sector Accounting Board (PSAB)[41] introduced Regulation 3150, an asset management driver. The PSAB 3150 was approved by the Canadian provincial governments and requires all municipal governments in Canada to record and include all tangible capital assets in

[38] Transfund, 1997, *RAMM road condition rating and roughness manual*
[39] Deighton's Total Infrastructure Management System, retrieved from *www.deighton.com/new-zealand-peer-exchange/*
[40] Traffic Monitoring System, retrieved from *www.nzta.govt.nz/*
[41] /www.frascanada.ca/public-sector-accounting-board

financial statements under the care and control of the municipality. Since 2009, all public sector municipal agencies in Canada are required to comply with PSAB 3150. They are responsible for the preparation of AM plans.

With just under 3 million people, **Alberta** is one of the wealthiest provinces in Canada, primarily because of its vast reserves of natural resources. Approximately the size of Texas, Alberta has a large road network which, because of wide temperature fluctuations and significant heavy truck use, experiences substantial preservation and maintenance needs. **Alberta Infrastructure and Transportation (AIT)**[42] is responsible for overseeing not only the road network, but also other major types of infrastructure in the province.

Management Several factors have influenced AIT's development of a comprehensive **asset management program**. Perhaps most important were economic worries in the late 1980s and early 1990s that put pressure on the government to downsize and become more efficient. By the mid-1990s, this led AIT to outsource much of its maintenance and capital renewal activity (planning, design, construction supervision, and maintenance operations) to private companies.

The evolution of **government policy** toward infrastructure has also had an important influence on the evolution of asset management practice in AIT. In the late 1990s, a policy of encouraging more coordinated capital planning was adopted, which in 1999 was incorporated into the government's business plan. In 2002, the government adopted a policy on alternative capital delivery mechanisms, which included encouraging public-private partnerships as a means of providing more infrastructure.

In 2003, the first 3-year capital program under this new fiscal management structure was adopted, which was supported by a 5-year capital plan, a 10-year strategic plan, and a 25-year futures plan. Asset management was a critical theme in all of the plans. The decision support structure provided by AIT's information systems was critical in the development of many of the strategies.

Although not exactly **a driver for asset management**, another reason AIT has been able to show such progress in its asset management program is the continuity in top leadership. The same political party has been in power since 1971, and government ministers responsible for AIT have had long tenures. This continuity in leadership, along with a policy of adopting business practices for

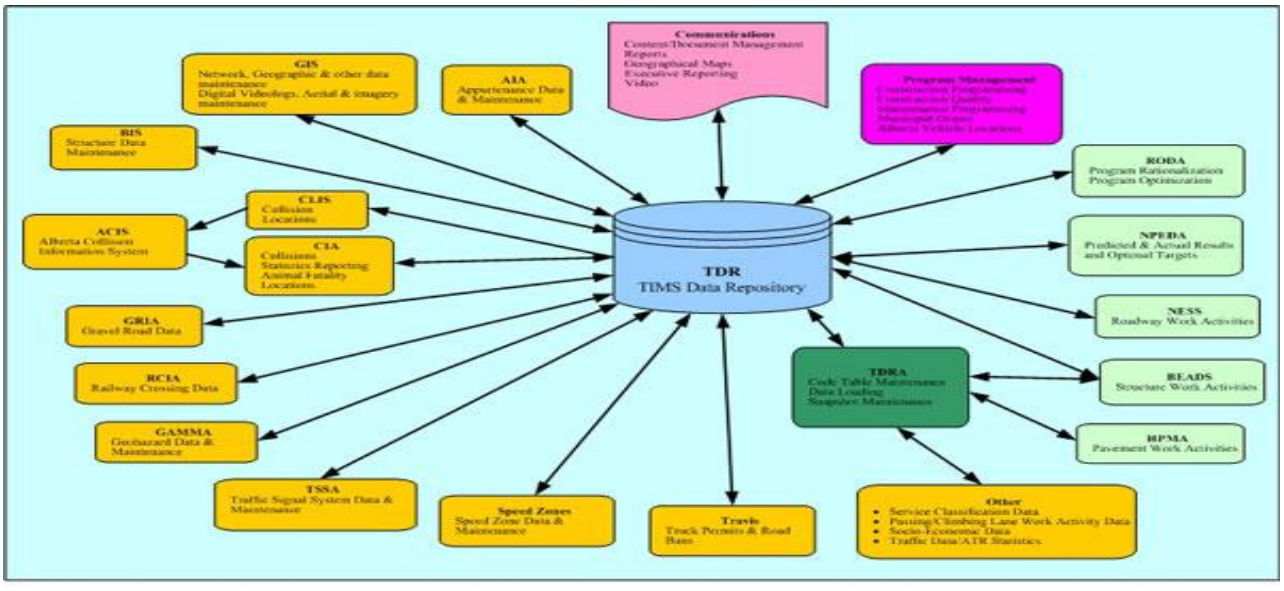
[42] *www.inftra.gov.ab.ca*

governmental operations, has led to asset management techniques becoming part of the strategic management of the agency.

This combination of seeking greater financial efficiency in program delivery, providing oversight for outsourced functions, and the need to update its legacy systems led AIT to develop a comprehensive asset management system called the **Transportation Infrastructure Management System (TIMS)** (Fig. 3.3)[43].

AIT began developing its transportation infrastructure management system (TIMS) in 1996. By 2006, TIMS consisted of a suite of 20 software applications that cover such highway assets as bridges, roads, culverts, signs, signals, and other associated structures and appurtenances. TIMS is expected to integrate the different databases, allowing AIT to optimize program delivery. The data included in TIMS are referenced to a common datum; highway attribute data are referenced to a common network. Data are collected using geographic coordinates and reported using linear referencing. The provincial highway system, municipal road network, and bridges are included in the TIMS databases.

Figure 3.3 Transportation Infrastructure Management System, Alberta Infrastructure and Transportation (AIT)



[43] Transportation Infrastructure Management System (TIMS), retrieved from *www.transportation.alberta.ca*

TIMS consists of several core components (Fig. 3.3), including the following:

Network Expansion Support System (NESS)—NESS is a decision support system that uses expert opinion and objective information to define current and future conditions of the road network.

Bridge Expert Analysis and Decision Support (BEADS) System - This prototype system examines different bridge strategies, combined over the entire bridge network, to facilitate short-term programming (3 to 5 years), analyze long-range budget scenarios (longer than 5 years), evaluate status of the bridge network, and assess impact of policy decisions.

Highway Pavement Management Application (HPMA) - It consists of an inventory of pavement assets, including pavement condition (current and historical data), an estimate of current and future network deficiencies and needs, the selection of maintenance and rehabilitation treatments, an economic assessment, and the selection of an optimal program of investment.

In Australia an important step was the introduction of New Accounting Standards and the first National Asset Management Committee in 1993 (NAMS Australia) which subsequently partnered with the NAMS Group in New Zealand and published the (IIMM –International Infrastructure Asset Management Manual).

Until recent years there has been little regulation and legislation driving AM practice, apart from Financial Reporting Requirements under various Australian Accounting Standards which are made by Australian Accounting Standards Board (AASB) and serve to address the financial reporting needs of the public sector. Across Australia, public sector agencies have been required to progressively implement accounting principles which includes the recognition of all infrastructure assets. The natural extension to this has been the implementation of strategic asset management practices.

With more than 189,000 lane-kilometers of sealed road, **New South Wales (NSW)** has one of the most extensive road networks in Australia. The Roads and Traffic Authority (RTA)[44] of New South Wales is the agency responsible for the major roads and bridges on this network.

[44] *www.rms.nsw.gov.au/*

Similar to other Australian states, New South Wales has been using public private partnerships to build some major new projects, and has contracted out a portion of its road maintenance activities to private contractors. In both cases, the provision of asset management strategies is incorporated into the concession deeds or contracts.

A major Driver for RTA's approach to asset management is the New South Wales Department of Treasury[45]. The department has adopted a policy with a stated objective of "managing infrastructure as a long term renewable asset and to use an integrated package of recurring maintenance with capital renewal to achieve modern standards without increasing functional capacity. The Treasury expects each agency to adopt its own policy consistent with the Treasury's and is one of the most active in encouraging asset management practices.

The government's transport minister and the community **are another driver.** They expect RTA to provide the most cost-effective service possible. Asset management helps RTA do this. In addition, asset management enhances RTA's relationship with other agencies, such as the Department of Infrastructure, Planning, and Natural Resources and the Treasury. It helps RTA compete for funds with other agencies at the state and federal levels, and provides greater scrutiny and accountability for program and project management. Finally, asset management allows RTA to provide better workforce planning, an important challenge with its aging workforce. RTA has had very stable political leadership, with the most recent minister staying for 8.5 years. This has allowed RTA to develop a strong base of support for asset management among government leaders.

RTA has information systems for inventory and condition data that can be used to assign project/work tasks as well as to monitor systems performance. The physical assets monitored include road pavements, bridges, corridor assets, traffic facility (signs, lines and markings), and traffic signals.

RTA has purchased commercial software to manage its road network inventory data. The **Road Asset Management System (RAMS)** is the repository of road pavement and corridor inventory and condition data, including engineering history. A **Traffic Asset Information Management System** (TAIMS) keeps track of the traffic facilities inventory (road signage, pavement markings, line marking, and safety barriers), including work task scheduling and management. RTA has separately developed in-house information systems to manage bridges (BIS) and slope stability,

[45] *www.treasury.nsw.gov.au/*

works ordering, contract management, and project management systems. Maintenance work is tracked through a Maintenance Contract Management (MCM) system. When maintenance work is completed, reports are submitted to the asset management group for recording in RAMS, BIS, etc. Regional maintenance planners are responsible for tracking planned maintenance. RTA uses a link/node location referencing system to locate its inventory and condition data on the state road network. This is used in conjunction with global positioning systems (GPS) technologies for asset inventory updates.

In United States a structured body of practices in AM, first entered the US state and local government arena in the transportation sector in the late '60s and early '70s. The establishment of Department of transportation [46], by an act of Congress on October 15, 1966, government concerned with transportation, brought a new way of systematic inventory, condition assessment, service level determination and optimized renewal techniques which have been taught for 3 decades. The same day saw the establishment of The Federal Highway Administration[47] (FHWA), an agency within the U.S. Department of Transportation that supports State and local governments in the design, construction, and maintenance of the Nation's highway system (Federal Aid Highway Program). The Office of Infrastructure within the Administration provides leadership, technical expertise, and program assistance to help in Asset Management practices.

A further step into Asset Management practices was the publishing of Statement No. 34 [48], in June 1999 from Government Accounting Standards Board (GASB) which, for the first time required that all government entities use accrual accounting a new accounting principle that required the valuation, depreciation and reporting of all assets, including infrastructure assets (such as roads, bridges and dams). For the valuation of infrastructure assets, the Statement authorized both a standard depreciation approach and a modified approach that relied upon asset management analysis and systems as acceptable methods. That action also authorized a combination of the two if, in the judgment of the agency, depreciation was appropriate for some asset classes while the modified approach was appropriate for others.

[46] www.transportation.gov
[47] www.fhwa.dot.gov
[48] Summary of Statement No. 34, retrieved from *www.gasb.org/*

3.2 Overview of Political, Economic Situation in the Balkans

As mentioned in the introduction the case study taken in consideration is part of Route 7 which connects three countries Albania, Kosovo and Serbia and port of Durres with Pan-European transport corridor 10. The political and economic situation among these countries is of crucial importance to the case study in terms of management and maintenance operations. The demand for transportation for the highway depends on the social, political cooperation and economic integration of these countries.

Over the past 15 years, these 3 countries and in general Western Balkan countries have undergone a very difficult transition from socialist toward market economies and from overtly authoritarian toward more plural governance systems. They have done so under difficult conditions characterized by political, ethnic and sectarian tensions and war, redrawn borders, the emergence of new states and new institutions, and persistent problems of poor governance and corruption, political instability, and opportunist interventions by outside powers. Several of these countries today might be characterized as illiberal democracies effectively captured by small groups of people who control their country's media, public institutions and large swathes of the economy. The region is clearly burdened by a conflict heritage, ongoing regional instability and a persistent sense of insecurity.

This situation impedes regional cooperation, European integration processes and economic cooperation - particularly in the field of small and medium enterprises, the IT sector and science, youth cooperation, the rule of law, the fight corruption, and migration issues. Obviously, these are of vital to long-term stability and generally understood as a possible catalyst for reconciliation, political dialogue and for creating the wright environment for the implementation of infrastructure asset management processes.

A **historical overview** back to the constitution of the Socialist Federalist Republic of Yugoslavia is needed to explain tensions among western Balkan countries and particularly, Serbia, Kosovo and Albania which negatively influence the amount of traffic on the highway and revenues.

The **Socialist Federalist Republic of Yugoslavia** was constituted after the Second World War as the successor of the Kingdom of Yugoslavia. Although it was a Communist country, it was different from other East European Communist states. In contrast to these countries, after Stalin's expulsion of Yugoslavia from the Communist Information Bureau in 1948, Yugoslavia tended to be both

independent and socialist. In the 1950s, the implementation of economic, political and cultural reforms started and as of the 1960s Yugoslavia opened its borders. This enabled the Yugoslavian citizens to move freely, go abroad, travel and even work and study, which was impossible in other Communist states.

However, after Tito's death in 1980, movements of national revival emerged throughout the region. These developments helped the nationalist Slobodan Milosevic come into power, leading in the following years to the violent dissolution of Yugoslavia. He mobilized masses and made credible threats against the governments of Slovenia and Croatia. He appointed his followers in power in three out of Yugoslavia's eight political units: Kosovo, Vojvodina, Montenegro. At the end of 1980s, Slovenian and Croatian elites were in favor of a looser federation between the Yugoslav states as well as political and economic reforms. Furthermore, neither Slovenia nor Croatia wanted to participate in Serbia's repression of troubled Kosovo. These and other differences led to the dissolution of Yugoslavia, although in that period, after the initial economic crisis at the beginning of the 1980s, Yugoslavia was at its economic peak and was close to joining the European Community.

At the beginning of the 1990s, Slovenia and Croatia gained independence and transformed the reserve defense forces into armies (the majority of members of the Yugoslav People's Army, JNA, consisted of Serbs). The JNA was expelled from Slovenia several days after the proclamation of independence. The situation was more complicated in Croatia, which had a huge Serbian minority. The international community in Europe and abroad failed to prevent war, first in Croatia and later in Bosnia and in Kosovo.

Kosovo was an autonomous region in Serbia (just like Vojvodina in the north of Serbia) whose status granted an almost equal membership in the Yugoslav federation. At the end of 1980s, Serbia tried to limit Kosovo's autonomy (both political and cultural), which led to the creation of the Albanian movement for autonomy and independence, and the Kosovo Liberation Army. Several actions against Serbian police forces in 1997 provoked a violent response from the Serbian side against the Kosovo Liberation Army and civilians. As a result, NATO forces reacted and launched their military bombing operation against Serbian military positions, from the end of March until the beginning of June 1999. The operations ended with UN Security Council Resolution 1244. The resolution authorized and established the UN Interim Administration Mission in Kosovo (UNMIK), which led to Kosovo's proclamation of independence in 2008.

Serbia and Kosovo are still in process of normalizing relations between them in the present days. The major problem is Serbian unwillingness to recognize the independence of Kosovo. An almost constant air of tension and instability remains, especially in the northern part of Kosovo, where Serbian minorities have received promises of protection from Serbian authorities. To open the chapters for accession, EU made conditional for Serbia and Kosovo the normalization of relationship with each other.

From a general point of view, the major problem effecting relations between the countries remains the public discourse on wars, which is still segregated according to partisan perspectives. Every party has its own 'truth' concerning the interpretation of the conflict, which makes the establishment of good relations between neighbors difficult. Although the situation is much better than 10 to 15 years ago and negative feelings are diminishing, public opinion surveys show that populations still consider neighboring nations their biggest enemies.

3.3 EU investments in Western Balkans and transport sector

Economically, between 2001 and 2008, the EU was the Western Balkans' largest trading partner and a critical source of financial support and investment. The 2009 financial crisis negatively influenced economic growth throughout Europe and particularly in Western Balkans countries. Recession and unemployment in the EU zone eventually spilled over to the Wester Balkan countries through decline of demand, lower exports, diminished investments and decreased remittance incomes. The crisis not only set back economic growth and development, but it also had important political and social implications throughout the region, paving the way to populist and nationalist movements. Ultra-nationalism and populism movements were the main cause of regional wars in the 1990s. Between 2004 and 2007, 10 Central and Eastern European countries entered the European Union. Their rate of economic growth was significantly higher than that of the Western Balkan countries at the same stages of transition. These countries were able to connect with Western European countries more easily and quickly than their counterparts in the Western Balkans (IMF, 2015), due to their shorter geographical distance and advanced transportation infrastructure. The low level of regional integration and cooperation of Western Balkan countries is one reason why various sectors of economy are so nationally focused and fragmented. Commercial exchanges among neighbor countries and the rest of Europe are further undercut by under-developed transportation infrastructure. The pervasive informal sector poses another challenge. It has a corrosive impact on the overall business environment and competitiveness, undermining the tax

system while contributing to a climate of lawlessness. Stalled structural reforms, political divisions and persistent problems in infrastructure have only exacerbated the existent situation.

The EU sought to oppose the negative impacts through the so-called **Berlin Process**[49]**.** This intergovernmental initiative sought to reinvigorate multilateral ties between the Western Balkan countries and EU member states, while deepening regional cooperation on matters pertaining to infrastructural and economic development.

The EU also engaged in multilateral efforts to encourage greater regional cooperation. The **Western Balkans Summit in Trieste** [50]on 12 July assembled the Heads of Governments, ministers of foreign affairs, economic development and transportation from the Western Balkans, senior officials from other Berlin Process participating countries (Germany, Austria, France, Italy, the UK, Croatia and Slovenia), and key officials from the European Union. The focus of the discussions was the strengthening of economic cooperation, particularly in the field of small and medium enterprises, the IT sector and science, youth cooperation, the rule of law, the fight of corruption, terrorism, extremism and radicalism, and migration issues. A range of agreements were reached to achieve these goals. These included the free circulation of goods, services and people to expand the regional economic market,

The EU's **Stabilisation and Association Process** [51]**(SAP)** rests on four pillars including "regional cooperation and good neighbour relations". There are currently six SAPs in force: with the former Yugoslav Republic of Macedonia (2004), Albania (2009), Montenegro (2010), Serbia (2013), Bosnia and Herzegovina (2015) and Kosovo (2016). This process aims to progressively establish a free trade area between the EU and the Western Balkans by liberalizing trade of goods, aligning rules on EU practice and protecting intellectual property.

Regarding infrastructure and transport, national efforts must be put into a trans-national perspective, moreover after Albania has become a European Union candidate country. The efforts of EU and Government are to align Albania's transport policy with the European Transport Policy and coordinate its transport infrastructure with its neighbouring countries – the Western Balkans countries comprising Albania, Bosnia and Herzegovina, Macedonia (FYROM), Montenegro,

[49]."THE BERLIN PROCESS". Retrieved May 26, 2014.
[50] "WESTERN BALKAN SUMMIT 2017". Retrieved 24 March 2017.
[51] Stabilisation and Association Process retrieved from *ec.europa.eu/*

Serbia, and Kosovo. EU members have adopted a roadmap to a Single European Transport Area, towards a competitive and resource efficient transport system.

The South-East Europe Transport Observatory [52] (SEETO) is of special relevance in this trans-national context. This regional transport organisation was established by the Memorandum of Understanding for the development of the Core Regional Transport Network (MoU) signed on 11 June 2004 by the Governments of the Western Balkans countries and the United Nations Mission in Kosovo and the European Commission. The aim of the SEETO is to promote cooperation on the development of the main and ancillary infrastructure on the multimodal **SEETO Comprehensive Network** and enhance local capacity for the implementation of investment programmes.

The aim of **SEETO Comprehensive Network**, is to attract international traffic flows and increase the regional mobility along the Network. This goal will be achieved by the support of transport infrastructure through efficient **integrated traffic management systems**, enforcement of the market rules in transport, removal of cross-border bottlenecks and transport non-physical barriers, as well as enhancement of the rules and practices in the areas of transport safety.

In joining this organization Albania's objective was to facilitate its integration within Southeast Europe in compliance with the goals of the SAA (**Stabilisation and Association Agreement)** signed on 12 June 2006 and entered into force on 1 April 2009. The facilitation of integration includes segments of segments of the Pan-European Corridors IV, V, VII and X. The main international corridors of interest to Albania include:

- ✓ The main East – West Corridor between the port of Durres and FYR of Macedonia and part of Corridor VIII;
- ✓
- ✓ **The Durres-Kukes-Morine border with Kosovo Corridor (case study).** It is seen as having major potential regional impact by providing a better connection through Pristina to Corridor X and to Serbia.

In the context of the Regional Cooperation Council (RCC), the **South-East Europe 2020 Strategy** [53] **(SEE 2020)** has set up some ambitious targets for the transport sector, including, decrease of the cost of transport per unit of transport service for 20%, decrease in TEU transport costs to the EU

[52] South East Europe Transport Observatory retrieved from *ec.europa.eu/*

[53] Regional cooperation Council (2013, November) *South-East Europe 2020 Strategy* retrieved from *www.rcc.int*

average and improvement of transport infrastructure utilisation rates to over 40% of designed capacity.

The **"Transport" dimension** of the SEE 2020 Strategy builds on the commitments given by the countries in the context of the SEETO Comprehensive Network mentioned above and the obligations of **Western Balkans Summit in Trieste** on 2017,12 July. The aim of this Summit was to: (i) establish an integrated market for infrastructure and transport, (ii) enhance the transport operations within the region and with the EU, and (iii) offer an effective basis for future investment projects in the transport sector. To cope with **SEE 2020** strategic actions, a specific Regional Programme has been established for Transport which aims to: (i) create efficient and smooth functioning transport system in the SEE region; (ii) allow speeding up policy and regulatory reforms; and (iii) concentrate investments on key corridors and interconnectors.

3.4 Albania Background and Transport sector

Albania's record since it embarked on transition in the early 1990s has been impressive. The country has successfully built the foundations of a market-based economy, created democratic institutions and gradually built capacity in the public administration to cope with political and economic transformation. These efforts have resulted in a track record of macroeconomic stability, as well as the fastest rates of GDP growth in South Eastern Europe (SEE). However, Albania remains one of the poorest countries in Europe with a Gross National Income per capita (GNI) estimated at US$ 11,884 in 2016[54], with widespread poverty, high unemployment, substantial regional disparities and weak governance structures. The program of the present Government, which took office in September 2013, seeks to focus on improving governance and rule of law, reducing corruption and breaking monopolies, improving the business environment, accelerating rural development, and fostering the development of human capital.

The recent Country Assistance Strategy [55] noted that future growth will be increasingly reliant on higher investments levels on infrastructure. The business environment faces considerable administrative barriers, weak governance, corruption, ambiguities in property and land rights, poor quality and high cost of infrastructure and utilities combine to increase the cost of doing business and limit access to credit and financial services. These constraints represent major barriers to the development of firms despite recent improvements in regulations.

[54] *data.worldbank.org*

[55] World Bank. 2006. *Albania - Country Assistance Strategy (English)*. Washington, DC: World Bank.

Transport demand has changed radically since 1991, reflecting the structural changes in the economy and the realignment of trade flows in the region. The NSSED Progress report of 2012 notes that the demand for transport grew by 10.1 percent in 2012, with the majority of this growth resulting from the continued growth of road transport. The number of registered vehicles has grown at an annual average rate of 14 percent for cars. (13 percent for all vehicles) since 1999. On the other modes, the activity in the port sector was reported to have grown by 5.9 percent in 2016, and the aviation sector, in terms of passenger numbers, by approximately 8 percent in the same year.

There are many institutional actors responsible for the regulation and execution of transport policy in Albania. At the national level, the recently established Ministry of Infrastructure and Energy [56] (MIE), is responsible for the policy and regulatory framework, together with the technical standards for the road, railway, civil aviation and maritime transport sub-sectors. The national road network is the responsibility of ARA (Albanian Road Authority) [57]. This body employs some 166 staff.

The National Road Network in Albania totals about 18,000 km long including about 3,719 km of National Roads: the primary road network is about 1,200 km (the main corridors), with nine main connections which made up the basis of the network. Total length of the secondary network is about 2,500 km; 10,500 km are interurban roads, and the rest of 4,000 km is under the jurisdictions of autonomous units, enterprises or companies.

The road infrastructure compares poorly to regional comparators in extent and quality. Albania ranks among the countries with the lowest density of roads, including highways per kilometer per 1000 inhabitants. A recent report of Eurostat on key statistics about countries that have sought to expand toward the European Union show that this indicator is in value of 1.4 km /1000 inhabitants. Albania leaves behind only Kosovo 1.1 km/ 1000 inhabitants. Meanwhile Montenegro has the highest indicator, with 13.5 km / 1,000 inhabitants, followed by Macedonia with 6.9 km / 1,000 inhabitants.

Poor transport infrastructure is regarded as one of main cause of difficulties for many firms and individuals. A qualitative survey of both poverty, and its causes, noted that, after employment and income, many Albanians considered infrastructure problems to be the main cause of their difficulties and a significant factor in their low standard of living. Rural inhabitants and leaders

[56] *http://infrastruktura.gov.al/*
[57] *http://www.arrsh.gov.al/*

acknowledged that poor road access makes it difficult for farmers to reach markets, contributes to rural to urban migration, and affects the delivery of health and education services.

Mortality and morbidity from road traffic crashes is a serious public health issue. The rapid growth in vehicle ownership, poor observance of traffic signals and rules by drivers, particularly in and around urban areas, is contributing to an increase in the number of road traffic accidents, underlining the fact that road safety is a significant social and economic issue in Albania.
On average, recent research has estimated the costs to amount to between 1-2 percent of GDP. Whilst the annual fatality rate, based on official statistics, which reflect a considerable amount of under under-reporting, has been slowly decreasing over the past six years, the fatality rate per 100.000 inhabitants in 2015 at 14 was still the highest in Central and Eastern Europe and about 3 times the average rate in the EU 28 countries (e.g. UK 3, Italy 6) [58].

Insufficient maintenance expenditures and lack of professional management of assets has increased the rate of deterioration of the network and increased the costs of road users. The majority of the expenditures by the Albania Road Authority (ARA) have been on capital investments during the last years, to accelerate the integration of the transport systems, and establish an integrated market for infrastructure and land transport, maritime transport and inland waterways.

The government of Albania formally adopted the Albanian National Transport Plan (ANTP). The ANTP, prepared with the support from the European Union CARDS program, provides the basis for an overarching framework for the development of the transport sector. The primary emphasis in the road sector is the rehabilitation and upgrading of the existing road network.

3.5 Albanian Road Authority (ARA) and its organizational structure

The MIE (Albanian Ministry of Infrastructure and Energy) has overall oversight of the road transport and has historically managed the infrastructure through the General Directorate of Roads (GDR). It oversees road safety, driver licensing and vehicle
registration and inspection through the General Directorate of Road Transport Services.

GDR was replaced in 2009 by the Albanian Road Authority (ARA), which has a more formal arrangement with the Ministry within context of a service agreement and is the asset manager of road infrastructure. It was created as a result of recommendations from ANTP (Albania National

[58] *https://data.worldbank.org/*

Transport Plan), in the Final Report for the Institutional Capacity Building and Transformation of the GDR (General Road Directorate) into a Public Enterprise dated Dec. 2007 referred to as the Dec 2007 Report. These recommendations, which purpose was to make ARA the nation's main road asset manager, led to the creation of the Albanian Road Authority (ARA) as Law No. 10 164, dated October 15, 2009. ARA is responsible for managing the national road network as defined in the Road Code and fulfills the following duties:

- ✓ Establishes electronic traffic management centers and approves their status;
- ✓ Ensures security for all road users;
- ✓ establishes and maintains the system for the administration of state roads and bridges;
- ✓ assists in the annual updates and five-year reviews of the Albanian National Transport Plan (ANTP) for the road transport sector, in cooperation with the Institute of Transport (IT);
- ✓ Maintain and implement the Albanian Road Construction Manual and Technical Specifications;
- ✓ takes initiatives for studies, research and experimentation on efficiency, traffic, traffic and road safety;
- ✓ prepares medium-term development programs and annual work program for construction, reconstruction, maintenance, preservation, and development of state roads in accordance with the priorities set out in the strategic documents;
- ✓ Maintains accounting books, draft and publish financial records and reports on the status of the performance of the business, including auditing reports of authorized accounting experts, in accordance with the accounting law and financial statements;
- ✓ Reports to the Minister responsible for the activity carried out in accordance with this Law.

4. CASE STUDY, SOCIAL IMPACT AND PROBLEMATICS *(technical level)*

The previous chapter was focused on describing the best practices of top asset management countries such as Uk, New Zealand Canada, Australia, Uk, Usa on a strategic level, the reforms they have undertaken to implement asset management in their governmental and agency's structures. It tried to describe the governmental institutions with road management authority situation in developing countries with a focus in Albania and analyse the problems that afflict them on the strategic level, as well as the reforms they should undertake to make implementing asset management their priority.

This chapter will introduce the case study taken in consideration (highway Durres- Kukes- Morine) as a very important axis which connects Albania to the Pan-European corridor 10, its actual physical conditions, value and performance. It will discuss the problems this highway experiences because of lack of adequate planning and life-cycle management and the benefits deriving from its construction. The goal of this chapter is to understand the problems deriving from the lack of life-cycle planning and management on a strategic level and how this leads to tangible problems on the technical level.

4.1 Introduction to Pan- European Corridors

Establishment of an integrated transport network within certain geography has been aimed at regulating mainly economic relations and consolidating socio-political cohesion in that geography. The initial example of such a massive planning and construction were the ancient Roman roads running throughout the territories of the Empire. A similar structure was established in England during the Industrial Revolution, on a smaller scale. What was achieved through establishing a transport network is the creation of a functioning single market which further consolidates political and military power.

Based on this incentive, the European planners had realised that the European integration has slowed down during the 1980s and Europe has lost its competitiveness in comparison with the USA and Japan. Furthermore, the collapse of the bi-polar system and the effects of globalisation have strengthened the market forces and world order has been restructured. The European integration, therefore, has gained impetus and sopranationality facilitating the operation of market forces, has dominated the process of integration, to some extent at the expense of intergovernmentalism. In this

regard, the Single European Market programme, which would induce a functioning integrated Europe-wide transport system, was initiated by the Commission in strong collaboration with transnational interest groups. This system would necessitate not only integration of national transport infrastructure of each member country, but also construction of new infrastructure extending beyond the borders. Together with the impetus of the European integration, the Maastricht Treaty creating the European Union has granted the Community organs with the competence to establish such kind of network throughout Europe. For this purpose, the EU has developed different financial instruments to ensure the realisation of European scale great projects and prioritised limited projects (priority projects) presented by the Member States.

The integration of the former socialist countries with the European market after the collapse of Soviet Union, facilitated the extension of this "planned" system to these neighbouring countries. Hence, development of a pan-European transport networks running throughout Europe and beyond has been promoted and the Pan-European Transport Network project has been initiated in the 1990s to integrate the Eurasian region within a single transport system to be contributed to the creation of a larger market. In this regard, the Trans-European transport networks (TEN-T) has been established within the EU and the arteries connecting it with the distant regions have been identified through the concepts of "Corridors" and "Areas".[59]

The Corridor and Area concepts have been put forward by EC/EU as a tool to improve the transport infrastructures of the neighbouring Central and East European countries and to ensure their integration with the developing European transport networks. The Pan-European Transport Corridors comprising mainly the CEE countries, have been promoted by the EU. In the creation and implementation of these networks, the European Commission supported by the European market forces, has led the process. This process has been implemented in the neighbouring regions through the intergovernmental cooperation, enhanced by the EU's financial and administrative instruments. Although the pace and content of this process has differed from the TEN-T, the countries concerned have reorganised their national infrastructure planning in accordance with the map of this project.
The EU has also used the whole network project as a pre-accession strategy tool to integrate the countries intended to be a member of the Union. The acceding and candidate countries, therefore, have been incorporated into not only the physical infrastructure but also political, economic and social activity of the Union. It is obvious that this strategy has been successful, given the accession of the CEE countries to the Union in 2004. Therefore, the need for revision of the corridor concept ap-

[59] EUROPEAN COMMISSION (2005) *TEN-T priority axes and projects*, Retrieved from *http://ec.europa.eu*

peared. Nevertheless, the competing strategies of the countries on the existing corridors as well as identification of new priority corridors, complicate the revision process.

The concept of Pan-European Transport Network was debated during the early 1990s through **"Pan-European Transport Conferences".** The Pan-European Transport Conferences originally organised by the European Commission and the European Parliament of the European Communities (of the European Union) in close collaboration with the international organisations responsible for transport, basically the European Conference of Ministers of Transport (ECMT) and the United Nations Economic Commission for Europe (UNECE) and the representatives of the European countries, accession countries and other countries invited, to promote the establishment of all the necessary components for a future Pan-European Transport Network. [60]

The **First Pan-European Conference** was held in Prague on 29-31 October 1991, in an atmosphere where the reform process towards a democratic and a market-oriented system was started within the Soviet Union and the Central and Eastern European Countries; the European Community was prepared for Economic and Monetary Union, and Political Union in parallel to the completion of the Single Market; the Uruguay Round negotiations were concluded as of December 1990 emphasising the gradual removal of barriers to multilateral free trade; "Prague Declaration on an All European Transport Policy"; development of an efficient, intermodal, combined, safety and environmental-friendly all European transport system based on the principles of market economy and fair competition together with an adequate European transport infrastructure network plan, were set as the objectives.

At the **Second Pan-European Conference** on 14-16 March 1994 in Crete, it was referred to "the need of cooperation in Europe necessitates the gradual opening of internal markets to third countries and the defence of the principles of a social market economy with free and fair competition, and welcomed the steps to develop a Europe-wide transport policy. Furthermore, it also defined, to some extent, the conditions for the development of such policy in all participating states and at European Community level, which are the principles of social market economy and free and fair competition; safe, multi-modal and environmental-friendly transport; legal, technical and fiscal harmonisation, and coordinated planning. Last but not the least, the corridor concept was defined in the

[60] European Commission Directorate General VII, TINA Office Vienna (1998, December) *Status of the Pan-European Transport Corridors and Transport Areas*

development of a pan-European infrastructure as a starting point. Therefore, the countries of Western, Central and Eastern Europe were incorporated into the networks of the European Union by the nine identified long-distance transport corridors, together with the Trans-European Networks laid by the Maastricht Treaty.

A year after the EU had adopted the guidelines for the development of the Trans-European Transport Networks in 1996, **the Third Pan-European Conference** was held on 23-25 June 1997 in Helsinki, where common principles of a Europe-wide transport policy were laid down. In "Helsinki Declaration Towards a European Wide Transport Policy: A Set of Common Principles", the overall objective was defined as "to promote sustainable, efficient transport systems which meet the economic, social, environmental and safety needs of European citizens, help to reduce regional disparities and enable European business to compete effectively in world markets." What is more, non-discrimination, sustainability, protection of transport users, workers and the public at large, cooperation, interoperability, subsidiarity, transparency, contribution to costs, efficiency in the use of infrastructure and consultation were enumerated as the principles, to be applied to the realisation of the objectives. In this respect, a tenth corridor and the Pan-European Transport Areas for maritime basins were added into the Pan-European Transport Network. The agenda of the Helsinki Conference was set by the five-point action plan announced before Helsinki. The plan highlighted five themes for action: fixing the Pan-European Corridors and Areas as a framework for ensuring efficient transport services with all EU neighbours (similar approach to the Mediterranean Basin); preparation for extension of the TEN to the applicant countries as a part of the preaccession process; a common approach to transport technology throughout the pan- European network; the encouragement of intelligent transport technologies; and closer cooperation on research and technology.

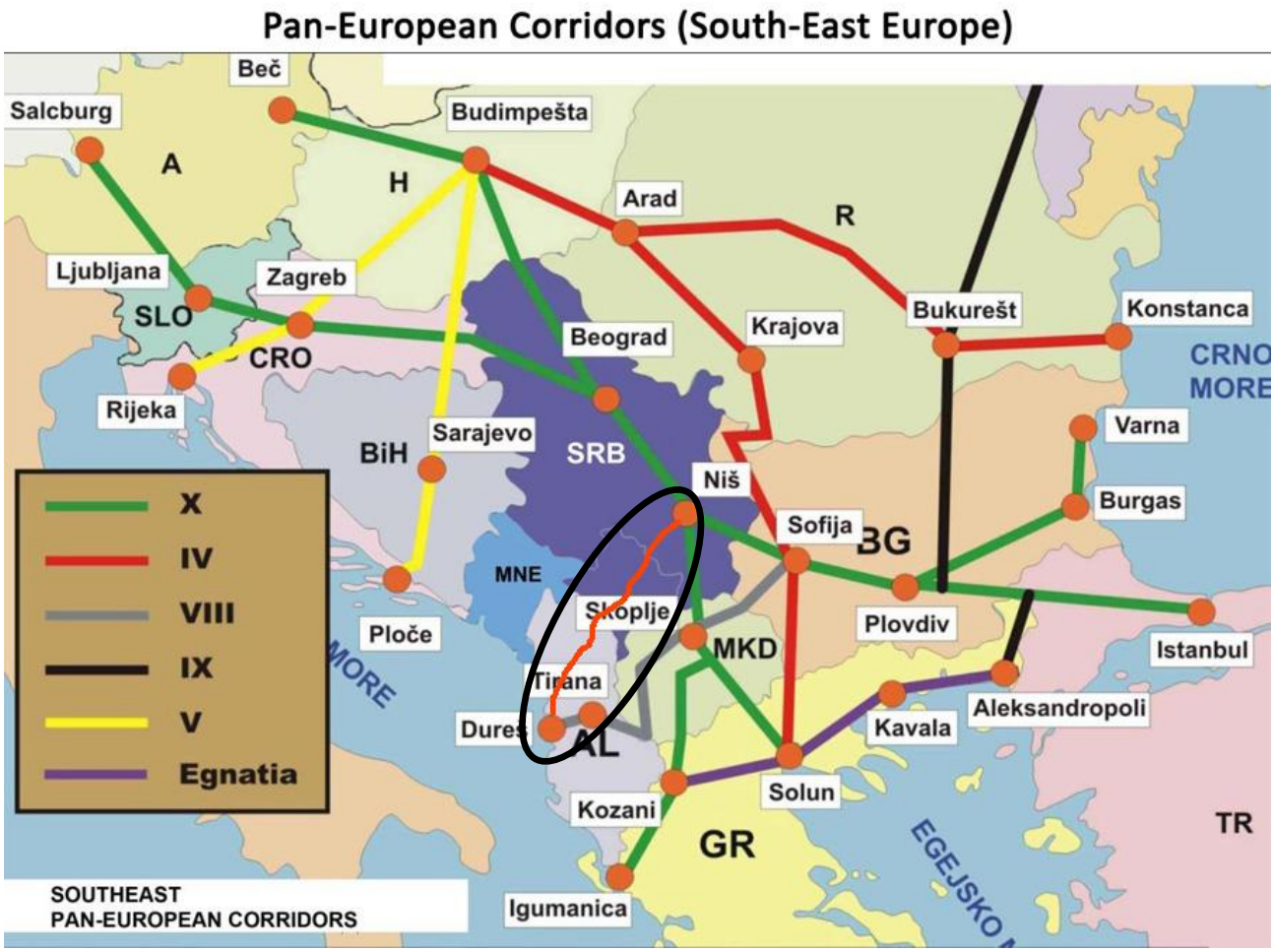
4.2 Pan- European Corridor X

Pan-European Corridor X **(Figure 4.1),** was identified as the tenth Corridor at the Pan-European Transport Conference in Helsinki in 1997, and was included into the network of the Pan-European Transport Corridors, in order to accelerate the integration of Western Balkans with Europe. It is the "youngest" of the Pan-European Transport Corridors and the most important transport axis for the Western Balkan region.

The corridor development was initiated in parallel to the stabilisation process of the region. It is a multimodal Northwest-Southwest link, connecting Salzburg (Austria), Ljubljana (Slovenia), Zagreb (Croatia), Belgrade, Nis (Serbia and Montenegro), Skopje (Macedonia) and Thessaloniki (Greece).

The Corridor has four branches. Branch A is Graz (Austria), Maribor (Slovenia), Zagreb (Croatia); Branch B is Budapest (Hungary), Novi Sad, Belgrade (Serbia and Montenegro); Branch C is Nis (Serbia and Montenegro), Sofia (Bulgaria) and further along Corridor IV to Istanbul; Branch D is Veles, Bitola (Serbia and Montenegro), Florina, Kozani-via Egnatia and Igoumenitsa (Greece). It consists of 2528 km of railways, 2300 km of roads, 12 airports and 4 sea and/or river ports.

Figure 4.1 Pan- European Corridors (South - East Europe)



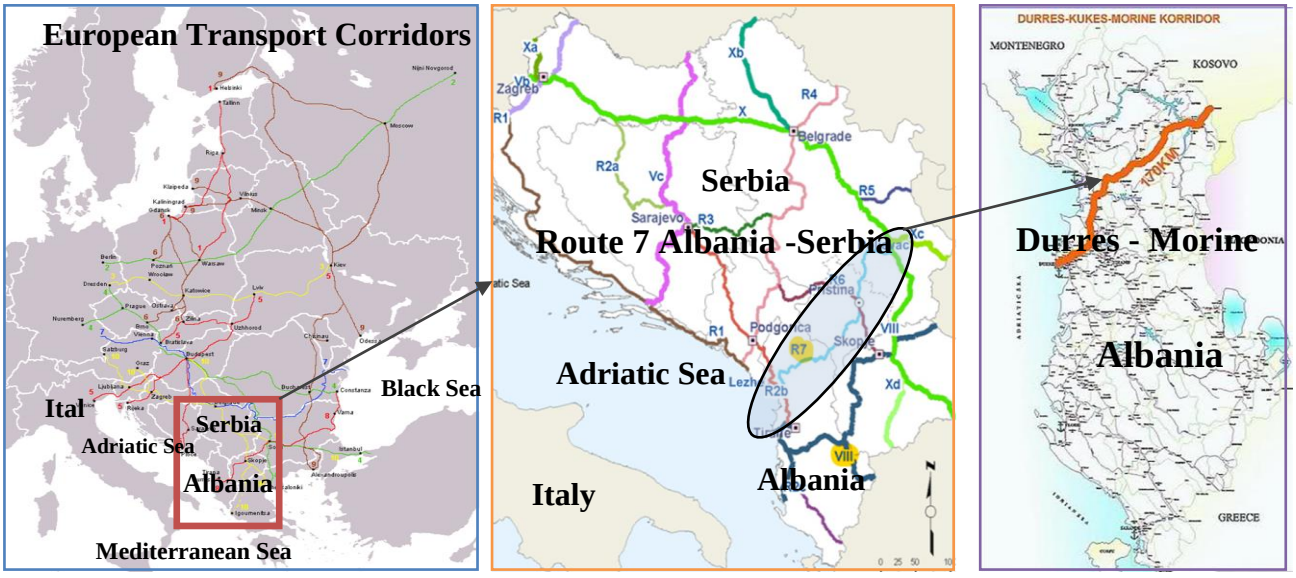
For Hungary and Bulgaria, Corridor X provides an opportunity to improve the road and rail links to former Yugoslavia. For Western Balkan countries, both rail and road projects to Hungary are important. Any developments along Corridor X are largely dependent on the stabilisation of the situation in the Balkans crisis. Route VII, which includes the Durres – Kukes- Morine section provides a crucial connection to Corridor 10. Port of Durres, the final destination, has to become the most important port, providing Serbia with access to Adriatic Sea. Greece pays special attention to develop its maritime links and to modernise its port infrastructure, due to its geographical advantages. The ports such as Thessaloniki and Alexandroupolis are the final destinations of Pan-European

Transport Network (Corridors IV and X, Via Egnatia Motorway of the TEN-T). Moreover, the importance of these ports is crystal clear as far as the project of trans-Balkan oil pipeline planned to be constructed from Bulgarian port of Burgas to Greek port of Alexandropolis is concerned.

4.3 Case study: Highway Durres – Morine

As introduced in the first chapter, the case study taken in consideration in this dissertation is the **Durres - Morine** highway, segment of the European Route VII between Albania and Serbia, including in perspective the connection with the Pan European X corridor to Nish in Serbia, continuing in Romania, Bulgaria and beyond **(Figure 4.2).** It is seen as having major potential regional impact by providing better connection through Albania, Kosovo and Serbia.

Figure 4.2 Durres- Morine segment, part of Route VII between Albania and Serbia

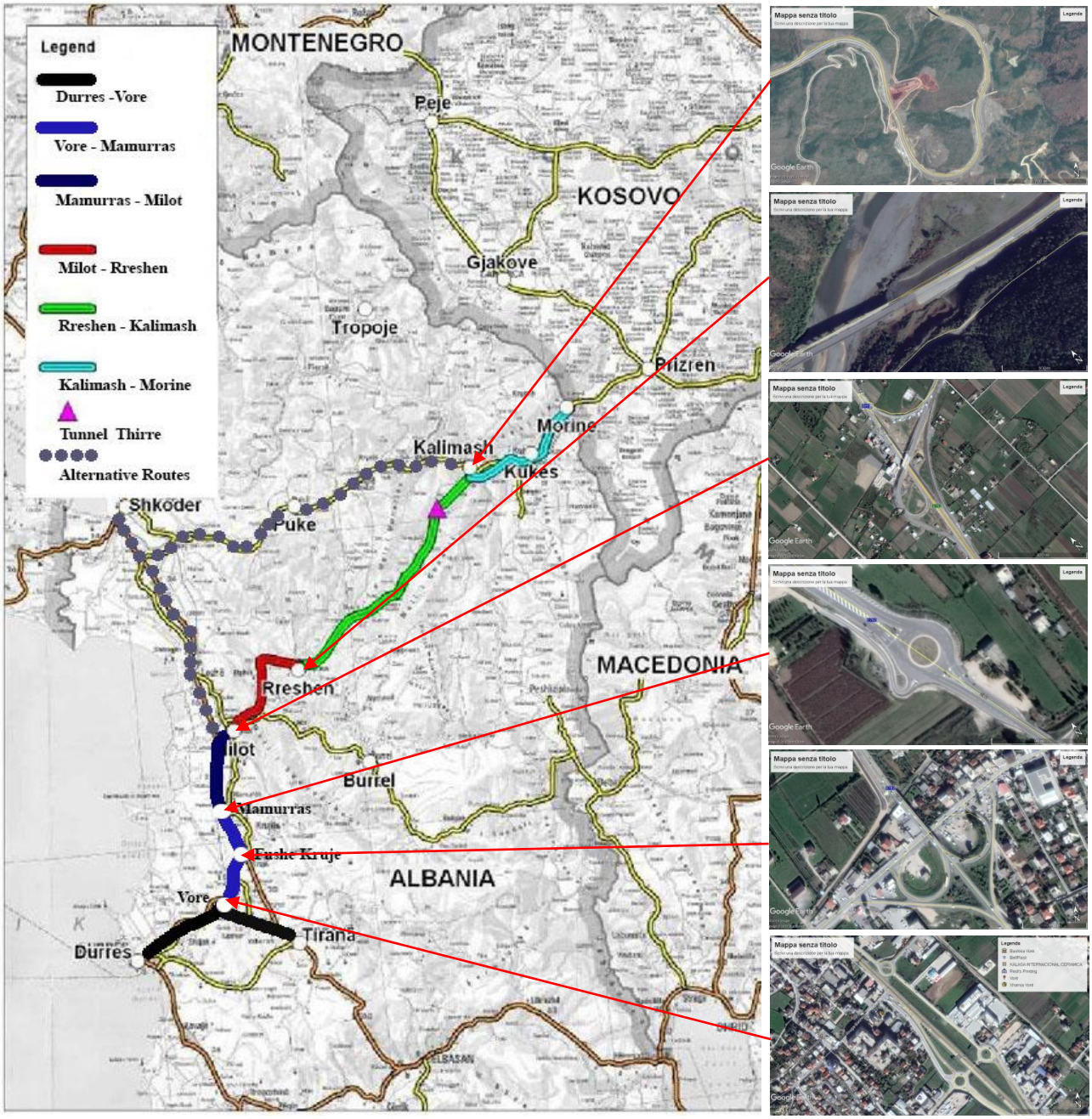


The four sections which compose the 170 km long highway from Durres to Kosovo border (Figure 4.3) are:

- ✓ **Durres - Vore**, dual carriageway (22 km), segment of the Albanian State Road 2 (SH2) which connects Durres to the capital of Albania, Tirana. This main Interurban road was the first to be constructed, during years 1997-2002 and is one of the busiest roads in Albania.
- ✓ **Vore - Mamurras**, single carriageway (20 km), segment of the Albanian State Road 1 (numbered SH1), which connects Durres to Shkoder, the main city in north Albania, and continues to Montenegro.

- ✓ **Mamurras - Milot**, dual carriageway (13.4 km segment of the Albanian State Road 1 (numbered SH1), which connects Durres to Shkoder, the main city in north Albania, and continues to Montenegro.
- ✓ The newly constructed **Milot - Morine**, dual carriageway (110 km), which connects Milot to Morine border with Kosovo, and continues to Nish where it meets the Pan European Corridor 10.

Figure 4.3 Sections of Durres – Morine segment



It includes the following interchanges: Vore, Fushe-Kruje, Mamurras, Milot, Rubik, Rreshen, Reps, Thirra, Kalimash and Kukes.

4.3.1 Physical Conditions, value, performance and problematics

The Durres – Vore segment of the case study, part of the Albanian State Road 2 (SH2), is a dual carriageway, 22 km long, with a maximum speed limit of 90 Km/h. Being the first four-lane carriageway road built in Albania, during years 1997-2002, it connects Durres to the capital city Tirana, reaching a peak of 50.000 AADT. This arteria passes through the Durres-Tirana Region (Durrana), the most industrialized in Albania, which has the highest GDP rate per capita and is the economic center of the country.

Along the road, because of urbanization and industrialization, many small towns have grown-up and many manufacturing companies have built their production buildings. The secondary roads which connect the main road Durres-Vore to these towns and production buildings are in poor conditions **(Figure 4.4).** The exit and entry points are uncontrolled, with lack of horizontal and vertical signage, and in most of the cases the junctions do not exist or are badly designed during the design phase, resulting in road traffic jams and bottlenecks, as well as accidents and safety issues for people.

Figure 4.4 Junctions, exit roads at Durres-Vore

Changes in land utilization have increased the traffic demand, making it the busiest interurban road in Albania as well as one of the most dangerous. During the last 15 years, this important road has never undergone major renovations, except of pothole patching activities, leading to poor pavement, vertical and horizontal signage and safety conditions. Because of inexistent cleaning activities and obstruction of main drainage basins from construction works, some sections of the road, completely immerse in water during heavy rainfalls, cutting off the link between Durres and Tirana **(Figure 4.5).** During the last 3 years, with the increased number potholes in the right lane, the most trafficked one, many drivers find driving in this lane difficult, changing lane and creating traffic jams.

On June 2018, ARA (Albanian Road authority) makes the following announcement "The Albanian Road Authority and the Road Police inform the media and the public that starting from Monday (11th of June), as part of the World Bank's performance maintenance project, emergency intervention will be initiated for the repair of asphaltic layers at the Durres- Vore axis. The interventions for the entire highway in the two senses will be implemented in June"

On peak summer touristic season, where the traffic inflow reaches its peak, ARA (Albanian Road authority) announced the total closure of the highway due to emergency interventions for road reconstruction, as it has become a danger to citizens. Police wants to avoid this axis and vehicles from Durres to Vore, and further north Albania will pass from the secondary roads, which cannot handle all the traffic and are in poor conditions.

Figure 4.5 Heavy Rainfall Durres-Vore section

Instead of developing a life-cycle asset management and taking a proactive approach to prevent degradation of this arterial road, past and present governments and road authorities have always reacted afterwards without resolving the problems, which still persist.

The **Vore – Mamurras** and **Mamurras – Milot** segments **(Figure 4.6),** are part of the Albanian State Road 1 (SH1). While the first one, **Vore – Mamurras,** is still a single carriageway (20 km), the second one, **Mamurras – Milot**, recently underwent major renovation, widening it to dual carriageway (13.4 km). The Albanian State Road one connects Durres/Tirana to Shkoder, the main city in north Albania, and the capital of Montenegro, Podgorica. It forms part of the Adriatic-Ionian motorway, connecting the Albanian- Montenegrin border (Hani Hotit), with the Albanian-Greek border (Kakavije). This motorway is part of Route two of the European Core Road Network and European route E851.

When designed in early 2000s, this road was planned to be dual carriageway. However, the lack of funding at the time only allowed for one carriageway to be constructed, leading to traffic overload and high number of accidents. Due to the high number of fatal accidents, the section between Milot and Fushe- Kruje was unofficially named as the "Road of the Death" by many media reports for its structural deficiencies and uncontrolled entry and exit points.

Figure 4.6 Vore – Mamurras Section

This segment having an AADT (Annual Average Daly Traffic) of 20000 vehicles, bears all the traffic departing from Tirana (capital city) towards North Albania resulting in an over utilized

segment with high road mortality and morbidity from road traffic crashes and serious and increasing public health issue). The exit and entry points are uncontrolled, with lack of horizontal and vertical signage, and in most of the cases the junctions do not exist or are badly designed during the design phase.

The **Milot – Morine** segment, part of the Albanian Highway network (A1). Linking Milot, approximately 60 km north east of the Adriatic port of Durres, with Morine at the Kosovo border, the route constitutes the central section of the wider Albania to Kosovo Highway, connecting Durres with Pristina. Passing through **Milot-Rrëshen-Reps-Thirre-Kalimash-Kukes-Morine**, it is the largest infrastructure investment in Albania and the most important in terms of transportation, economic and social benefits. Although the approved project was expected to be dual-carriage way, the first section, **Milot- Rreshen,** is still single carriageway with one lane in each direction **(Figure 4.7).**

Figure 4.7 Milot- Rreshen Section

The section **Rreshen-Morine** (Fig 4.8) is composed of four lanes, two lanes in each direction with maximum speed allowed 80-100 km/h, this segment reduced the distance between Tirana (Albania) and Pristina (Kosovo) by 65 km, from 330 to 265 km (Figure 4.8).

Figure 4.8 Rreshen- Morine section

The project started only in 2003, when the World Bank funded the feasibility study. Part of the highway, the segment between Rrëshen (north-central part of Albania) and Kalimash (northeastern part) was inaugurated on June 26, 2009. The four-lane highway became the largest infrastructure project in Albania. Its initial cost was estimated at about € 600 million, but then it approached 1 billion euros, though it has never come up with a final figure of its full cost up to the current stage.

With its construction, the AADT was projected from 12,000 to 15,000 vehicles (the European standard for highway construction). But today, after almost 10 years since its construction, the average annual daily turnover of vehicles reaches about 9000 only during the summer season. In the days out of this season, the average number reaches around 4500 vehicles. On average, around 1.8 million vehicles circulate around the Nation's Road, of which about 20% are freight vehicles.

Constructed in stages, this section of the Highway comprises three segments, built to differing engineering standards:

- ✓ **Milot - Rreshen** segment (26 km), single carriageway (numbered A1), financed by the World Bank, IDA and the OPEC Fund. Connection is provided at Milot with the north-south Tirana to Shkoder Highway, linking the Albania capital to the Montenegro border.
- ✓ **Rreshen - Kalimash** segment (61 km), dual carriageway (numbered A1) through mountainous terrain, built with Government funding by Bechtel -Enka JV between April 2007 and June 2009. It includes a 5.6 km twin-bore Thirra tunnel.
- ✓ **Kalimash - Morine** segment (31 km), dual carriageway (numbered A1), completed in 2011 and principally comprising a four-lane dual carriageway, with the exception of seven short bridges which are two-lane.

The most important factor to take into considerations is the reduction in **terms of time**. The previous roads connecting Milot with Morine border with Kosovo, were 5 m wide, composed of many narrow horizontal and vertical curves, limited speed and were unable to handle the passenger and freight traffic volume between the two countries. These narrow roads passed alongside the mountains at 1000 m above sea level and descended to 300-600 m in the valleys. 5-7 hours were needed to cross the 170 km distance from Durres to Morine border, with an average speed of 30-45 km/h instead of the actual 2 hours and 30 minutes under normal conditions (Figure 4.9).

Figure 4.9 Old road sections of Milot- Morine

About 4.5 km of the highway are composed of **bridges and structures up to 80** m high making it an engineering challenge for the construction companies (Figure 4.10). Along the segment 29 bridges are built, also called "artwork", which together reach 4 km in length.

Figure 4.10 Bridges of Milot- Morine section

The bridges are divided into different spaces, at the beginning and end of the shoulders and between the legs. These spaces are about 40 meters long and are crossed by three concrete beams with a trapezoidal height of 2 meters and a weight of 165 tons one. The highest bridge is located in the

northern part of the segment, 90 meters high, while the longest one in the southern part, 360 meters long.

A significant **distance and time** reduction came from the construction of the **Thirr Tunnel**, in Kalimash (Figure 4.11), 5.6 km long, composed of 4 lanes, 2 in each direction, a massive work in the mountains. Considered to be one of the largest engineering works not only in Albania but also in the Balkans, it was built in two years at a dizzying speed. Composed of two parallel galleries, with a length of 5.6 km each, the rock mass excavated for its completion reaches 33 million m3.

Figure 4.11 Thirr Tunnel, Milot- Morine section

The two Galleries have a height of 10 meters and a width of 13 meters each and are equipped with ventilation chimneys, with a very powerful system for air circulation. Separate rooms have been opened for escape as a safety measure in case of a fire in the tunnel, and rescue purposes. The two parallel galleries are connected to each other at different points to allow vehicles to change direction and to go from one tunnel to another during the path in the heart of the mountains, are equipped with lighting and sidewalks on both sides of the carriageway and also with special compartments for the passage of the electrical, telephone, cable and security control.

The segment **Milot – Morine** experiences **various problems** still today, because of wrong strategic planning before construction and professional life-cycle management after construction which have led to insufficient maintenance expenditures, as well as almost inexistent traffic growth.

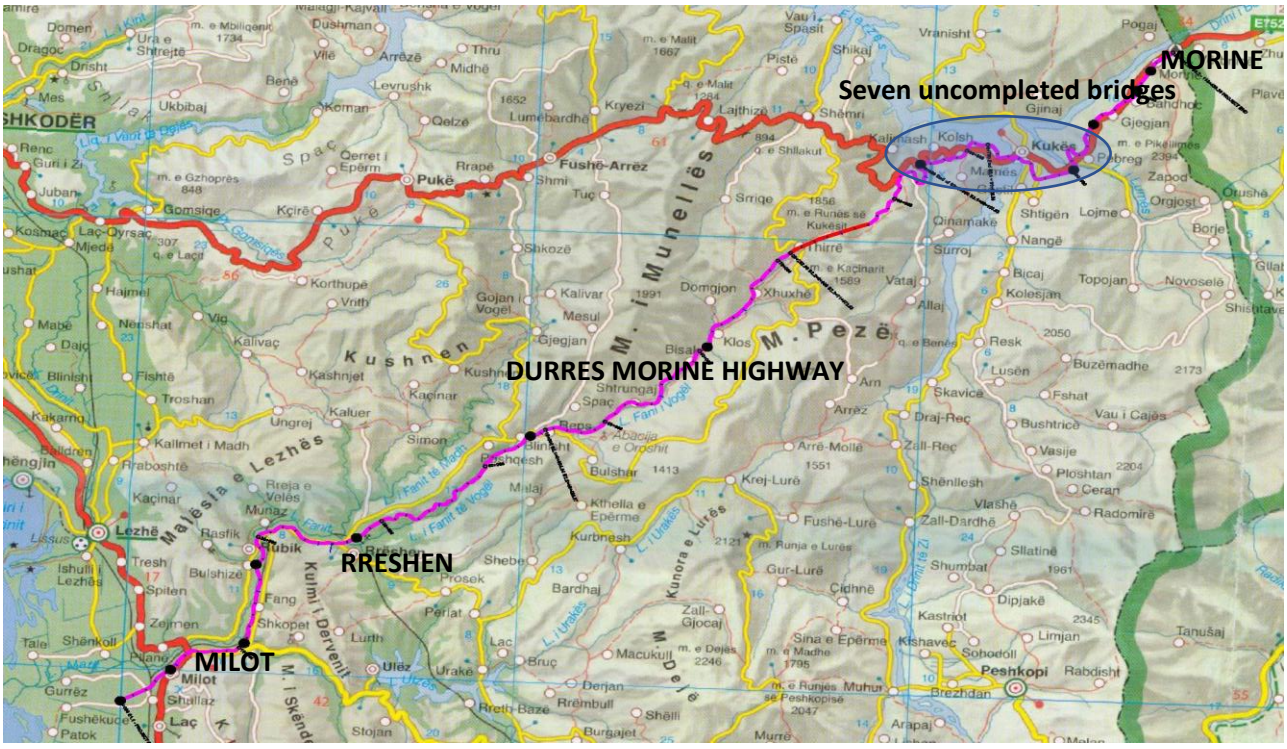
Milot - Rreshen the first section of the highway Milot – Morine is still to be completed. Nowadays, it remains single carriage, with a significant AADT, which increase the crossing time and accidents. In fact, the maximum speed allowed in this section is 50-60 km/hour, creating traffic lines, bottlenecks and confusion. The two other sections **Rreshen – Kalimash** and **Kalimash – Morine**

are dual carriageway with a max speed allowed 80-100 km/h. Being newly constructed, their overall condition is satisfactory The AADT is low compared with the other sections taken in consideration, making the drive smooth and pleasant. However, after almost 10 years from their construction, these sections, very frequently, are blocked by falling stones during heavy rainfalls which are dangerous for the driver's safety and cause the interruption of service **(Figure 4.12)**

Figure 4.12 Falling stones, Rreshen- Morine section

Today, there are seven uncompleted bridges near Kukes region source of deadly source of deadly accidents **(Figure 4.13).**

Figure 4.13 Seven uncompleted bridges, Kukes region



Because of these half-finished bridges, seven sections of the highway change narrow from dual carriageway to single carriageway creating bottlenecks and confusing the drivers, especially during night **(Figure 4.14).**

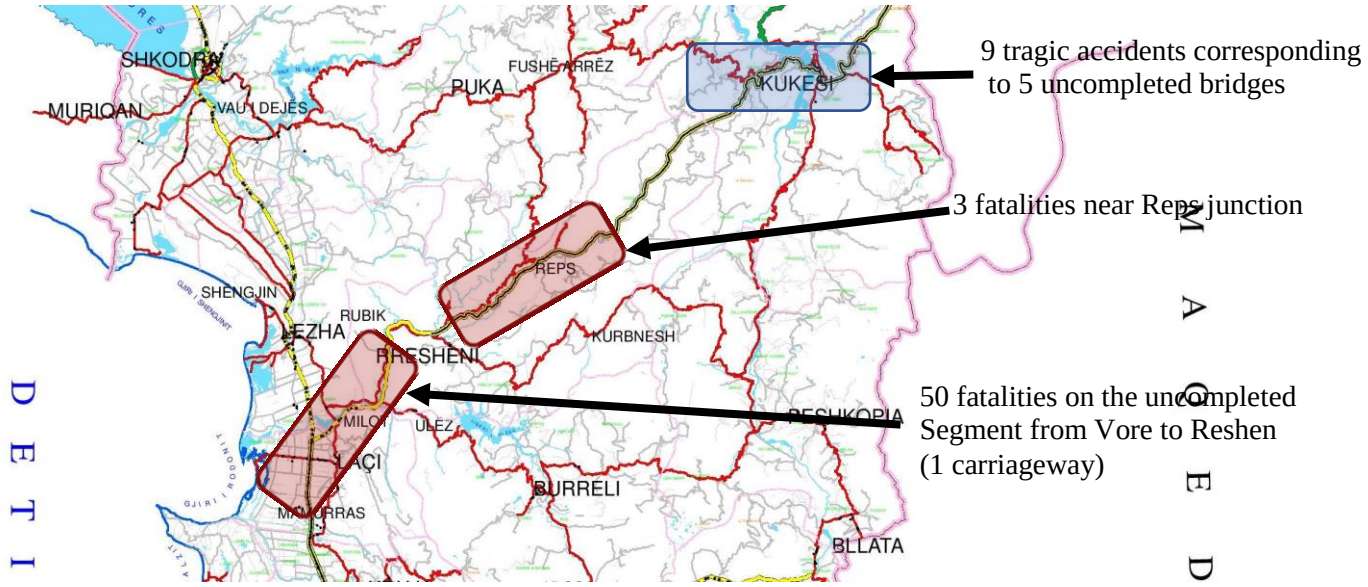
The overall segment from **Milot to Morine** has no pedestrian overpasses in its entire length. Alternative routes and secondary roads are in mediocre condition **(Figure 4.15),** and the distance between subsequent exits of the highways is very long. This segment gives the impression that it was designed to connect 2-3 countries without taking in consideration the social-economic conditions of the inhabitants of the small villages along the route. Small villages are cut in two by this segment and this is reflected in the bollard, cut every 2 km, with people who put at risk their life to cross this section.

Figure 4.14 Uncompleted bridges, Kukes region

Figure 4.15 Secondary road connecting the highway to the city of Rreshen

The following map of the accidents occurring in **Vore – Rreshen** segment (Figure 4.16) reveals the problematic situation encountered in the different sections of the segment. The first segment from **Vore** to **Rreshen**, single carriageway, bears all the traffic departing from Tirana (capital city) towards North Albania resulting in an overutilized segment. This is reflected in the number of accidents occurring over the years, with 50 fatalities from 2011 to 2014. Other three fatalities are located near the Reps junction. Considering the poor conditions and connections of the secondary roads with the main trunk, and the lack of pedestrian overpasses, inhabitants try to cross the highway becoming a target for the vehicles which travel at 100 km/h.

Figure 4.16 Map of deadly accidents on the highway (years 2011-2014)



Source – Ministry of Transport and Telecommunications

Due to all the problematics showed in the previous pages and to a lack of funding for maintenance the government in 2016 outsourced the maintenance and operating of **Rreshen- Morine** highway to a Turkish company through PPP (Public-Private-Partnership) procurement methods. The main objective of this concession is the improvement of the highway. Under the foregoing conditions, the concessionaire will build, upgrade, and maintain the highway for 30 years and will collect the tax revenue and have the responsibility to finance the upgrades of the highway. It also should complete the bridges over the Drin River in Kukës and implement the most urgent geotechnical stabilization works. The contract between the government and concessionaire foresees the application of a flat tariff of 5 euros for the use of the highway by Albanian and foreign vehicles which the company tried to initiate collecting in May 2018.

Figure 4.17 Riots at Kukes Region, concessionaire toll, building

However, due to lack of roadside side slopes and unauthorized entrance-exits from the secondary roads to the motorway, the company is finding it almost impossible to start implementing the contract. The lack of information and costumer consultation before deciding to apply a tariff, which was deemed excessive, prompted heated protests by inhabitants of Kukes Region (Figure 4.17).

4.3.2 Economic Impacts *(Benefits)*

The Highway Durres- Morine is considered as one of the most important Albanian infrastructure works, which created, not only economic opportunities for Albania, Kosovo and Serbia, but is also distinguished as being the only road infrastructure in the European continent linking two states of the same nation. The impact on the economies of the two countries has been positive compared to the levels ahead of its construction, both in trade and in the exploitation of tourist potentials. This infrastructure investment not only made it possible for many tourists from Kosovo, Serbia and Macedonia to visit the country but also helped the expansion of trade with Kosovo and Serbia, thanks to the free trade agreement and improved accessibility to the port of Durres.

Almost 10 years ago, the two countries Albania and Kosovo, shared a barrier almost insurmountable: the distant distance to physically reach each other, prevented the development of trade in business or tourism. Today, Kosovo, the trade with which was inexistent years ago, is among the main export partners and the only one with which Albania has a trade surplus. Albania became one of Kosovo's main trading partners and obviously the construction of the highway has had significant impact with time and cost reduction.

Trade relations between Albania and Kosovo became more significant since 2003, while tourism recognized the most significant growth during 2010-2011. (INSTAT) In October 2003, Albania and Kosovo liberalized a considerable trade between them, to achieve in 2007, with entry into CEFTA, the full liberalization of bilateral trade.[61]

Data from the Albanian Institute of Statistics show that during 2010-2014, exports experienced significant shifts, and increased drastically compared to 2009 levels[62]. There was a rising trend until 2012, which went down in 2013 and marked an increase in 2014. In 2015, exports from Albania to Kosovo accounted for 8.6% of the total, from 7.3% in 2014 and 4.7% in 2007 before the construction of Durres - Kukës. The exports during this period were mainly concentrated in the "Minerals, Fuels, Electricity" and "Construction Materials and Metals" groups. The most exported product from Albania to Kosovo in 2015 was giza and steel with about ALL 5.4 billion (4% annual growth) followed by fuels and minerals, with about ALL 5 billion, which saw an annual increase of 22%. The exports of agricultural products experienced excessive growth, too. Vegetables sales in Kosovo grew by 45%, reaching 750 million ALL. Even the exported fruits were 50% higher than

[61] http://cefta.int/

[62] Gjergji FILIPI INSTAT (2015) *STATISTICAL YEARBOOK 2010-2014*

the previous year, to reach almost 600 million Lek. Cement is one of the products that failed to find the neighboring market on 2015.

A study of the impacts on trade between Albania and Kosovo, after the realization of "Ibrahim Rrugova" segment, continuation of the Milot - Morine segment, was conducted by RIVET and KFOS, in 2015. This study showed that the construction of this road has been more favorable to Albania's producers that to those of Kosovo. However, the Kosovo consumers, as a result of the construction of Route 7, had access to a wider range of products, and in many cases consumed those products at lower prices due to lower cost of transport.

Although Route 7 did not have much impact on Kosovo's export growth to Albania, it is now serving as the main route for the exports of other countries such as B&H, Macedonia and Serbia to Albania through Kosovo. The use of Route 7 for transporting the goods of neighboring countries to Albania can benefit the economies of Albania and Kosovo (increased revenues on road tolls, fuel sales, hotel and restaurant industries, etc).

This is happening due to the construction of the Kalimash tunnel which drastically reduced the costs of transporting goods from and to the Port of Durres. This way, not only Albania was closer, but it also facilitated business access from Kosovo and other neighbor countries to other markets and provided them with the opportunity to use one of the largest ports in Albania for a short time.

The quickest access to the port of Durres allowed the enterprises of neighbor countries to have diversified routes to transport products apart from the corridor through Thessaloniki. The road helped to reduce costs by about 50% compared to Greece and Montenegro.

The volume of trade exchange between the 2 countries have increased rapidly. However, they still do not meet the initial expectations right after the construction of the highway. Various studies have shown that this difference is, partially, due ***to historical developments and administrative divisions of the two countries***, as well as the absence of infrastructural connections.

Kosovo's production system and consumption profile has been part of the production and distribution chain of the former Yugoslavia and the infrastructure network developed over the last centuries has been oriented towards other Yugoslav republics. Albanian's trade has been oriented towards European Union countries, where the main trading partner remain Italy and Greece.

Various Albanian experts say that for a further development of trade between the two countries it is necessary to identify the competitive advantages, especially in sectors such as agriculture and industry, and then coordinate fiscal, administrative and sectoral policies to enable higher levels of economic integration than current levels.

Lack of Albanian products comparable to Kosovar imports has reduced the expected contribution of this investment. The study showed that there is structural poverty between goods traded between the two countries and that they are often unsustainable. Experts say that even in favorable technical and administrative situations, for example, the closure of the border with Serbia and the imposition of full trade barriers on Kosovo, which lasted for 58 days in 2011, both countries showed significant weaknesses in filling the markets. During this year Albanian exports, almost, did not contribute to the replacement of Serbian goods in Kosovo. Countries that replaced goods from Serbia at a significant level were Macedonia and Greece.

Also, it is estimated that the highway is an indirect subsidy made to third countries who make use of this alternative for faster and lower cost transport, "said the Institute's analysis. According to him, economic relations between Kosovo and Albania are limited to trade exchanges of export / import profile without any significant advances in direct investment attracting in common or respective terms.

According to survey data, the peak of investments in Kosovo by businesses from Albania was registered in 2010, with 108 new enterprises. Commercial enterprises, as well as construction and pharmaceuticals dominated. The study underlines that "Despite the fact that the two countries' mutual trade portfolio is unsatisfactory and considering the poor supply of products on the mutual markets, it is expected that in the coming years, exchanges between Kosovo and Albania to grow even further, due to cultural ties, planned infrastructure upgrading, modernization of administrative procedures, greater knowledge and technology circulation as well as other factors. In addition to the potential, Albania's access to the market provides an automatically higher level of consumption. The importance of Albania lies in the fact that it provides offshore for Kosovo goods.

4.3.3 Social Impacts in Albania

There is no doubt that Route 7 has contributed to the growth of tourism from Kosovo to Albania. Both Kosovars and Serbians can reach Albania in less time to spend their holidays. Albania became

the "San Tropez" of tourism for these countries, especially for Kosovars. This event was later named “Patriotic Tourism”.

INSTAT data shows that inflows of foreign allowances across the land border (where Morina's inflows accounted for more than 50% of the total) marked a significant increase shortly after 2008, reaching the peak in 2015, by more than 5 times. In one year in Albania there were about 1.5-1.8 million citizens from Kosovo, 70% of whom come from June to August. During 2009, the tourism industry estimated value was 29% higher than that of export of goods and services.

In 2010, the number of foreign visitors to Albania was estimated at about 3.5 million, of which about 1.7 million were citizens of Kosovo. The shortened travel distance (in 2.5 hours) made coastal areas more accessible and at a lower cost. The favorite destination for many years remained Durres, whose beach area became the 'second home' of compatriots from Kosovo. Tourism in Albania was also favored by the same culture and traditions, the common language, but also by the fact that for the same quality it could take a cheaper vacation. The construction of Durres – Morine helped also the access to remote areas of southern Albania which were unexploited before the construction. As a result, economic benefits were extended to other areas of the country. Weekend tourism was also developed, while figures grew even further on joint holidays or sporting events.

The development of "patriotic tourism" also affected other sectors such as retail sales, the real estate market, accommodation, etc., thus generating more jobs and added value and affecting exchange rate, where the Lek's position strengthened against euro and dollar currency.

After the construction of the Nation's Road, the interest of Kosovo Albanians for the purchase of apartments in Albania increased. The property owners in 2009 spoke of a great interest by Kosovo Albanians, Macedonians and Diaspora, who were about to start booking second houses on the coast after the construction of the road. The sales prices of apartments ranged from 400-900 euros per square meter. Only in 2011, the purchased apartments and apartments reached about 30 million euros of value. One of the most favorite areas of Kosovars was Durres, from the Rock of Kavaja and extending to Golem.

The tourism and home purchase helped to develop local economies, provided the state with additional income from taxes such as VAT, sleeping fees, visits to tourist attractions, etc., created new seasonal jobs, and new business opportunities. In the summer of 2016 the number of tourists

from Kosovo reached the highest historical level, with about 1.3 million citizens who entered for the period June-August, occupying more than half of foreign tourists coming to Albania.

The construction of Milot - Morine section revived many small communities in the north Regions of Albania. The communities before the construction of the highway were lifeless, without a clear future prospective. In Fan Municipality of Mirdite Prefecture, nine new secondary gravel roads were built which clearly reflected the development of the area. 1500 new residences were built during the construction for Albanian Turkish and US workers only in Fan Municipality adding sharm and elegance to the area. After the construction, measures were taken by the residents, not to flee their lands but to exploit them for profits. There were 500 families receiving economic aid in the municipalities of Fan and Klos before the beginning of the construction of the highway. Now only 45 families still receive economic aid.

4.3.4 Excessive cost of construction

Milot-Morine section otherwise known as the Nation's Road, part of the case study **Durrës – Morine**, is among the most important infrastructure projects, not only in Albania but also in the Balkans. Despite the economic and social benefits for Albania and Kosovo the segment Milot – Morine of this route is reknown for its controversial debates, due to the high cost paid for its construction, which still today has to be completed.

Constructed on the premise of creating wealth from the increase of trade and tourism the construction cost doubled in both countries compared to the initial prices offered. The American-Turkish Construction Company, Bechtel- Enka, won the contract to build the 110 km from Milot to Morine border for 418 million euros. Instead, the cost rose up to 950 million euros.

Following a six-month investigation, documents from United Nations published by BIRN (Balkan Investigative Reporting Network) show that lobbying, non-competitive offers, non-fixation of the limit price and “inflated” prices, inadequate planning, poor management, lack of transparency, have driven the total cost of the construction up to 1 billion euros for 110 km of highway, forcing Albanian government to divert funds from other more primary projects, such as the construction of schools, hospitals and other less expensive infrastructural projects, and leading to police investigations for corruption and office abuse.

The prosecution team noted that the contracts were signed without a limited price agreement or a detailed construction plan, allowing the price to rise constantly and out of control.

Albania was not able to borrow from international financial institutions because both the World Bank and the International Financial Fund had advised not to finance the highway project, as the country did not have the necessary funding for such an expensive infrastructure. The country was forced to consult commercial banks, to take loans at higher rates than the market.

Criticisms and concerns about the agreement were reflected in the same way in Kosovo, where the cost of the motorway also increased more than double the initial price from 400 million euros for 102 km to 820 million euros for 77 km, according to an unprecedented report released to BIRN under the law on access to official documents. In addition, the government had to allocate an additional 128 million euros for expropriation of private land.

The trade between Albania and Kosovo has not have the expected increase since the road opening and the highway remains underutilized still today. Experts estimate that the road is only used at 10% of its capacity

5. TRANSPORT IMPACTS AND INFLUENCE ON ASSET MANAGEMENT

This chapter will focus on transport impacts on the Durres-Morine highway in terms of traffic flows, historical traffic data, and how these impacts influence some of the asset management processes such as capacity/demand patterns, future demand, operation and maintenance of the axis.
It will analyse how different factors explained in the previous chapters, such as segmentation of the entire segment, problems among border countries, trade agreements, uncompletion of different sections are negatively impacting the expected outcomes regarding traffic, accidents, toll solutions on the entire segment. The goal of this chapter is to analyse the relationship that exists between strategic planning before construction and traffic loads and asset management processes after construction.

Reports from Egnatia Odos S.A. (EO), with support from Halcrow Group Limited, (January 2012)[63], on actual and forecasted traffic, and 2018 traffic data from Albanian Road Authority (ARA) will be taken in consideration and will be analysed for this purpose.

[63] IFC / Egnatia Odos (2012, January) *Milot to Morine Highway, Albania, Traffic and Revenue Forecasting Report* Document Version 5.0

5.1 Traffic demand, forecasted traffic and analysis of Highway Durres-Morine

The Durres – Morine highway forms part of the Albanian National Roads network, linking the Adriatic port of Durres, with Morine at the Kosovan border. Totalling 170km in length, the Albanian section of the Albania to Kosovo Highway has significantly reduced journey times between Durres and Kosovo by up to 4 hours. In February 2010, the Government of Kosovo announced the construction of the Kosovan part of the route onward from Morine to Pristina. It was finished in November 2013 with the Vërmicë-Pristina segment ending in Gjurgjica at the M9. On future completion of this Kosovan section, onward connection to the Pan-European Corridor X will also be provided. As showed in the previous chapter this axis is segmented in 4 different sections for study purposes, **Durres - Vore**, **Vore - Mamurras**, **Mamurras - Milot**, and **Milot – Morine**.

The Durres – Vore segment of the case study, part of the Albanian State Road 2 (SH2), is a dual carriageway, 22 km long, with a maximum speed limit of 90 Km/h. Being the first four-lane carriageway road built in Albania, during years 1997-2002, it connects Durres to the capital city Tirana. This arteria passes through the Durres-Tirana Region (Durrana), the most industrialized in Albania, which has the highest GDP rate per capita and is the economic center of the country.

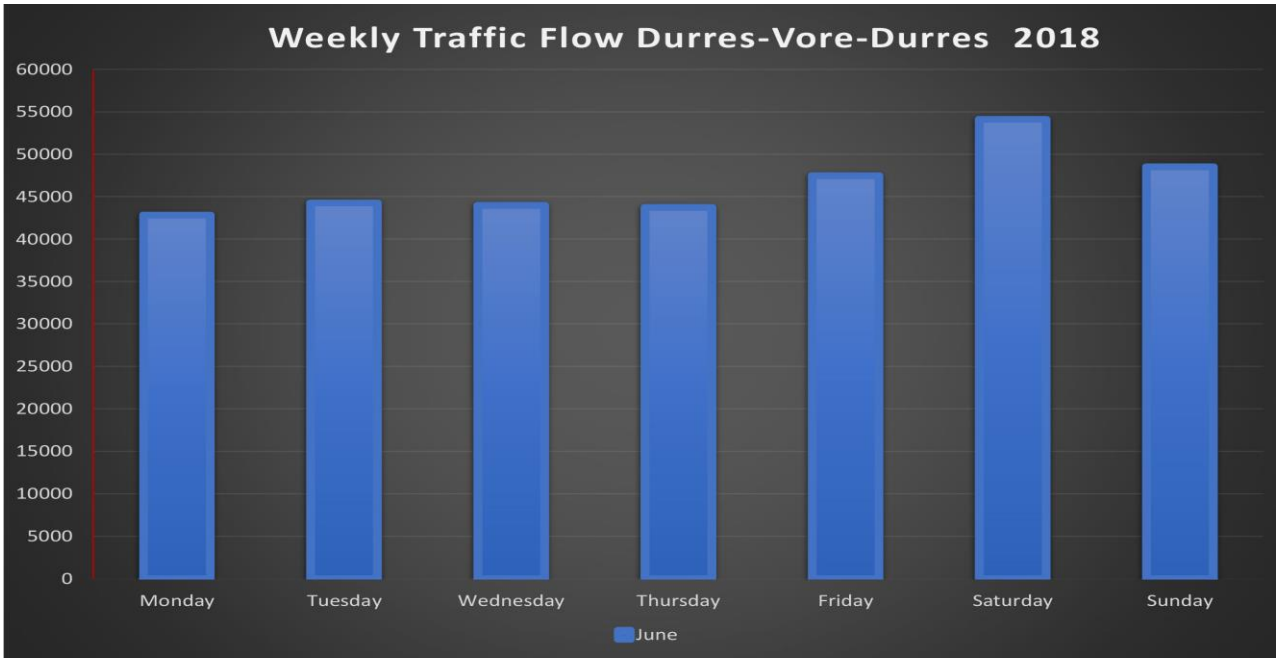
Figure 5.1 and **5.2** show the June 2018, weekly traffic flows of this section in both directions with vehicles classified according their type, car, van, bus, truck, lorry etc. The daily amount of traffic ranges from 42846 vehicles on Monday to 54136 vehicles on Saturday making it the busiest road in Albania.

Figure 5.1 Weekly traffic flows Durres – Vore- Durres, June 2018

ATC Traffic count Durres- Vore - Durres												
	Motor	Car	Car With Trailer	Van	Bus	Truck	Lorry	Lorry With Trailer	Other	Durres Vore	Vore Durres	Total
Monday	64	34332	35	3985	1157	863	658	933	819	21420	21426	42846
Tuesday	64	35721	46	3936	1171	956	686	886	817	22092	22191	44283
Wednesday	63	35020	31	4044	1191	817	509	1493	822	22567	21423	43990
Thursday	66	35074	38	3858	1168	1068	516	1127	836	22205	21546	43751
Friday	70	38544	27	4407	1126	912	622	965	823	24072	23424	47496
Saturday	54	44194	43	4964	1192	824	723	1137	1005	28572	25564	54136
Sunday	167	40066	30	3794	1194	907	709	847	827	22394	26147	48541
Percent (Sunday)	0,34%	89,98%	0,12%	3,36%	1,00%	1,15%	2,20%	0,18%	1,64%			100%

Source: ARA (Albanian Road Authority)

Figure 5.2 Weekly traffic flow Durres – Vore- Durres, June 2018



Source: ARA (Albanian Road Authority

Using the following formulas:

Q(h) = Q x 3600

Q(h) = capacity of a carriageway for 1 hour

Q = u x q

Q - Capacity of a carriageway for the time unit (second)

u – Number of lanes per carriageway

q- capacity of a lane for the time unit (second)

q= VW/ (d1+d2+d3+d4)

V= Maximum speed allowed

W= adjustment coefficient (decreasing if more lanes)

d1= average length of traveling vehicles

d2= distance traveled from the moment the preceding vehicle is spotted to the moment the brake pedal is pushed. d2= vt

d3= distance traveled from the moment the driver starts braking to the moment it stops.

d3= v2/2g(f+i) g= 9.91 m/s2

d4 = security distance

the maximum theoretical capacity of the segment is 750-1000 vehicles/h, per lane, or 4000 vehicles/h in both directions. Considering the section as composed of 2 carriageways of 2 lanes each, the maximum theoretical capacity per 24 hours in both directions would be around 75000-80000 vehicles. With 54136 vehicles/day in both directions, in June and considering that in August the traffic increases by further 20 % reaching its peak, we can deduce that the segment is near its saturation during the peak hours from 8 AM to 17 PM and needs capital investment to add another additional lane for each carriageway in an immediate future.

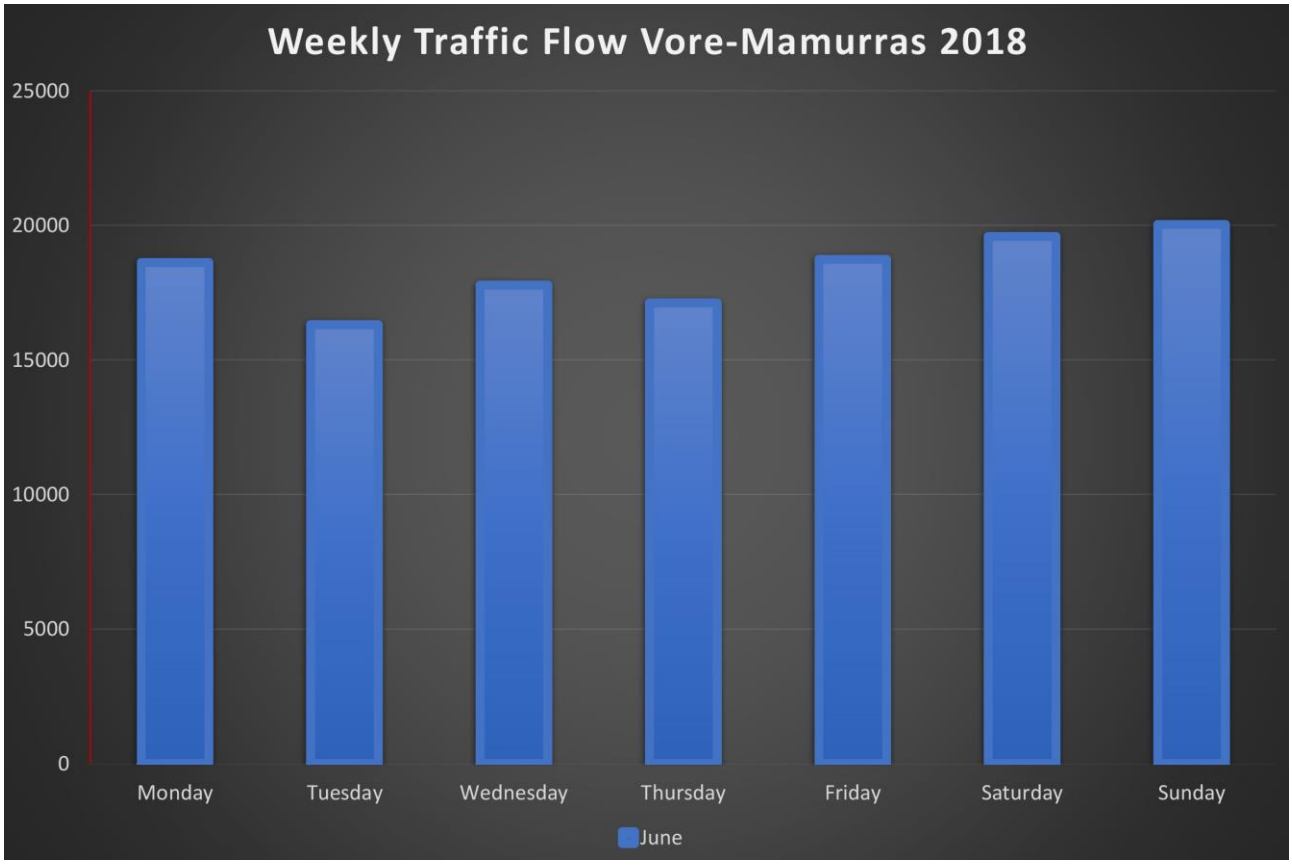
Vore - Mamurras, single carriageway (20 km), is the segment of the Albanian State Road 1 (numbered SH1), which connects Durres to Shkoder, the main city in north Albania, and continues to Montenegro. **Figure 5.3** and **5.4** show the June 2018, weekly traffic flows of this section in both directions with vehicles classified according their type, car, van, bus, truck, lorry etc. The daily amount of traffic ranges from 16317 vehicles on Tuesday to 20041 vehicles on Saturday. Using the above formulas, with a maximum theoretical capacity 750-1000 vehicles/h per lane, this single carriageway segment can bear 40000-45000 vehicles/day in both directions. During the peak hours 8 AM to 17 PM, the segment is utilized at 60-70 % of its capacity.

Figure 5.3 Weekly traffic flows Vore- Mamurras- Vore, June 2018

ATC Traffic count Vore – Mamurras -Vore												
	Motor	Car	Car With Trailer	Van	Bus	Truck	Lorry	Lorry With Trailer	Other	Vor-Fushekruje	Fushekruje-Vore	Total
Monday	31	13802	20	1642	407	459	435	937	897	9241	9389	18630
Tuesday	37	12578	38	1573	403	374	361	629	324	8440	7877	16317
Wednesday	46	12851	28	1851	392	414	345	1091	768	9040	8746	17786
Thursday	30	12486	42	1624	407	442	480	804	813	8495	8633	17128
Friday	24	13937	45	1682	397	436	354	988	885	9629	9119	18748
Saturday	55	14835	41	1720	409	403	400	887	848	10344	9254	19598
Sunday	43	16365	13	971	428	377	383	670	791	9054	10987	20041
Percent (Sunday)	0,21%	81,65%	0,07%	4,85%	2,14%	1,88%	1,91%	3,34%	3,95%			100%

Source: ARA (Albanian Road Authority)

Figure 5.4 Weekly traffic flows Vore- Mamurras- Vore, June 2018



Source: ARA (Albanian Road Authority)

Mamurras - Milot, dual carriageway (13.4 km segment of the Albanian State Road 1 (numbered SH1), which connects Durres to Shkoder, the main city in north Albania, and continues to Montenegro.

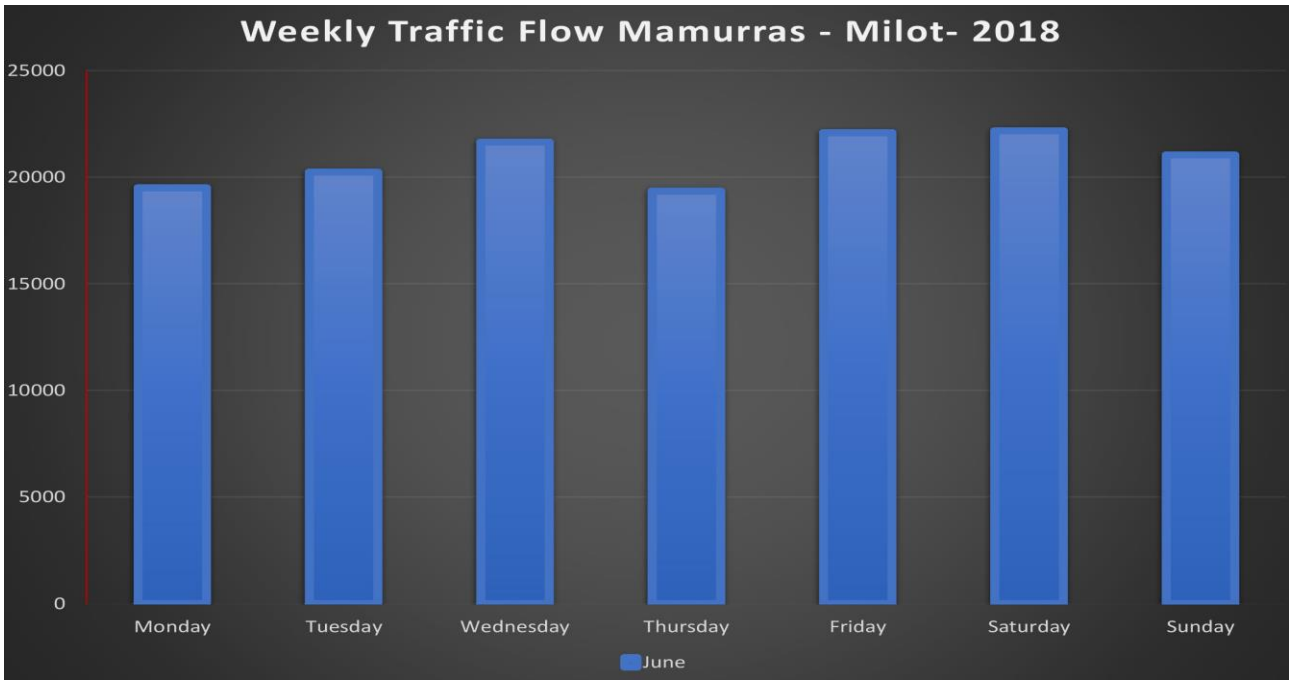
Figure 5.5 Weekly traffic flows Mamurras-Milot-Mamurras, June 2018

ATC Traffic count Mamurras - Milot												
	Motor	Car	Car With Trailer	Van	Bus	Truck	Lorry	Lorry With Trailer	Other	Fushekruje-Milot	Milot-Fushekruje	Total
Monday	67	13687	34	1761	906	785	806	776	684	9825	9681	19506
Tuesday	104	14228	30	1665	971	682	847	814	904	10032	10213	20245
Wednesday	69	15678	30	1973	848	779	786	804	684	11292	10359	21651
Thursday	70	13617	26	1787	872	790	726	789	676	9666	9687	19353
Friday	56	16132	35	1966	897	741	806	781	678	11509	10583	22092
Saturday	78	16921	15	1519	891	666	663	691	739	11032	11151	22183
Sunday	67	16627	14	1146	879	516	493	591	719	10647	10405	21052
Percent (Sunday)	0,32%	78,9%	0,07%	5.44%	4.18%	2.45%	2.34%	2.80%	3.42%			100%

Source: ARA (Albanian Road Authority)

Figure 5.5 and **5.6** show the June 2018, weekly traffic flows of this section in both directions with vehicles classified according their type, car, van, bus, truck, lorry etc. The daily amount of traffic ranges from 19353 vehicles on Thursday to 22183 vehicles on Saturday. Using the above formulas, with a maximum theoretical capacity 750-1000 vehicles/h per lane, this double carriageway segment can bear 75000-80000 vehicles/day in both directions. During the peak hours 8 AM to 17 PM, the segment is utilized at 60-70 % of its capacity.

Figure 5.6 Weekly traffic flows Mamurras-Milot-Mamurras, June 2018



The 114km central section from **Milot to Morine** passes in the towns of Rubik, Rreshen, Reps, Thirra, Kalimash and Kukes. Constructed in stages, this route comprises three sections, built to differing engineering standards:

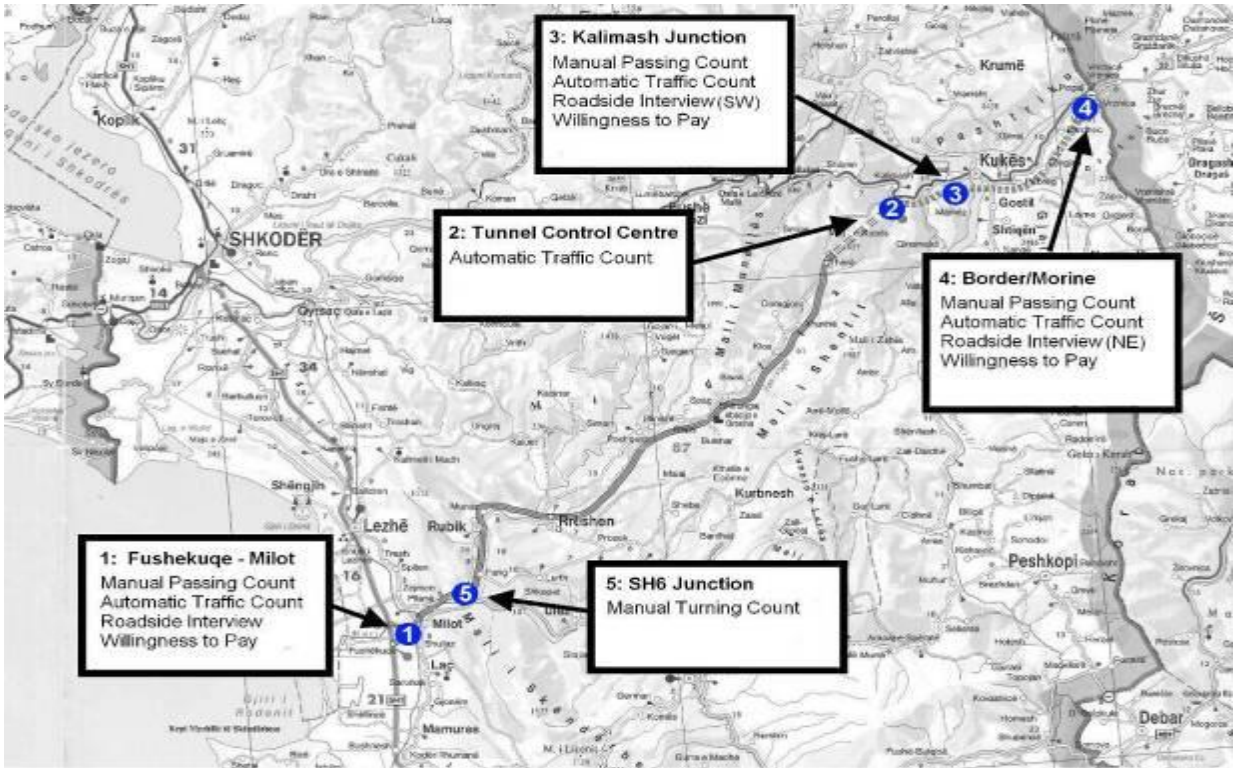
1. Milot to Rreshen section, two-lane single carriageway;
2. Rreshen to Kalimash section four-lane dual carriageway;
3. Kalimash to Morine section a four-lane dual carriageway.

Various traffic surveys have been completed along this route, between 15th and 31st July 2011, by Egnatia Odos S.A. (EO), (January 2012). The various surveys undertaken include the following:

1. traffic volume counts, including automatic traffic counts (ATCs),
2. journey time (JT) surveys.

Figure 5.7 shows the different survey and Count Site Locations for Milot - Morine Section. According to the report of Egnatia Odos S.A. (EO) (January 2012) observed flows on the A1 Rreshen to Kalimash section, four-lane dual carriageway, are low for the capacity provided, typically totalling between 2,000-4,000 vehicles per day; rising to a peak of 6,000 vehicles per day during summer holiday weekends

Figure 5.7 Survey and Count Site Locations



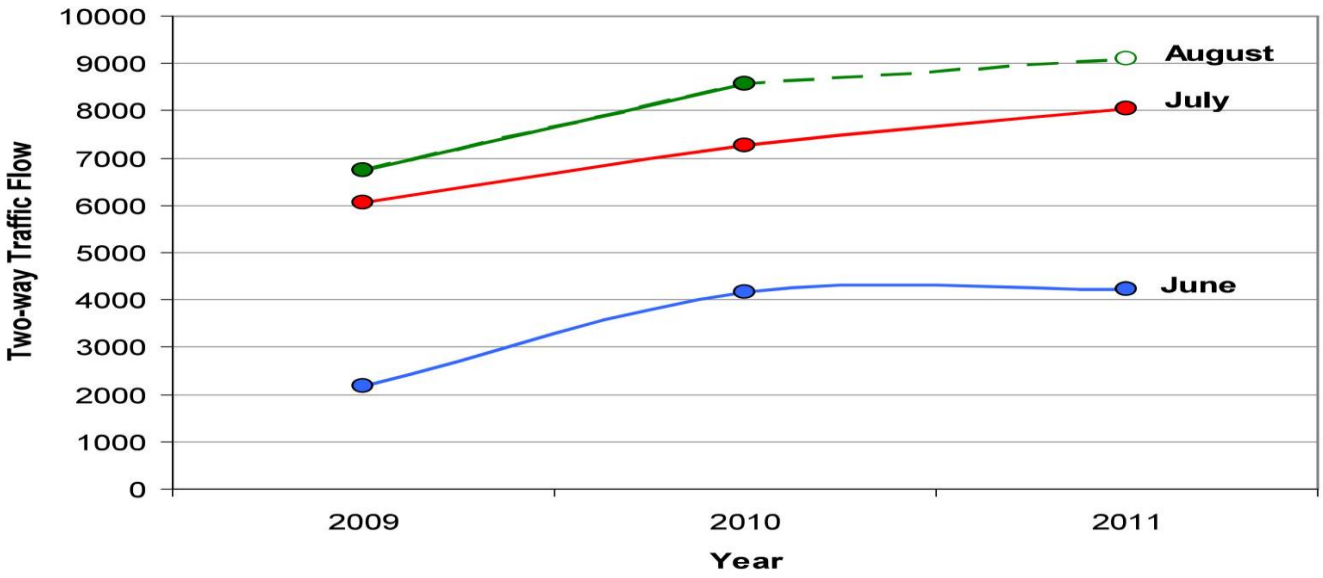
Sources: Egnatia Odos S.A. (EO), (January 2012)

Additional local traffic on the **Milot- Reshen** section, two-lane single carriageway, to the west results, in almost double the number of flows currently being observed as compared to **the Rreshen to Kalimash** section, with peak flows occuring between the SH6 (to Burrel) and the SH1 (west of Milot).

Figure 5.8 below shows the three-year trend in average weekly flow for the months of June, July and August, through the **Thirra Tunnel** on the **Rreshen to Kalimash** section, since its opening in 2009. A clear increase is evident from 2009 to 2011 for June, July and August, with the major increase occurring from 2009 to 2010 due to the surprise effect of highway opening. It is obvious from the chart that the overall traffic flow in June, for the three years taken in consideration, is substantially lower compared to July and August, both summer vacation months for foreigner who

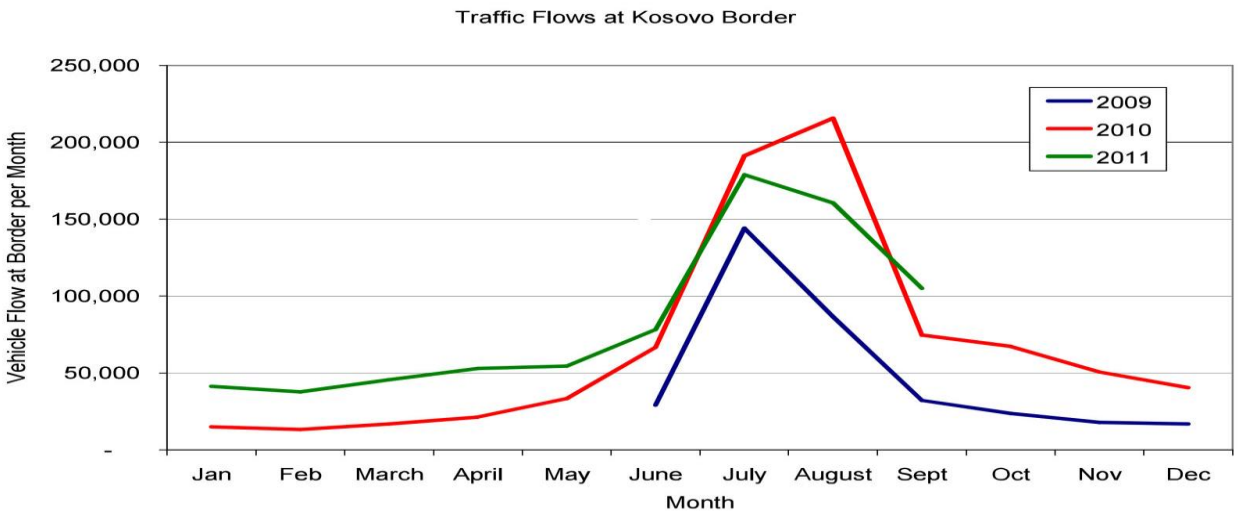
spend their holidays in the Albanian coast. As a result, the segment was used mainly for leisure purposes during these years, not for business and commodity exchanges between countries.

Figure 5.8 Average Weekly Traffic Flow through Thirra Tunnel



Sources: Egnatia Odos S.A. (EO), (January 2012)

Figure 5.9 Monthly Vehicle Flows at Border



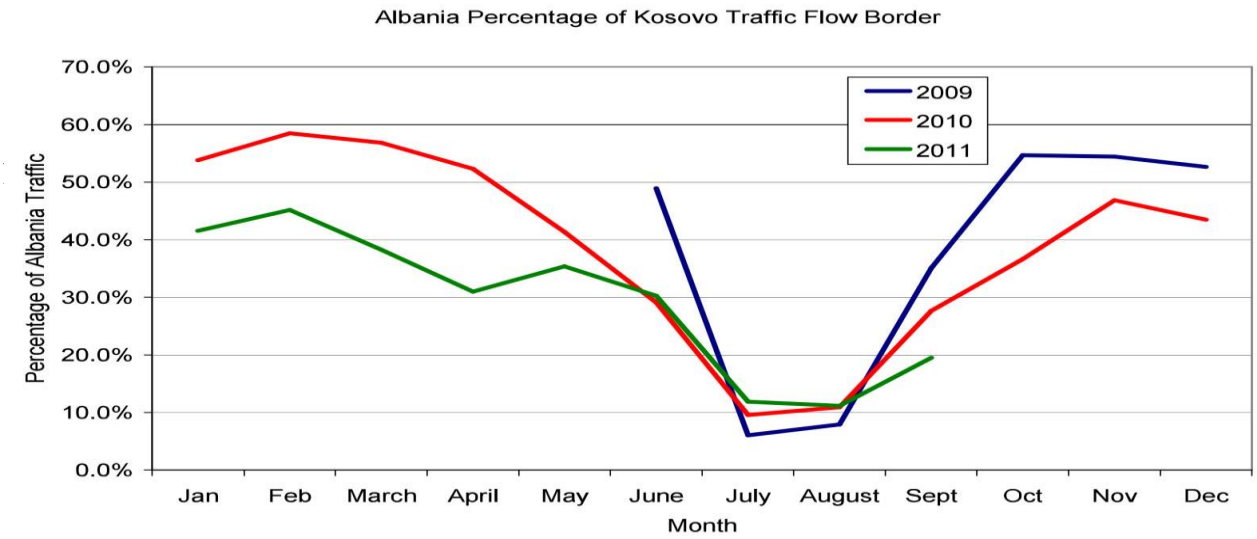
Sources: Egnatia Odos S.A. (EO), (January 2012).

This assumption is reinforced by looking at the above **Figure 5.9** which displays the traffic flow data 2009 to 2011, at the Morine border. The chart demonstrates an overall increase in the average number of vehicles crossing the border, during these years, although flows in July and August 2011 are below the corresponding monthly flows for 2010. Substantial difference, almost four times increase in flows is evident when comparing July and August with the other months of the year.

This difference reaches its peak in 2010, where the number of vehicles travelling in February 2010, is 10 times lower compared to August 2010. Although the non-holiday months appear to show growth, remains the fact that the main purpose of the journeys was to reach Albanian Coast for holidays.

The following **Figure 5.10** shows a split of Albanian and non-Albanian vehicles which reinforces the assumptions that the road was used mainly during vacation in Albania, by foreigners. For the non-holiday months, the split is typically between 40% and 60%, while for holiday months Albanian trips fall to between 7% and 12%, with almost 90 % of foreign vehicles entering Albania.

Figure 5.10 Split of Albanian Vehicles at Border



Sources: Egnatia Odos S.A. (EO), (January 2012).

Figure 5.11 shows the traffic flows, completed between Wednesday 15 and Sunday 19 June 2011, in four ATC Survey Locations, Milot, Thirra Tunnel, Kalimash and Kosovo Border, Eastbound to Kosovo and Westbound to Durres. Comparing the 12-hour traffic flows in the four different locations taken in consideration, the flows at Kosovo Border are the lowest among the four locations, 6,024 eastbound and 7,082 westbound respectively. Considering that the highway at this location is four-lane dual carriageway, with a capacity of around 2000 one-hour vehicles each direction, we can conclude that section is underutilized. Although the table shows an increase in the numbers of the vehicles which travel at Kalimash and Thirra Tunnel survey locations during 12-hours, the segment remains underutilized in these locations, too. The Milot survey located in the Milot to Rreshen section, two-lane single carriageway, counts almost twice the amount of traffic of the other survey locations, 12,507 eastbound and 13,495 westbound. The most utilized section of the Milot- Morine border segment is still to be completed, meaning that the traffic demand, levels of

service and external factors explained in the previous chapters were not taken in consideration during the planification phase and the allocation of funds was inappropriate.

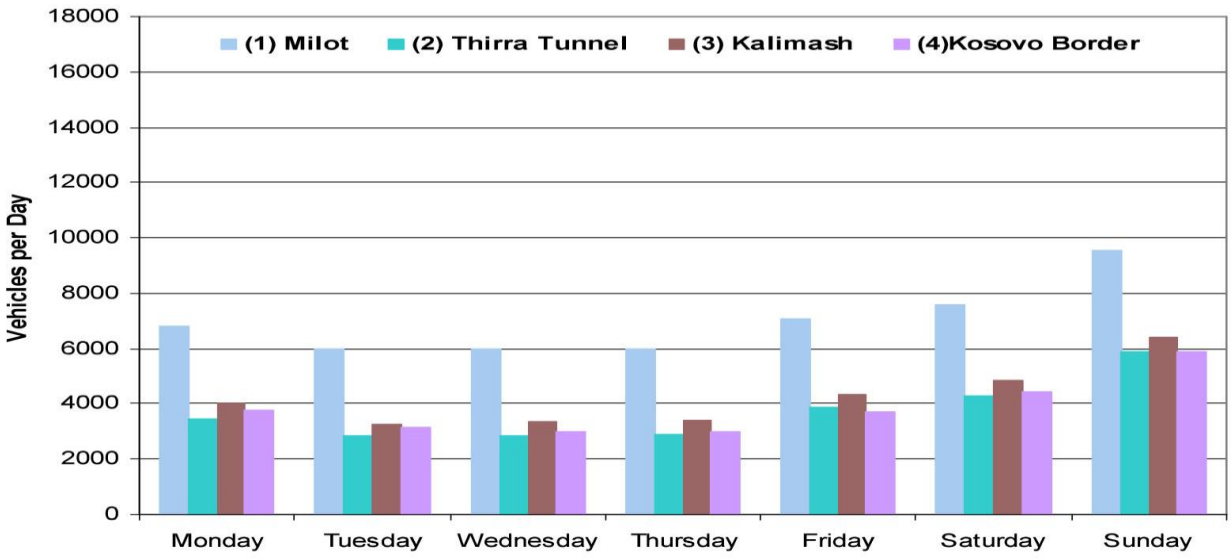
Figure 5.11 12-hour ATC traffic flows in June 2011.

Survey Location	ATC Traffic Flows	
	Eastbound	Westbound
(1) Milot	12,507	13,495
(2) Thirra Tunnel	6,703	7,077
(3) Kalimash	7,098	8,010
(4) Kosovo Border	6,024	7,082

Sources: Egnatia Odos S.A. (EO), (January 2012).

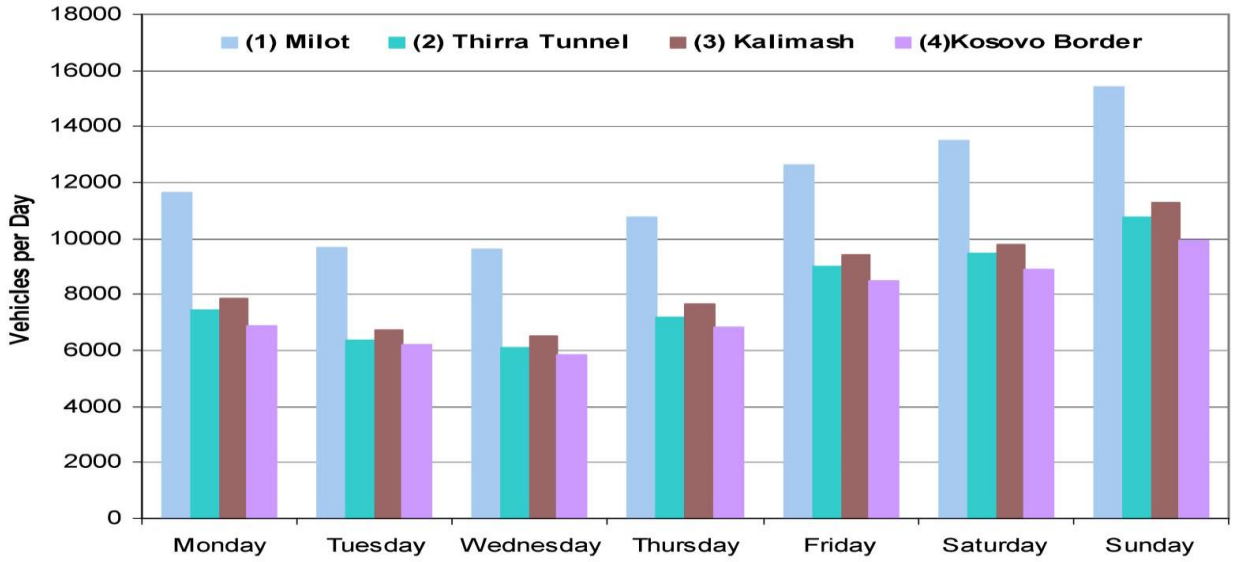
The total daily traffic flows recorded at each ATC site during the June 2011 are shown in **Figure 5.12.** Comparable daily traffic flows recorded at each ATC site during July 2011 are shown in **Figure 5.13**. Similar trends in traffic flows, as those in **Figure 5.11** during the 12-hour survey, are observed in both survey periods, with the Milot site experiencing highest traffic flows in both June and July, with volumes at all sites increasing throughout the week and over the weekend. A comparison of traffic flows in June with July shows an increase of 80% during July month throughout each day of the week, reinforcing the assumption that the main purpose of the axis during July is for leisure and summer vacation. This hypothesis is endorsed by the traffic flows on weekend, Saturday and Sunday.

Figure 5.12 Total Daily Traffic Flows Observed through ATCs in June 2011



Sources: Egnatia Odos S.A. (EO), (January 2012)

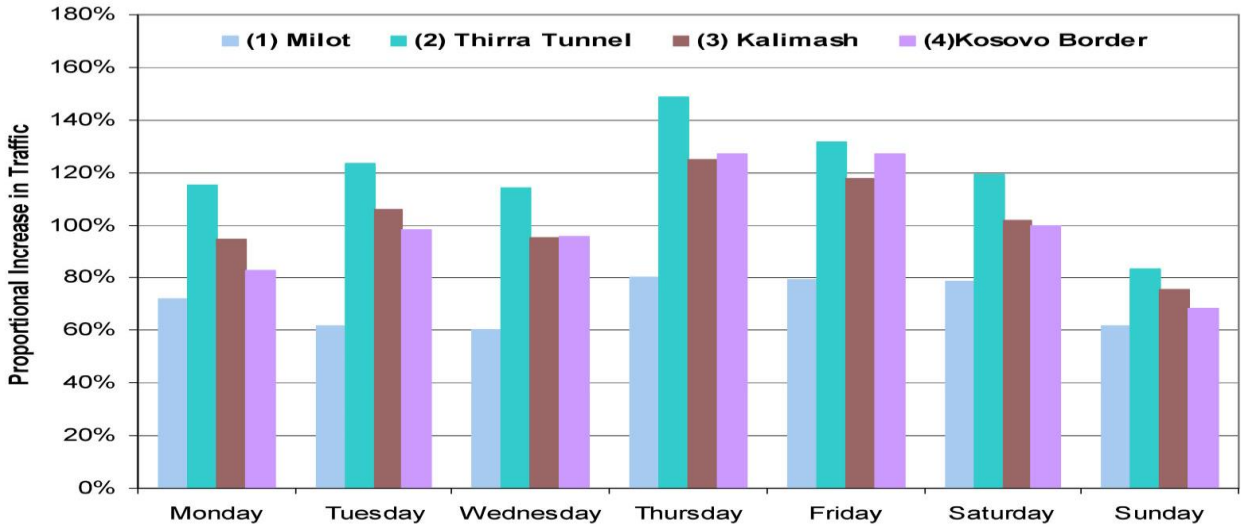
Figure 5.13 Total Daily Traffic Flows Observed through ATCs in July 2011



Sources: Egnatia Odos S.A. (EO), (January 2012).

Daily variations in this proportional increase are shown between each survey site in **Figure 5.14**. The greatest proportional increase in traffic occurs at the Thirra Tunnel, with average weekly flows observed in July amounting to a 120 % increase on June levels. A similar comparison of average weekly flow increases at other sites indicates a doubling of traffic at Kalimash and the Kosovo Kosovo. Whilst average weekly flow increases between June and July amount to a smaller 71% at Milot, the higher initial traffic flows observed at the site in June result in an absolute increase in traffic greater than at the remaining survey locations. Absolute increases and their corresponding absolute values are shown for each site in **Figure 5.15.**

Figure 5.14 Proportional Increases in Daily Traffic by Site (June-July 2011)



Sources: Egnatia Odos S.A. (EO), (January 2012).

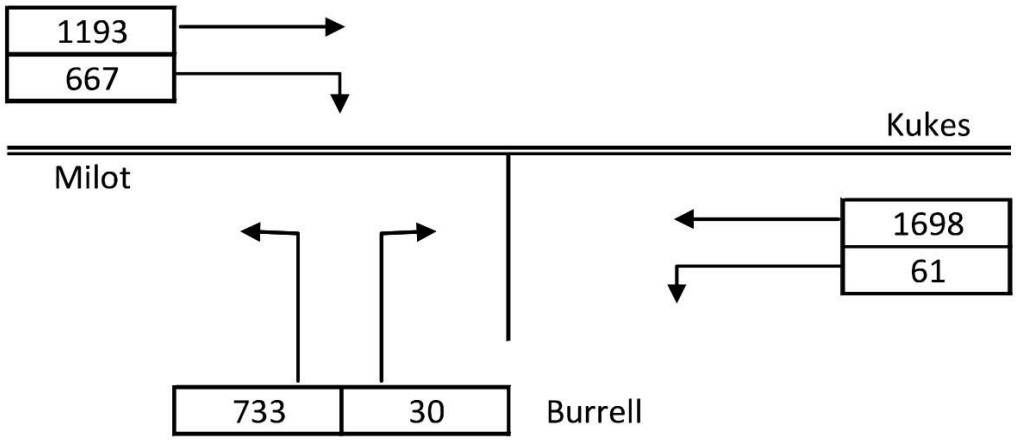
Figure 5.15 Absolute Increase in Total Weekly Traffic by Site (June-July 2011)

Survey Site	June 2011	July 2011	Increase	% Increase
(1) Milot	48,873	83,275	34,402	71%
(2) Thirra Tunnel	26,096	56,290	30,194	119%
(3) Kalimash	29,647	59,248	29,601	102%
(4) Kosovan Border	26,952	53,025	26,073	100%

Sources: Egnatia Odos S.A. (EO), (January 2012).

Figure 5.16 shows the 12-hour Average Numbers of the vehicles driving through the SH6 junction, a secondary road connecting the Milot- Rreshen section of the highway to Burrel. The number of vehicles entering and exiting the SH6 junction from westbound Milot is around 55 % of the total number of vehicles proceeding to Kukes, 700 out of 1193, while the number of vehicles entering SH6 Junction from Eastbound, Kukes, is around 2%, 50 out of 1698. The difference in percentage shows that the majority of the cars travelling to and from the remote region of Burrel are headed to Durres or Tirana, using, the two-lane single carriageway section, Milot- Rreshen, with only 2% using the four-lane dual carriageway section, Rreshen to Morine border. The shorter distance between SH6 junction to Durres and Tirana compared with the distance from the Kosovo Border influence these numbers. However, such a small percentage eastbound from a secondary road, suggests that highway is used mainly by vehicles to and from Durres headed to Morine border, other than the poor north-eastern regions of Albania such as Mirdite region (Burrel).

Figure 5.16 12 Hour Average Traffic Movements through the SH6 Junction



Sources: Egnatia Odos S.A. (EO), (January 2012).

The following **Figure 5.17** provided by GRD (General Road Directory), shows traffic growth to range from 4.4% to 9.4% per annum, for years 2007 to 2010. It shows the annual rates for counts at low flow (less than 10,000 AADT), high flow (10,000 or more AADT), and count sites in the Milot – Morine highway corridor. As we can see the major traffic growth, per year is observed on high flow routes such as the SH1, between Tirana, Durres and Shkoder, with 4.6% growth from 2007 to 2008 and 13% growth from 2008 to 2009, while the low flow routes such as highway Milot-Morine experience minor traffic growth, with 4.9% from 2007 to 2008 and 6.1% from 2008 to 2009. A minor increase in percentage, in traffic flows is experienced from 2009 to 2010, compared to 2008 to 2009. The major public investments in road construction and maintenance should have been allocated at SH1 route between Durres-Shkoder, which comprises the Vore- Milot segment which has an AADT of 17000-20000 vehicles and experiences a higher traffic growth instead of highway Milot-Morine, a low flow route, where the bulk of public investments occurred.

Figure 5.17 Traffic Growth from GRD Counts

Flow	Statistic	2007 to 08	2008 to 09	2009 to 10
All Sites	Annual Growth	4.4%	9.4%	9.4%
	No of Counts	16	17	20
Low Flow	Annual Growth	4.9%	6.1%	6.0%
	No of Counts	9	12	13
High Flow	Annual Growth	4.1%	13.0%	12.4%
	No of Counts	7	5	7
Corridor	Annual Growth	5.7%	8.0%	10.1%
	No of Counts	5	7	10

Sources: GDR (General Road Directory) Albania, January 2014

Figure 5.18 Forecasted Car/ Bus and Truck Traffic Growth in Albania

Time Period	Car Traffic Growth		Bus and truck Traffic Growth		External Tips
	Albania	Kosovo	Albania	Kosovo	
2011-2016	5.5%	4.4%	4.1%	4.7%	7.2%
2016-2021	6.5%	4.8%	4.4%	4.4%	7.2%
2021-2026	6.9%	4.8%	4.4%	4.4%	5.8%
2026-2031	6.6%	4.4%	4.4%	4.4%	5.8%
2031-2036	5.3%	3.8%	4.4%	4.4%	4.1%
2036-2041	3.2%	2.1%	4.4%	4.4%	4.1%
2041-2046	1,6%	1.1%	4.4%	4.4%	2.3%
2046-2051	0,5%	0.6%	4.4%	4.4%	2.3%
Additional Universal Factors	1.500 annual Trade and Tourism factor applied to Durres, Tirana and Kosovo zones up to 2030, 1.250 thereafter. • Elasticity value of -1.0 to predict the level of generated traffic in the base case.				

Sources: GDR (General Road Directory) Albania, January 2014

Analysing the Forecasted Car/ Bus and Truck Traffic Growth in Albania **(Figure 5.18),** and assuming that the same traffic growth will be experienced at the segment Milot-Morine border, it will take 20 years for this axis to reach a reasonable AADT, in order to be effective, maintainable and not underutilized, with an AADT of 7500 vehicles in each direction.

The previous traffic analysis was based on data recovered from ATC during the years 2009 to 2011 and traffic surveys completed by Egnatia Odos S.A. (EO), (January 2012). The following analysis will be based on traffic data provided by ARA (Albanian Road Authority) during June, July and August of 2018. The analysis will help to understand the traffic trends on the section Milot-Morine during 2018 and the comparison with the previous data completed by Egnatia Odos S.A. (EO) will help to understand the traffic trends from 2009 to 2018. It will show the correlation of strategic planning before construction with the asset management processes during the life-cycle after construction and how the poor strategic planning from the government of a developing country is negatively influencing the possible scenarios of asset management.

Figure 5.19 and **5.20** shows the June 2018, weekly traffic flows of this section in both directions with vehicles classified according their type, car, van, bus, truck, lorry etc. The daily amount of traffic ranges from 3487 vehicles on Tuesday to 5242 vehicles on Sunday. Using the above formulas, with a maximum theoretical capacity 750-1000 vehicles/h per lane, this double carriageway segment can bear 75000-80000 vehicles/day in both directions.

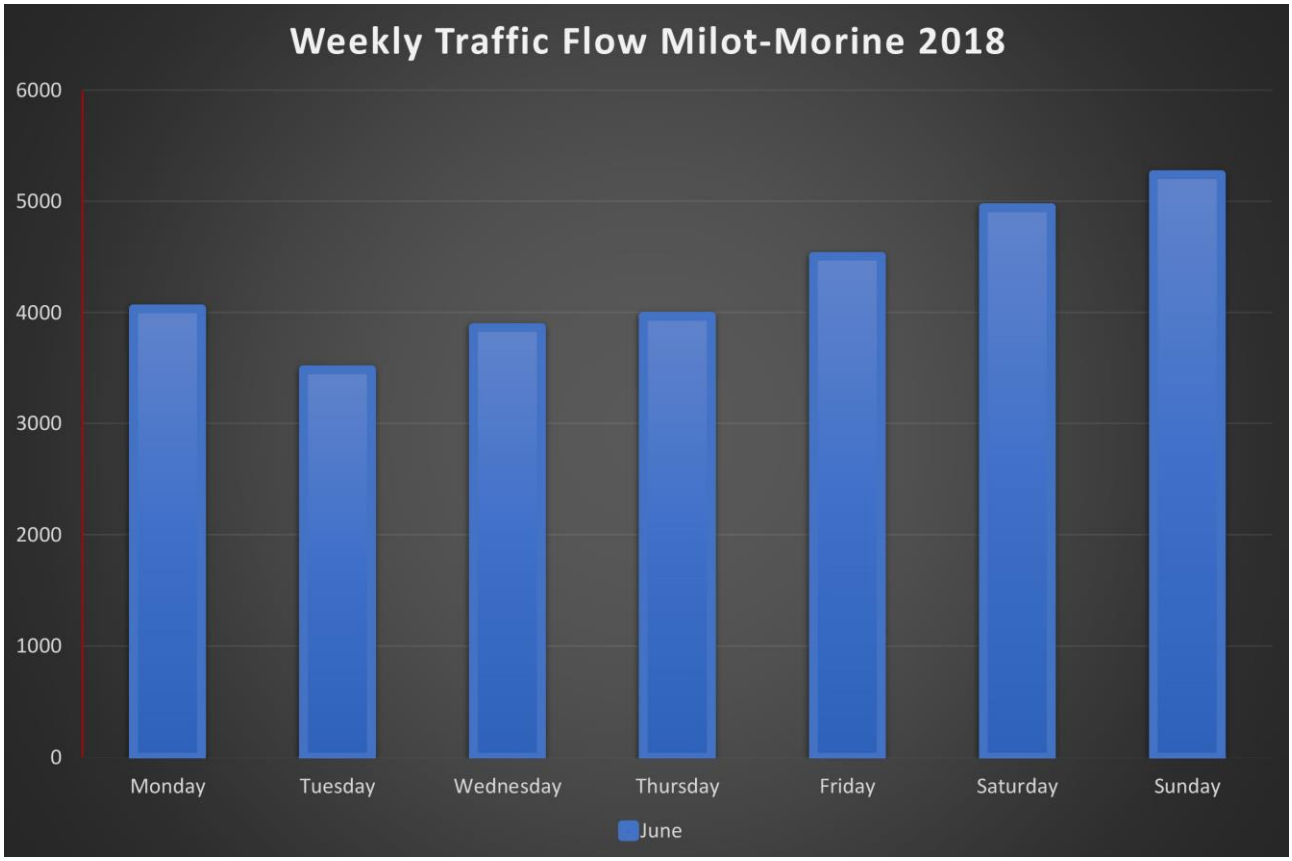
Figure 5.19 Weekly traffic flows Milot - Morine -Milot, June 2018

ATC Traffic count Milot-Morine-Milot												
	Motor	Car	Car With Trailer	Van	Bus	Truck	Lorry	Lorry With Trailer	Other	Milot-Morine	Morine-Milot	Total
Monday	20	2509	56	422	136	77	62	455	297	2163	1871	4034
Tuesday	12	2196	4	408	126	82	39	404	216	1769	1718	3487
Wednesday	17	2378	15	409	139	147	51	405	305	1922	1944	3866
Thursday	20	2392	59	445	131	61	48	485	327	1983	1985	3968
Friday	20	2814	78	577	209	62	49	379	319	2203	2304	4507
Saturday	17	3261	74	509	145	72	39	471	357	2506	2439	4945
Sunday	25	3576	59	402	163	88	210	387	332	2951	2291	5242
Percent (Sunday)	0,48%	68,21%	1,12%	7,67%	3,1%	1,68%	4,00%	7,38	6,33%			100%

Sources: ARA (Albanian Road Authority)

Instead after almost 9 years after its construction, the segment has an AWDT (Average Weekly Daily Traffic) in June of around 4300 vehicles, which means that the 1 billion $ segment is utilized at only 10 % of its capacity after 9 years. The max traffic load during peak hours, in June is around 300 vehicles/h, making it the most underutilized segment of the case study, where the bulk of governmental investments were allocated.

Figure 5.20 Weekly traffic flows Milot - Morine -Milot, June 2018



Sources: ARA (Albanian Road Authority)

The trend observed form Egnatia Odos S.A. (EO) reports where the overall traffic flow in the weekends was substantially higher than the traffic flow during weekdays, is still is visible in **Figure 5.20.**

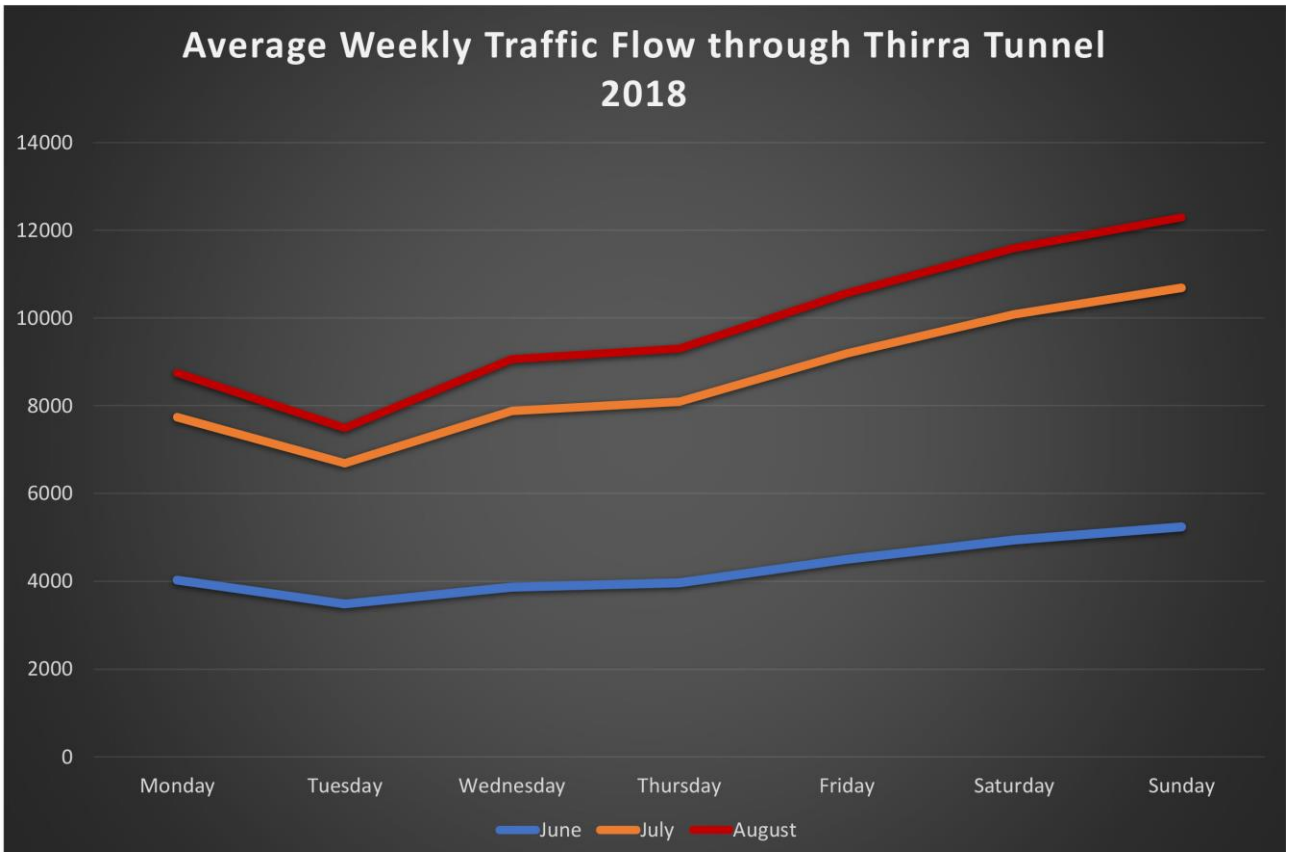
Figure 5.21 and **5.22** below show the average weekly flow for the months of June, July and August, through the **Thirra Tunnel** on the **Rreshen to Kalimash** section at 2018. It is obvious from the figures that the overall weekly traffic flow in June is substantially lower compared to July and August, both summer vacation months for foreigner who spend their holidays in the Albanian coast.

Figure 5.21 Weekly Traffic Flow through Thirra Tunnel, 2018

ATC Traffic count Milot-Morine-Milot 2018							
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
June	4034	3487	3866	3968	4507	4945	5242
July	7746	6694	7886	8094	9193	10087	10693
August	8752	7497	9068	9308	10571	11600	12296

Sources: ARA (Albanian Road Authority)

Figure 5.22 Weekly Traffic Flow through Thirra Tunnel, 2018



Sources: ARA (Albanian Road Authority)

This is the same trend observed at charts provided by Egnatia Odos S.A. (EO) reports during years 2009-2011 which suggests that after 9 years from the construction the segment in 2018, is still utilized mainly for leisure purposes not for business and commodity exchanges between countries. Further analysis shows a substantial increase in July and August during weekends while in June the weekends experience a minor increase.

Figure 5.23 and **5.24** show a comparison of the Egnatia Odos S.A. (EO) reports during years 2009-2011 with data from ARA (Albania Road Authority) of 2018. The comparison of these data present

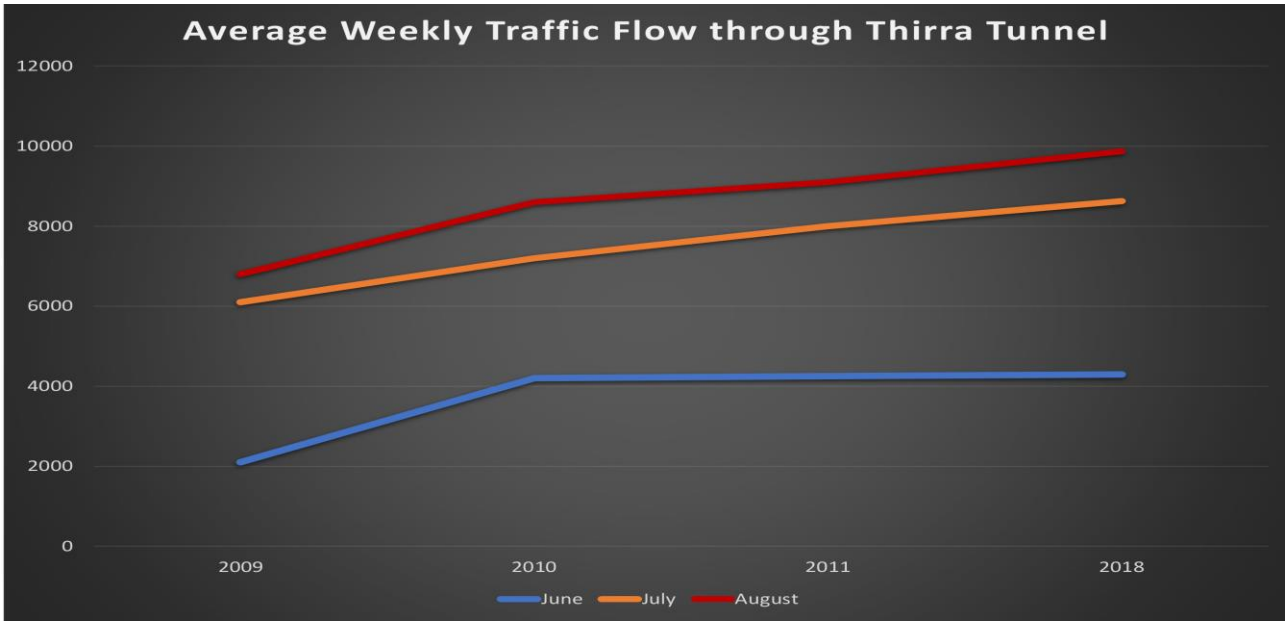
a worrying trend and a very problematic situation of traffic flows which is negatively influencing the overall processes of the management of this segment and forcing the Albanian Government to divert millions of dollars each year as a subsidy to the private concessionary to maintain and operate the segment. As it can be observed from the chart, for the month of June, the substantial increase in average daily traffic flows occurred from 2009 to 2010. In this period of time the average daily traffic almost doubled from 2200 vehicles to 4045, due to the surprising effect of the opening of the segment. After that, from 2010 to 2018 the average daily traffic flows increased overall 5.75% from 4045 to 4292 vehicles, showing that after 9 years from the construction this segment is not meeting the initial expectations right after the construction of the highway and is not contributing in the economic growth of Albania and Kosovo.

Figure 5.23 Average daily Traffic Flows through Thirra Tunnel, June, July, August 2009-2018

Average Weekly Traffic Flow through Thirra Tunnel				
	2009	2010	2011	2018
June	2200	4045	4100	4292
July	6050	7200	8059	8628
August	6800	8700	9010	9870

Sources: ARA (Albanian Road Authority), Egnatia Odos S.A.

Figure 5.24 Average daily Traffic Flows through Thirra Tunnel, June, July, August 2009-2018



Sources: ARA (Albanian Road Authority), Egnatia Odos S.A.

The substantial difference in July and August average daily traffic flows of compared to June, suggests that this segment is still utilized mainly for leisure purpose during vacation months. This trend was observed during the period of 2009-2011and is still present in 2018. The major traffic flows increase during these years occurred in July from 6050 vehicles/day to 8628 vehicles/day and August, from 6800 vehicles/day to 9870 vehicles/day suggesting that more tourist are travelling during July and August towards Albania from Kosovo, and apart from that the segment is still utilized at 10 % of the capacity.

Egnatia Odos S.A. (EO), (January 2012) forecasted the traffic growth for Milot-Morine section until 2051 taking into account factors such as GDP PPP per Capita and global Car Ownership growth, regional population growth forecasts to provide regional weighting, National GDP Growth rates Forecasted low, central and high scenarios for Milot-Morine where made**. Figure 5.25** shows the forecasted factors to be applied until 2051

Figure 5.25 Annual Growth Rates (per Annum)

Time Period	Car Traffic Growth			Bus/Truck Traffic Growth		
	Albania	Kosovo	Other	Albania	Kosovo	Other
2011-2016	5.9%	4.3%	10.9%	5.2%	5.1%	10.7%
2016-2021	6.3%	4.8%	9.4%	5.3%	4.8%	11.2%
2021-2026	6.5%	4.7%	7.8%	5.0%	4.3%	9.3%
2026-2031	6.6%	4.6%	7.6%	4.9%	4.2%	9.2%
2031-2036	6.0%	4.0%	5.1%	4.5%	3.6%	7.1%
2036-2041	5.5%	3.5%	5.0%	4.5%	3.5%	7.0%
2041-2046	4.9%	3.0%	3.0%	4.6%	3.4%	5.0%
2046-2051	4.1%	2.3%	3.0%	4.6%	3.3%	5.0%

Sources: Egnatia Odos S.A. (EO), (January 2012).

Within the high forecast scenario, **(Figure 5.26)** GDP and GDP PPP per Capita growth rates have been increased by 25% from the Central scenario. External trip factors have been increased by 20% from the Central scenario throughout the concession period with all other variables remaining constant.

The Low forecast scenario **(Figure 5.27)** has been developed to taking into account the uncertainty associated with the completion date of the connecting motorway in Kosovo between Morine and Pristina. Within the Low forecast Scenario, GDP and GDP PPP per Capita growth rates have been

reduced by 25% from the Central scenario. External trip factors have been reduced by 20% from the Central scenario throughout the concession period with all other variables remaining constant.

Figure 5.26 High Scenario Annual Growth Rates (per Annum)

Table 5.6 High Scenario Annual Growth Rates (per annum)

Time Period	Car Traffic Growth			Bus/Truck Traffic Growth		
	Albania	Kosovo	Other	Albania	Kosovo	Other
2011-2016	7.0%	5.4%	12.0%	6.1%	6.2%	12.3%
2016-2021	7.9%	6.1%	10.4%	6.3%	5.9%	12.8%
2021-2026	8.1%	5.8%	8.7%	5.8%	5.2%	10.7%
2026-2031	7.8%	5.5%	8.5%	5.8%	5.1%	10.6%
2031-2036	6.4%	4.3%	5.8%	5.2%	4.3%	8.3%
2036-2041	5.1%	3.2%	5.7%	5.3%	4.2%	8.2%
2041-2046	3.8%	2.2%	3.4%	5.3%	4.2%	5.9%
2046-2051	2.7%	1.2%	3.4%	5.4%	4.1%	5.8%

Sources: Egnatia Odos S.A. (EO), (January 2012).

Figure 5.27 Low Scenario Annual Growth Rates (per Annum)

Time Period	Car Traffic Growth			Bus/Truck Traffic Growth		
	Albania	Kosovo	Other	Albania	Kosovo	Other
2011-2016	4.9%	3.3%	9.7%	4.2%	3.9%	9.0%
2016-2021	4.9%	3.7%	8.2%	4.3%	3.8%	9.4%
2021-2026	5.0%	3.5%	6.8%	4.1%	3.4%	7.9%
2026-2031	5.1%	3.5%	6.7%	4.0%	3.3%	7.7%
2031-2036	4.9%	3.2%	4.4%	3.7%	2.8%	6.0%
2036-2041	4.8%	3.0%	4.3%	3.7%	2.7%	5.9%
2041-2046	4.8%	2.8%	2.6%	3.8%	2.6%	4.2%
2046-2051	4.6%	2.6%	2.6%	3.8%	2.5%	4.1%

Sources: Egnatia Odos S.A. (EO), (January 2012).

The overall trip matrix totals for each of the forecast years and growth scenarios are provided in **Figure 5.28.**

Figure 5.28 Matrix Totals for Forecast Years

Year	Growth Scenario	June Weekday	June Weekend	July Weekday	July Weekend	Net Growth
2011	**Base**	4,478	5,331	6,983	10,553	**0%**
2021	**Low**	7,008	8,310	11,143	11,143	**58%**
	Central	7,837	9,294	12,478	12,478	**77%**
	High	8,792	10,429	14,011	14,011	**99%**
2041	**Low**	16,813	19,948	27,459	27,459	**282%**
	Central	23,070	27,352	37,784	37,784	**424%**
	High	29,521	34,897	48,362	48,362	**569%**

Sources: Egnatia Odos S.A. (EO), (January 2012).

As can be observed in low scenario forecasted by Egnatia Odos S.A., the traffic flow in June is 7008 vehicles/day in weekday and 8310 vehicles/day in weekends. The traffic flow in July is 11143 vehicles/day in weekday and 11143 vehicles/day in weekends. Comparing these forecasted scenarios with the previous analysed data from ARA (Albanian Road Authority) for 2018, where the real traffic flow in June is 3972 vehicles/day in weekday and 5093 vehicles/day in weekends, and in July is 7922 vehicles/day in weekday and 10390 vehicles/day in weekends, questions arise.

Why the traffic is not increasing in Route 7?

The previous chapters tried to describe the factors that influence such an outcome. The factors that mostly influence the traffic outcome in this segment are others. The uncompletion of Prishtine-Nish segment within Serbia which would have connected the entire Route 7 with Pan-European corridor 10 is a major factor. After 10 years from its construction the entire Route 7 remains uncompleted with only the Albanian and Kosovar segments constructed. The entire Route 7, as explained in the previous chapters, was supposed to become the main route to connect port of Durres in Albania with Pan-European 10 Corridor in Serbia. The uncompletion of the Serbian segment makes impossible the traffic growth in the remaining 2 segments, where poor developing countries such as Albania and Kosovo cannot meet the demand for traffic. This situation is reflected in the outsourcing of the Albanian segment to the private concessionary, where Albanian government,

after 10 years, is still obliged to divert 5 million $ a year from other public projects to subsidy the concessionary for its management.

Another factor not taken in consideration when forecasting the future scenarios is the past tensioned social and political situation of the 3 countries connected by the highway. A **historical overview** back to the constitution of the Socialist Federalist Republic of Yugoslavia is needed to explain tensions among the western Balkan countries. Serbia and Kosovo are still in process of normalizing relations between them in the present days. The major problem is Serbian unwillingness to recognize the independence of Kosovo. An almost constant air of tension and instability remains, especially in the northern part of Kosovo, where Serbian minorities have received promises of protection from Serbian authorities. The Serbian and Kosovar governments are still discussing an exchange of territories in 2018. This situation of tension, coupled with the production systems of Albania which is oriented towards western Europe as compared to the production systems of Kosovo which was oriented toward Serbia, make it impossible for the AADT to increase with an acceptable rate. This situation impedes regional cooperation, European integration processes and economic cooperation - particularly in the field of small and medium enterprises, the IT sector and science, youth cooperation, the rule of law, the fight corruption, terrorism, extremism, radicalism, and migration issues. Obviously, these are of vital to long-term stability and generally understood as a possible catalyst for reconciliation, political dialogue and for creating the wright environment for the implementation of infrastructure asset management processes.

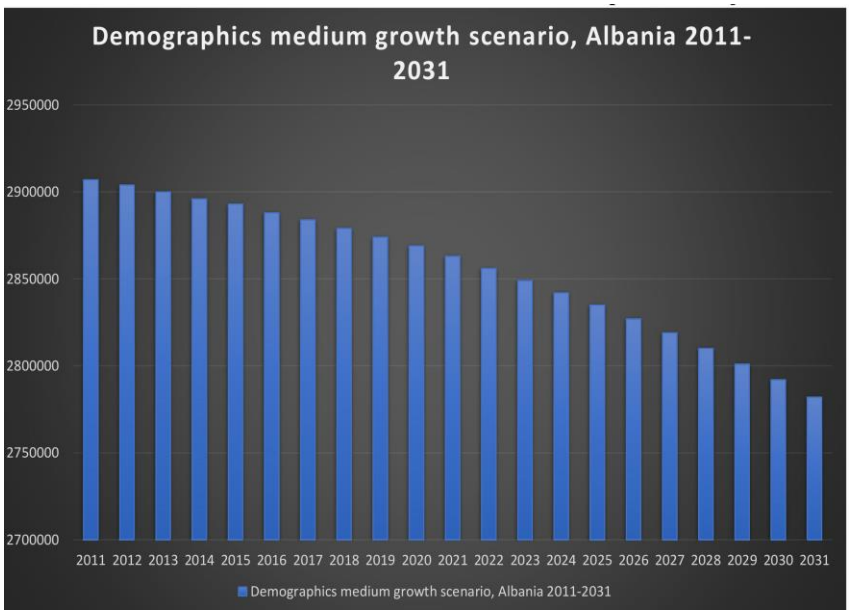
Figure 5.29 tries to explain another factor not forecasted accurately by Egnatia Odos S.A when trying the calculate the low, medium and high traffic growth scenarios for the future. The comparison of what was predicted from Egnatia Odos S.A and what is actual shows a completely different picture. Instead of growing by a rate of 0.7-0.9% annually, Albanian population is decreasing and is predicted to fall below 2.79 million people in 2031. This is due to the high emigration rate and low birth rate combined with the economical poor condition, corruption and political stability.

When the segment was built in 2009 the Government of a Developing country, such as Albania did not take in consideration these factors and decided to make such a major capital investment, regardless of the factors mentioned above, which could influence negatively the traffic flows in the future.

Figure 5.29 Demographics growth scenario forecasted by Egnatia Odos S.A and real growth demographic scenario by ISTAT (Albanian institute of statistics)

Period	Albania	Kosovo
2001-2006	1.2%	-
2006-2011	1.1%	-
2011-2016	0.9%	0.6%
2016-2021	0.7%	0.7%
2021-2026	0.8%	0.8%
2026-2031	0.8%	0.7%
2031-2036	0.8%	0.6%
2036-2041	0.8%	0.5%
2041-2046	0.8%	0.4%
2046-2051	0.8%	0.3%

Source: Egnatia Odos S.A



Source: ISTAT (Albanian institute of statistics)

Demographics medium growth scenario, Albania 2011-2021										
2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
2,907,000	2,904,000	2,900,000	2,896,000	2,893,000	2,888,000	2,884,000	2,879,000	2,874,000	2,869,000	2,863,000
Demographics medium growth scenario, Albania 2022-2031										
2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
2,856,000	2,849,000	2,842,000	2,835,000	2,827,000	2,819,000	2,810,000	2,801,000	2,792,000	2,782,000	

Source: ISTAT (Albanian institute of statistics)

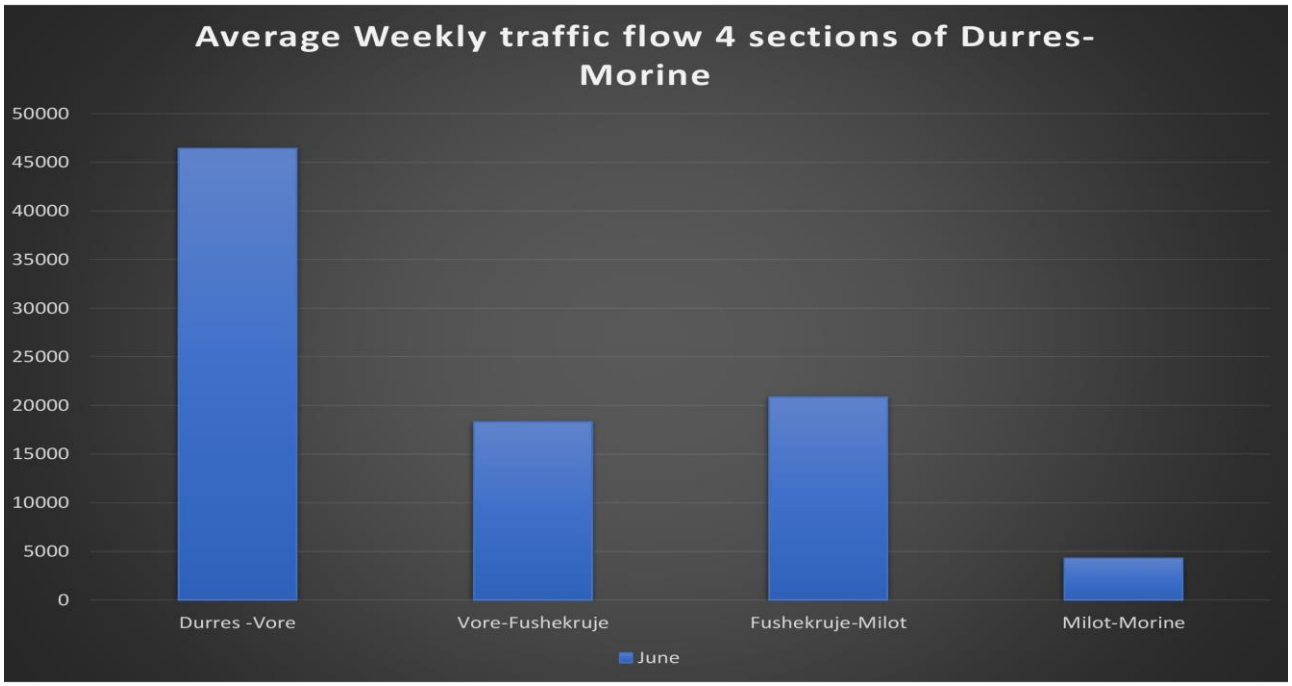
5.2 Comparison of traffic demand of the 4 sections of Durres-Morine

The following **figure 5.30** compares the Average weekly daily traffic flows in the 4 sections taken in consideration for the case study. From the chart, it is obvious that the first segment of the case study, Durres-Vore, handles the majority of traffic flows with over 45000 vehicles a day, while the traffic flows for the single carriageway Vore-Fushkruje are around 18000 vehicles a day. The last segment Milot-Morine, where the bulk of capital investments where allocates, handles just 4900 vehicles a day.

Despite of the evident traffic data which show a major traffic at SH1 and SH2 roads compared to Milot-Morine, the SH1 and SH2 roads still today remain problematic, with a high number of

accidents per year, while the government invested a high proportion of money at the construction of Milot- Morine section.

Figure 5.30 Average weekly daily traffic flows in 4 sections of Durres-Morine



Sources: ARA (Albanian Road Authority),

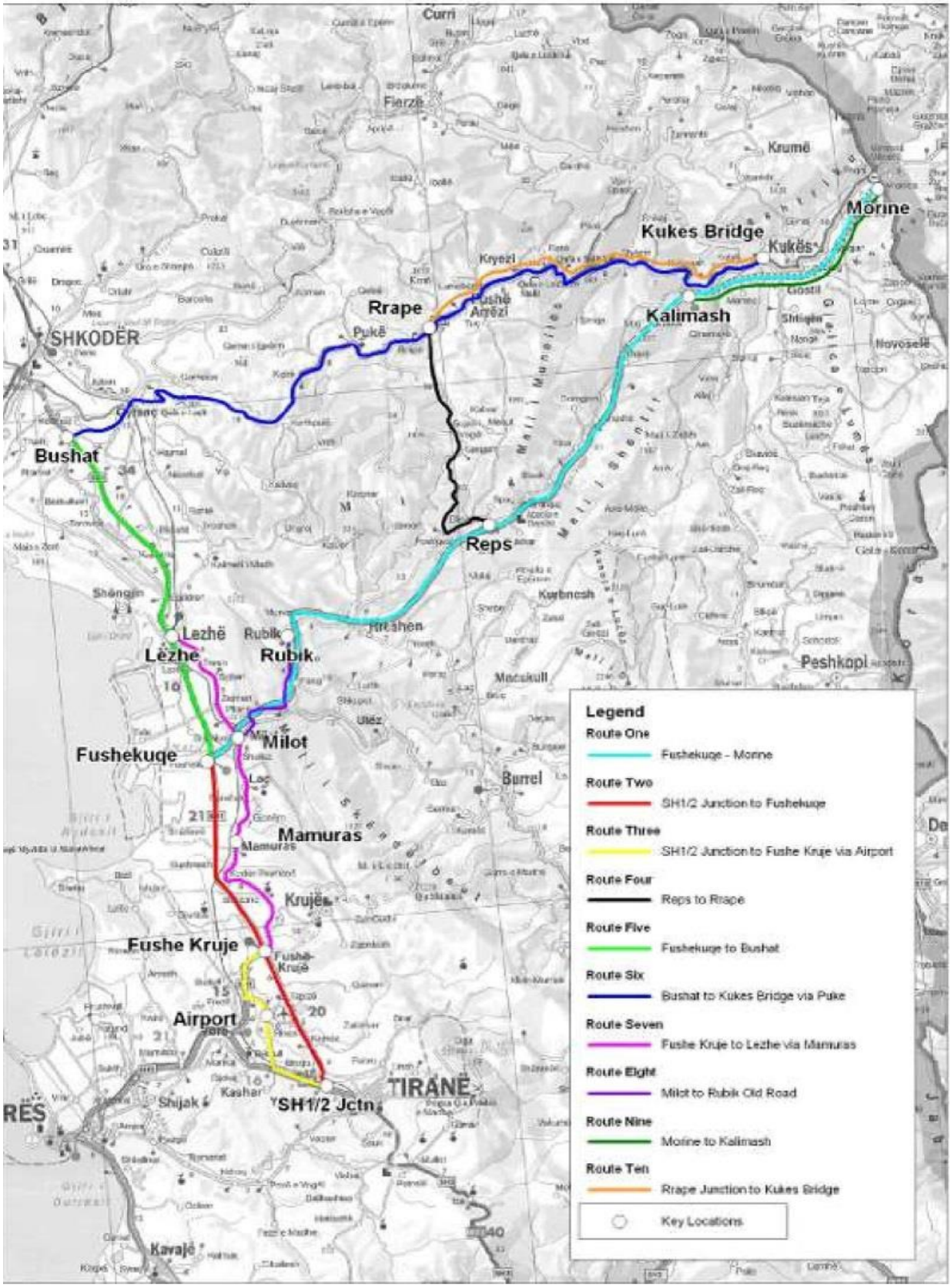
5.3 Alternative routes to reach Morine border with Kosovo

The following **figures 5.31** and **5.32** show the alternative routes to reach Morine border with Kosovo from Fushekuqe and the time, distance and average speed to cross these alternative routes and reach the border. Analysing the following information, the main route (Route 1), dual carriageway section, taken in consideration in this study, is the fastest and shortest route to reach Morine border with an average travel speed of 90 km/hour.

The average time in minutes to cross the entire section from Fushekruje to Morine, 120 km in length, is around 79.3 min. The only alternative route of this section to reach Morine border is the combined length of Route 5, Fushekuqe - Bushat with Route 6, secondary road, Bushat- Kukes Bridge. Route 5 section, Fushekuqe-Bushat is 50.2 km long with an average travel speed of 70 km/hour. The average time to cross this single carriageway section is about 42.5 min. Route 6, Bushat to Kukes bridge via Puke is 124.3 km long with an average travel speed of 43 km/hour. The average time to cross this single carriageway section in mountains regions is 173.5 min.

Figure 5.31 Alternative Routes to reach Morine border with Kosovo

Figure 3.16 Journey Time Survey Routes



Sources: Egnatia Odos S.A. (EO), (January 2012)

Figure 5.32 Time, Distance and Speed of Routes to reach Morine border with Kosovo

Table 3.23 Journey Time Data

Route		Min. Time	Max. Time	Average Time	Distance	Speed	
		min	min	min	km	kph	mph
Route 1 Autostrada	Fushekuqe to Morine	78.0	80.0	79.3	120.0	90.7	56.4
Route 2 Autostrada	SH1/2 junction to Fushekuqe	33.0	38.0	34.4	42.8	74.7	46.4
Route 3 Primary Road	SH1/2 junction to Fushekuqe via Airport	9.0	17.0	15.3	21.6	84.5	52.5
Route 4 Secondary Road	Reps to Rrape	57.0	60.0	58.5	37.6	38.5	23.9
Route 5 Autostrada	Fushekuqe to Bushat	40.0	45.0	42.5	50.2	70.9	44.0
Route 6 Secondary Road	Bushat to Kukes Bridge via Puke	173.0	174.0	173.5	124.3	43.0	26.7
Route 7 Secondary Road	Fushe Kruje to Lezhe via Mamuras	-	-	-	-	-	-
Route 8 Secondary Road	Milot to Rubik Old Road	15.0	17.0	16.2	14.2	52.5	32.6
Route 9 Autostrada	Morine to Kalimash	24.0	27.0	25.5	44.4	104.5	64.9
Route 10 Secondary Road	Rrape junction to Kukes Bridge	103.0	104.0	103.5	72.5	42.0	26.1

Sources: Egnatia Odos S.A. (EO), (January 2012)

Deciding to take these two routes from Fushekuqe to reach Morine border with Kosovo is a suicide compared with the case study taken in consideration. The combined length of these two routes is 174.5 km, around 31 % longer than the 120 km case study taken in consideration (Route 5 in the figure). The average amount of time spent driving through these routes is 216 min, around 2.72 times more than the 79.3 min average time needed to cross the case study (Route 1 in the figure).

Taking in consideration also the miserable conditions of the Route 5 and 6, single-carriage ways, with inexistent safety measures to protect drivers and deadly curves which require maximum

attention, we can conclude that the construction of Route 7 (Route 1 in the figure) was of crucial importance to the improvement driving conditions and times to reaching Kosovo border.

However, this huge difference in time, length, average speed and driving conditions to reach the border between the main route and alternative route indicates a lack of alternative routes to reach Morine border with Kosovo. It indicates that alternative routes and secondary roads which connect the main route to alternatives are almost inexistent and drivers are not willing to take them as an alternative to the Route 7 (Case study).

Figure 5.33 Riots at Kukes Region, concessionaire toll, building

This situation becomes problematic when tolling is imposed on drivers whose only route to reach Kosovo is Route 7. The government of Albania outsourced in 2018 the Rreshen-Morine section to a private Turkish consortium for operation and maintenance. The company started to impose a flat tariff of five euro on the section without taking in consideration the social-economic conditions of the poorest North-Eastern regions of Albania, referring to studies prepared by Egnatia Odos S.A, a private consultant company, about these conditions. The amount of money to be paid for crossing Route 7, the lack of prior information to customers (stakeholders who use the route), and the lack of alternative routes resulted in heated protests from stakeholders such as inhabitants of Kukes regions (Figure 5.33) which forced the government to revise tolling prices and required the company to invest additional costs for the reconstruction of the plazas.

6. WHY ROAD ASSET STRATEGIC PLANNING AND MANAGEMENT IS IMPORTANT IN DEVELOPING COUNTRIES

The following analysis is aimed to understand the importance of asset management level of planning described in the first chapter, such as strategic planning and that of external drivers such as historical, political, economic, social legislative & regulatory and commercial, during the planning and design phase of such an important large-scale project, as the Highway Durres- Kukes. These levels of planning and drivers combined with asset management processes, such as definition of service levels, traffic demand and forecast, asset knowledge, should be taken in consideration during the planning and financing faze of such important road infrastructures, as the neglection of one of them can highly influence the positive outcome in terms of asset management and financial and funding strategies in such a highly volatile environments of developing countries, such as Albania. The benefits and problematics of the case study, historical traffic data and lack of alternative routes to reach Morine border with Kosovo, described in the previous chapters will help in the analysis of the situation and how to improve strategies for funding and maintenance.

6.1 What has been done

The below figure 6.1, recalls the subdivision of the entire segment Durres – Morine into 4 sections for analysis purpose:

1. **Durres - Vore**, dual carriageway (22 km), segment of the Albanian State Road 2 (SH2);
2. **Vore - Mamurras**, single carriageway (20 km), segment of the Albanian State Road 1 (SH1).
3. **Mamurras - Milot**, dual carriageway (13.4 km segment of the Albanian State Road 1 (SH1)
4. The newly constructed **Milot - Morine**, dual carriageway (110 km)

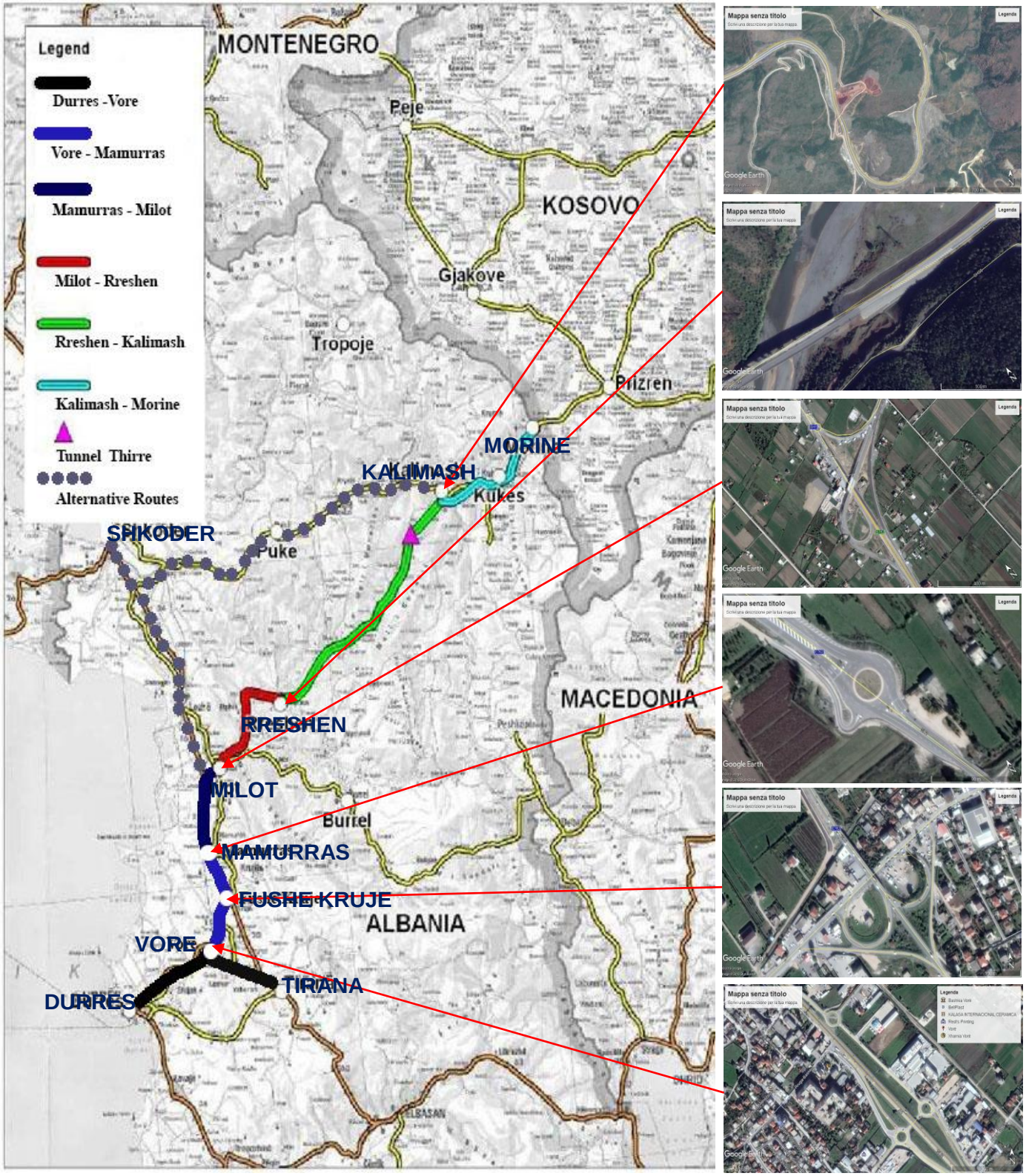
The Milot- Morine segment is subdivided into 4 further sections:

1. **Milot - Rreshen** segment (26 km), single carriageway (numbered A1)
2. **Rreshen - Kalimash** segment (61 km), dual carriageway (numbered A1)
3. **Kalimash - Morine** segment (31 km), dual carriageway (numbered A1),

Starting the analysis with the most important segment 92 km **Rreshen-Morine** dual carriageway, the government of Albania, a developing country, during the previous years of 2016, was struggling to find bid competitors for the concession of this segment, to operate and maintain the axis. This concession has long been controversial. According to the Albanian specialists, over 1 billion euros

of public funds were spent for its construction. Everything should have been anticipated from the beginning of the construction. The maintenance of the 110 km "Nation's Road", with international parameters, is very costly for the state budget of Albania

Figure 6.1 Sections of Durres – Morine segment



The Albanian Ministry of Transport and Infrastructure announced in 2015 the cancellation of the concession for the maintenance of the "Nation's Road" (Case Study), the main arteria connecting Albania with Kosovo. They rejected the offers of two companies, one Chinese and one Turkish because their offers where in conflict with the public interest. According to the committee, the submitted offers were twice as high as the expectations of the Albanian government and the World Bank. The Chinese company had offered around 10.4 million euros in subsidy for 11 years, while the Turkish consortium about 12.3 million euro. "We are assessing whether to redesign the same procedure or we will find another model for attracting private investment" said the Albanian Government.

As presented in the previous chapters, in 2016, the government finally outsourced the maintenance and operating of **Rreshen- Morine** highway to a Turkish company through PPP (Public-Private-Partnership) procurement methods. The main objective of this concession is the improvement of the highway. The concessionaire will build, upgrade, and maintain the highway for 30 years and will collect the tax revenue and have the responsibility to finance the upgrades of the highway. It also should complete the bridges over the Drin River in Kukës and implement the most urgent geotechnical stabilization works. The contract between the government and concessionaire foresees the application of a flat tariff of 5 euros for the use of the highway by Albanian and foreign vehicles which the company tried to initiate collecting in May 2018.

The five-euro flat tariff for this 92 km segment, 0.05 euro/km, is one of the most expensive in Europe per km, passing through the poorest regions Albania and in Europe. Without taking in consideration western European countries, such as France or Germany where the GDP per capita, $ 38,476 and $ 44,469 respectively, is almost 9-10 times higher than Albanian GDP, $ 4.537,[64] and toll prices are lower per km than Albania,[65]a comparison can be made with neighbouring countries like Serbia and Macedonia with comparable GDP per capita.

Serbian and Macedonian GDP per capita according to the World Bank were $ 5.900 and $ 5.442 respectively, on 2017, while Albanian GDP per capita was $ 4.537 on the same year. Although the difference in GPD is consistent, almost 30 % higher for Serbia and 20 % for Macedonia, compared to Albania, toll prices are higher in Albania per km of travel. The toll rate for the 237 km Serbian highway segment, Beograd-Nish, is 800 RSD (Serbian dinar)/6.75 Euro [66]while the toll rate for the

[64] *https://data.worldbank.org/*

[65] *https://www.tolls.eu*

[66] *http://www.putevi-srbije.rs/ (official website)*

37 km Macedonian highway segment is 80 MKD (Macedonian dinar)/ 1.3 Euro[67]. Based on this data the toll price/km in Serbia is 0.028 euro/km while in Macedonia is 0.016 euro/km. The 0.05 euro/km toll price imposed on **Rreshen-Kalimash** segment is 78 % higher than 0.028 euro/km of Serbia and 310 % higher than 0.016 euro/km of Macedonia.

Referring to chapters three, four and five of this dissertation where social impacts, problematics, benefits, traffic demand and alternative routes to reach Morine border where described, we can understand the importance of strategic planning and external drivers for developing countries, during the planning and design phase of such an important large-scale project, as the Highway Durres- Kukes. The higher toll prices compared to neighbouring countries such as Serbia and Macedonia, set by the Albanian government and the private Turkish concessionary after the Egnatia reports analysed in chapter five, are a clear example of how the overlook of strategic planning and different factors can be translated into problems on the technical level and higher prices for the stakeholders.

While the connection of Albania, Kosovo and Serbia, through **Rreshen-Kalimash** segment, as part of the European network segment of the European Route VII between Albania and Serbia, including in perspective the connection with the Pan European X corridor to Nish in Serbia, continuing in Romania, Bulgaria and beyond was and remains of crucial importance for the neighboring countries as a mean for further economic and social integration with the European Union, data on excessive cost of construction and maintenance, uncompletion of the entire segment due to lack of funds, combined with the weak traffic demand after a decade for its construction (90 % for leisure purposes), lack of alternative routes and neglection of social-economic conditions of the North-eastern regions of Albania do not justify this strategic and highly expensive investment of a Albanian and ARA (Albanian Road Authority), on this segment for the Albanian stakeholders.

The government of Albania and Albanian Road Authority, during the **strategic planning** phase neglected the drivers of road asset management or probably did not take them in consideration at all. They neglected the social and political environment among Balkans countries such as Serbia, Kosovo and Albania, characterized by around 30 years of tensions, which was crucial to the appropriate utilization of this segment for the common economic growth and integration in the European Union. Instead the segment remains still underutilized, with a weak traffic demand in which the main purpose of traveling is leisure. The weak traffic demand, combined with

[67] *http://www.roads.org.mk (official website).*

uncompletion of the segment due to lack of funds, as a result of excessive construction, is reflected at the difficulties to find private concessionaries which could maintain the Rreshen-Morine segment and on the high tolling price imposed to the stakeholders.

The government of a developing country such as Albania and the Albanian Road Authority, neglected the importance of strategic external factors such as legislative, regulatory, commercial, financial, social and environmental during the strategic planning phase. By weighting each of these factors differently they could have developed the visionary and valuable long-term strategic plans to achieve the prefixed outcomes.

Instead of using an "Top-Down" approach where the decisions of the Government and ARA influenced the outcome of the results for this segment, the public institutions of Albania, should have used an "Down-Top" approach, by implementing the right Information systems and teams within their structure. By using this approach they should have gathered information and created a wide database on traffic demand, social environment and the balancing of business benefits and long-term impacts across socio-demographic groups, internal environment, commercial environment which are the basis for a long-term visionary strategic planning of road infrastructures.

Highlighting the importance of the **Rreshen-Morine** segment for the involved countries, such as Albania, Kosovo and Serbia, and for their better connection and integration within the Balkan region and European Union, reason for which this segment was constructed, **the dual carriageway, four-lanes** investment could have been constructed as a primary road of **a single carriageway**, two-lines, 3.5 m each, complying with the European standards. The necessary funds allocated for the construction of the **dual carriageway segment**, would have been sufficient to complete the entire segment without creating the problematics of today such as the billboard cut every 2 km, lack of pedestrian overpasses and the segment would have carried the appropriate amount of traffic resulting rentable, without being underutilized, as it is today. Further investment resulting from the remaining of the allocated funds could have been made to improve the condition of the secondary roads. By improving the condition of the secondary roads, the internal demand from the north-eastern regions of Albania would have been increased, and the Albanian stakeholders would have been taken more in consideration. The axis would have satisfied the internal and external demand, and the costs for its operation and maintenance would have been affordable by the Government. The segment would have been connected naturally with the nearby **Milot - Rreshen** segment (26 km), single carriageway, without interruptions or changes in the number of lanes at Rreshen. These way, traffic bottlenecks which may be present today for this result could have been avoided. Road

safety would have been improved by making a better use of financial resources and refine the horizontal and vertical road signs.

Traffic data regarding the single carriageway **Milot-Rreshen** analyzed in the previous chapter supports this hypothesis. The internal demand for this section is higher than that of **Rreshen-Morine** because of the closer location to Durres and Tirane, the major port and capital of Albania. The entire segment **Milot-Morine** (numbered A1) would have been completed, increasing its value and performance, and the intersection (at Milot) with the other North-South main arteria from Vore to Shkoder (named SH1) could have been improved.

As presented in the previous chapters the **Durres - Vore**, dual carriageway (22 km), segment of the Albanian State Road 2 (SH2) is the main Albanian arteria which connects Durres and Tirane the major port city and the Capital. It handles an AADT of around 45000-50000 vehicles compared to the newly constructed **Rreshen-Morine** section which handles 4500. The traffic load in this segment is growing yearly and the segment is overutilized, resulting in poor pavement conditions and secondary roads, traffic jams, bottlenecks and decreased safety conditions. The government should have been focused more on this segment instead of **Rreshen- Morine** section and should have taken a proactive approach rather than retroactive.

The same condition is presented in the **Vore- Mamurras** section and **Mamurras- Milot** section. These segments are part of the longer Albanian arteria Tirane-Shkoder which passes through the major cites of middle to North Albania. This arteria handles an AADT of 19000 vehicles. Instead of having been completed in its entire length complying to European standards, this arteria is still segmented due to lack of funds and management, and experiences similar problems as the **Durres-Vore** segment. The government should have allocated more resources on these segments and should have taken a proactive approach rather than retroactive.

6.2 What should be done

Albanian Government and ARA (Albania Road Authority) should take a more strategic approach described as "visionary and managerial" in managing the road network of Albania, a developing country, by trying to make legislative and regulatory reforms within their structure to pave the way for the implementation of Asset Management. Following the examples of the top Asset Management countries the government should introduce effective financial reporting requirements and accounting standards, which can increase the transparency and improve resource allocation and

should promote infrastructure AM practices, policies and systems. They should focus more on the social environment and balance the business benefits with the long-term impacts across socio-demographic groups and involve different interest groups in the decision-making processes. They should make more customer consultation activities and ask customer groups about their needs in order to understand what customers value in managed road assets and what they require.

ARA should incorporate an Asset management team within its organizational structure which can coordinate the efforts of different departments such as Planning, projects and operation teams to achieve higher productivity and appropriate financial resource allocation. This teams can establish policies which translate governments strategic vison into specific objectives, targets and plans to achieve the defined levels of service.

Introduction of information systems within ARA is of crucial importance to record Physical information about the assets and have in place an asset inventory which contains data about the assets description, integrity, maintenance and condition, essential to the achieve accurate outcomes. By having an asset inventory in place, ARA can rate the asset based on their condition and performance and prepare a risk management framework by identifying the criteria to evaluate the risk. They can make the appropriate asset management strategies and optimise the decision making.

Focusing on the case study of this dissertation, as was described in the previous chapters, the **Rreshen-Morine** section is outsourced to a private concessionary for operation and maintenance. ARA by implementing an Asset management software, such as Work-Tech Asset Management Software, which contains the asset inventory and having incorporated within its structure an asset Management team of various specialists, can define performance measures and levels of service required, and monitor the concessionary in order to have a cost-effective management of the section and meet the objectives.

Durres-Tirane segment (which **Durres-Vore** is part) is the most important in the country, handling AADT of 45000-50000 vehicles and connecting the two major cities. This segment should be of primary importance for the government and ARA as it is continuously experiencing traffic growth over the years which is not satisfied by the supply. The government and ARA should allocate more financial resources to this segment, for its maintenance and rehabilitation. The overutilization of this axis is resulting in pavement degradation on the most travelled right line and drivers are forced to block the surpass line. The poor conditions of the secondary roads, the exits and entrances cause traffic jams and accidents. By taking a proactive approach rather than retroactive, ARA should

create an inventory for this segment, the oldest in the country, (2002) about the condition, maintenance history and replacement cost to define the best asset management and financial strategies for its long-life cycle maintenance or expansion with a third line for carriageway. It should improve the condition of road signs for safety issues and close all the uncontrolled entrances or exits. It should define better performance measures and levels of service taking in consideration customer groups.

The same proactive approach should be taken for the **Vore- Shkoder** segment which in the future will be included in the Blue Corridor (Adriatic–Ionian motorway) connecting Trieste, Italy with Kalamata, Greece (Figure 6.2).

Figure 6.2 Adriatic–Ionian Motorway

Actually, this segment is the backbone of North-Western Albania, where the majority of cities are located, as the only major arteria to reach Montenegro. This segment needs to become as soon as possible of the same level of service, nr of carriageways and width, to comply with the European levels of service instead of being sectioned into two segments **Vore-Mammuras** and **Mamurras-Milot**, the first single carriageway and the second dual carriageway, linked together by roundabouts (figure 6.3). The entire segment **Vore - Mamurras**, single carriageway, should be widened into dual-carriageway, to naturally link it with the other dual-carriageway segment **Mamurras – Milot** and levels of service should improve, including road sign for safety purpose, intersections with the secondary roads, entrances and exits

Vore bridge (figure 6.4), which provides connection with the **Durres-Tirane** segment should be monitored very carefully, as its construction dates back to 30-40 years ago (during Communist era), and funds should be allocated to renew or replace it.

Figure 6.3 Link between Vore-Mammuras and Mamurras-Milot sections

Figure 6.4 Vore bridge

7. DISCUSSION, CONCLUSION AND FUTURE WORK

7.1 Discussion

The main objective of this dissertation was to explain and understand the benefits of having a visionary, life-cycle asset planning and management approach in the developing countries, through the implementation of road asset management practices. These practices are not just a valuation of asset, estimation of deficit, or the establishment of inventory databases. Their true implementation includes a cultural change that promotes a proactive organization-wide system for the life cycle management of road asset to deliver services to the customers and optimize their engineering, social, economic and environmental performance. It requires major legislative and regulatory reforms, expertise and knowledge, adaption of advanced information technology systems to document and communicate initial data about assets in a more accurate manner, greater transparency and quality in reporting arrangements.

The thesis tried to explain the challenges that small developing countries, such as Albania, face in changing their approach to plan and manage their road assets, where impeding factors, such as inadequate planning, insufficient competition, low credibility of institutions, lack of transparency, difficult political environment and relationships with neighboring countries influence the decisions made on a strategic level, which in turn influence processes on an operational level, such as maintenance. The description and analysis of the case study were an example of this close relationship among strategic, tactical and operational levels, where a very expensive road infrastructure investment is not delivering the required levels of service and is influencing the allocation of funds on other important road infrastructures. Having an implemented road asset management framework, would have allowed asset managers to understand the key drivers of demand, prepare demand projections and identify the best way of meeting that demand by analyzing factors such as population change, economic growth etc. It could have influenced the decision made by the government, which focus should have been to satisfy the internal demand for roads by providing better levels of service rather than the external demand by investing in road which main purpose is for leisure travelling.

7.2 Conclusion

The case of Albania, a developing country, demonstrated that, although capital investments on important road infrastructures are of crucial importance to the developing countries, contributing in

the social and economic integration with the neighboring countries and major continental networks, the decisions made by governments and responsible authorities regarding these investments should take in consideration other factors such as financial capability and socio-economic environment to make the right decision. Asset management (AM) practices, *if implemented effectively in the challenging social, political, legislative and business environments of developing countries, hold the potential for heightened performance and major cost savings of the assets throughout their entire life.*

Therefore, organizations in these countries undertaking this strategic approach to plan and manage their Infrastructures must have a clear understanding of the external factors that influence the successful implementation of the AM processes, as well as their organizational behavior to improve their asset management planning.

7.3 Future Work

The work on this dissertation can be useful for further research on various case studies located in other developing countries and change the approach with which the governments and asset managers of these countries, manage their road assets. Asset management practices, if implemented effectively in the different social, political, legislative and business environments from country to country, hold the potential for heightened performance and major cost savings of the assets throughout their entire life.

LIST OF FIGURES

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