Development of Tirana's road infrastructure after the 1990s

MSc. Ing. Iva JOSIFI
ADVISOR: PROF. DR. TANIA FLOQI

Abstract

As road transport constitutes the main mode of movement in Albania, road safety remains, of course, a very important aspect. Official statistics, especially for our country, report that it is among the first countries with a large number of car accidents compared to other Western European countries, compared to the corresponding number of vehicles in use per 1000 inhabitants. Both globally and in Albania, over the medium to long term, trends show that globalization and expected population growth will lead to increased demand for transport, exceeding the capacity of SIT's existing systems. Increasing traffic jams, increasing dependence on fuel, increasing pressure on public budgets, and building new infrastructure is not a solution to meet the growing demand for transport from citizens and service providers. The era of vigorous development of science and technology did not have any other options than to include the field of Transport. It has therefore proven to be an innovative alternative to traditional measures to address problems and transport needs, implementation of 'smart' signaling systems, otherwise known as Intelligent Transport Systems.

Key words: *transport, road, Intelligent Transport Systems, infrastructure.*

Albanian road network. Introduction

The National Road Network under the jurisdiction of ARA is divided into 2 main categories:

- **primary roads** that are numbered from Sh1 to Sh9, plus highways (A1 Milot-Morinë, A2 Tirana-Durrës and the newly built part of the A3 Elbasan-Tirana highway);
- **secondary roads**, numbered from Sh20 to Sh99, as well as some road axes without any reference number.

With the construction of new segments within the Sh1 to Sh9 road network, the old alignments must also be included in the secondary network (e.g., the Sh4 section from Dama to Fier, etc.).

The primary network consists of main roads and some main secondary roads and since it connects all major cities and tourist centers it carries most of the country's traffic.

According to the World Bank's Results-Based Road Safety and Maintenance Project,

the following functional road categories have been identified based on the characteristics of the network under consideration:

Primary road (P) means the highways of Albania and the main road corridors.

Primary-secondary roads (PS), means the roads of Albania - except for the primary roads that connect the main cities and tourist centers, as well as lead to border crossings with neighboring countries, within Albania.

Secondary road (S); AND
Albanian Development Fund (ADFDF) roads

According to the Albanian Road Authority (ARRSH), the total length of the National Road Network is estimated at 3,848 km. According to her:

- all primary roads in the main network and about 2/3 of the total length of the secondary network are paved roads.
- about 48% of the total length of the primary network and 21% of the secondary network is on flat land.
- 34% of the primary network and 56% of the secondary road network is in mountainous terrain.
- The National Road Network under the jurisdiction of ARA includes a total of 590 bridges (with a total length of over 10 m).

- This network carries most of the country's traffic.

According to the World Bank, the total length of the National Road Network is slightly higher than 4,288 km, where:

- roads P and PS carry most of the traffic of national roads, with average daily traffic of 6,695 vehicles per day, which carry 76% of vehicle use.
- S and ADF roads have an average traffic of 1,705 vehicles per day and carry only 24% of vehicle usage, even though they constitute 56% of the length of the network.
- the network carries about 4.523 million vehicle-km per year that consumes about 595 million liters of fuel per year resulting in 1.48 million tons of CO2 per year.

TABLE 1. Traffic and use of vehicles (Source: World Bank)

Rrjeti	Trafiku		Përdorimi (milion automjete-km)	
	% Rrjetit	Mesatarja	Përdorimi	Përdorimi
	< 1,000 AADT	TDMV	(m auto-km/vit)	(%)
P	5%	7 194	3 064	67.7%
PS	31%	4 212	361	6.9%
S	68%	1 757	1 072	24.8%
FSHZH	100%	751	25	0.7%
Totali	43%	3 916	4 523	100.0%

Since 2007 the Albanian Development Fund (AFDF) - has supported the reconstruction of 142 secondary and local road sections and bridges across the country in a total of 1,170 km in the period 2005-2013.

The ADF impact indicators have been quite positive, such as:

- 60% reduction in travel time compared to the period before the investments.
- 21% increase in traffic volume on reconstructed road sections.
- 8.5% reduction in the cost of public transport.
- reduction in the cost of vehicle maintenance and service for 90% of road users, etc.

Road condition monitoring

The assessment of the network condition revealed that 83% of the overall network, 91% of the primary and secondary roads and 77% of the secondary and ADF networks are in a stable condition (very good, good or relatively good), which require only periodic and routine maintenance.

According to the World Bank and visual on-site inspections by international consultants, among the signs of poor quality are:

i) premature demolition of new asphalts and some structures
ii) the use of different design standards in adjacent sections.
iii) weak and contradictory alerts and other security problems.
iv) non-repairs of electrical equipment.

TABLE 2. National Road Network with conditions and traffic data (Source: World Bank)

Klasifikimi i Rrjetit Rrugor	Kohëzgjatja		Gjendja			
	km	%	Shumë mirë ose Mirë	Relativisht mirë	Keq ose Shumë keq	Mesatar IRI[10]
P	1 167	37%	66%	24%	10%	4,5
PS	235	7%	62%	34%	3%	4,6
S	1 672	53%	38%	37%	25%	6,4
FSHZH	90	3%	100%	0%	0%	3,5
Totali	3 164	100%	52%	31%	17%	5,5

The functional design of Intelligent Transport Systems

Intelligent transport systems (SIT) alone cannot solve all transport problems. Not even any other single technology can solve this. SIT applications will not reduce demand for mobility and access, nor increase highway capacity. But SITs can provide transportation agencies with additional tools to manage transportation challenges while maximizing the safety and efficiency of existing infrastructure.

SIT application requirements can affect many aspects of planning and design, including earthworks, hydraulics, structures, traffic engineering and environmental disciplines, and early deployment of SIT can help manage traffic during project implementation. Therefore, the integration of SIT in the planning and development processes of the project is critical to building and ensuring support for its investments.

SIT devices vary from simple traffic control and passenger information systems to high-speed automatic incident detection devices and cooperative vehicle-to-infrastructure systems.

A functional Intelligent Transport Systems project needs to be undertaken to establish the requirements on which the detailed project is based. The SIT functional design for any new SIT capacity should include:

- Identification of the main transport monitoring subjects and main roads.
- Integration with existing transport systems and main roads
- Choosing the technology that is suitable for the purpose
- Procurement of system components based on defined standards.
- Cost of administration, maintenance, and management throughout the life of the product.
- Security requirements, by the standards.
- The project allows for high availability
- Prevention of environmental damage
- Devices that are physically and technologically robust and reliable.

Supporting infrastructure

It is important that road designers approach the provision of SIT supporting infrastructure from a holistic point of view. This includes consideration of SIT applications related to the project, which may be outside the scope of the current project.

The design of the SIT must consider several parameters and technical data, such as: road geometry, landscape design. drainage systems, road structures, other street furniture such as static signs, lighting, electrical service plants, public services, and supply, etc. some specific requirements of SIT.

This will allow addressing conflicts that may arise regarding the permitted spacing of SIT equipment, channel routes and long distances to other road services, etc.

SIT devices require power and reliable communications links to operate efficiently. The civil infrastructure must allow the transmission of SIT electrical and communication cables. Designs should allow for piping, pits, ducts, antennas, cabinets, and layers or structures as needed. Where possible, SIT equipment and supporting infrastructure (including manholes and drains) should be located on external thresholds.

Consideration of possible requirements for future road changes (such as road widening, emergency lane routing and/or separation for differential speed limits) should be made in the SIT design. While the granting of SIT applications may not be required immediately, land acquisition and civil works should be undertaken to allow these to occur easily in the future.

Intelligent transport systems

The main reasons for implementing SIT include:

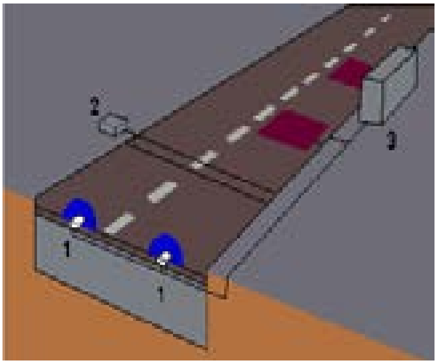
- improving road safety.
- improving the efficiency of the road network.
- improving the efficiency of the transport system.
- reducing the environmental impacts of the transport system.

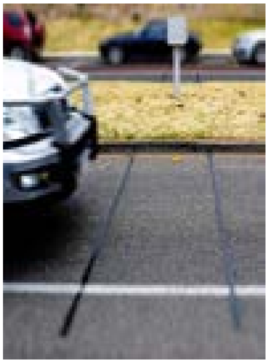
These systems depend on many different technologies and equipment, including vehicle detectors, message signs, display monitors, closed circuit television (CCTV) and telecommunications networks.

Road mounted vehicle detectors

Newer alternatives in off-pavement (non-invasive) sensors include: Video images, Doppler radar Acoustic sensor

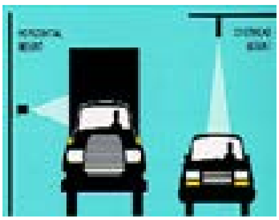
Type: 1. Magnetic sensors, 2. Pneumatic Tube/ Detectors 3. Inductive Loop/ Detectors

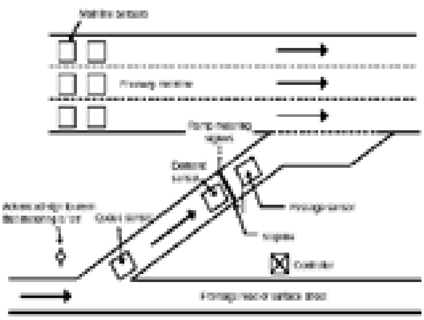




Type: 4 Piezoelectric sensors

Road mounted vehicle detectors





VDS layout in a highway application

Strategic planning of VDS design in urban areas may be more beneficial when provided for future expansion. This includes both the detection equipment and the real estate required for this equipment.

Vehicle calculators/classifiers

Vehicle controllers/classifiers collect and record traffic volume and vehicle classification data. Classification may also be an additional feature of the previously described vehicle detection systems. Classification can be done based on speed, vehicle length and/or the number of axles. The basic classification according to the number of axles and the distance between axles or groups of axles is widely adopted.

The system considers vehicles and combinations of vehicles up to sixteen axles. Data capture can include each vehicle's travel lanes, lane data, date, time of day, and classification.

VEHICLE CLASSIFIER

VEHICLE CLASSIFIER

Components of vehicle calculators/classifiers may include:

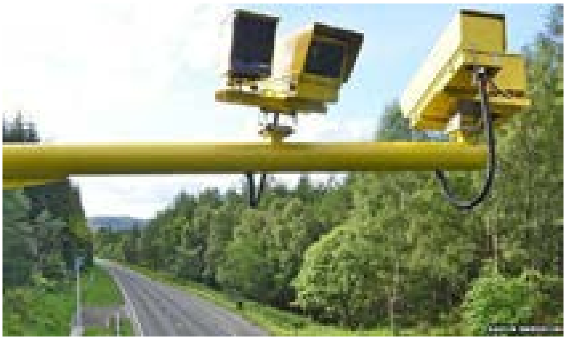
- a data entry device capable of collecting, processing, storing, and transmitting vehicle data.
- axle sensors to detect vehicles, vehicle speed, and axle spacing - sensors can be pneumatic tubes, piezoelectric sensors Communication interface to allow local/remote connection.
- Field cabinet and all necessary interconnect cables and various materials to make an operational system.
- Access to maintenance.

Closed-circuit television camera systems

Closed-circuit television (CCTV) systems provide a means by which road agencies can effectively monitor the road network, and detect and respond to incidents.

Real-time CCTV coverage allows Traffic Management Center operational staff to immediately identify incidents as they occur as the time an incident is detected/verified affects response time and effectively minimizes the number of traffic disruptions as a result.

Example of placement of roadside CCTV camera system.



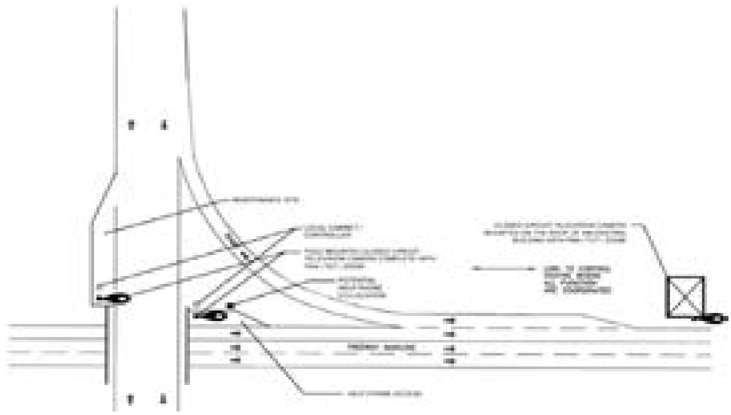
Cameras are typically approved for road coverage with this service. The main components in the terrain field for a route include an SIT booth, camera pole, base, camera, and bracket.

Typical incident verification includes:

- confirmation that an incident has occurred
- determining the location and exact direction of travel and
- obtaining and assessing the nature and as many additional details as possible about the incident.

Cameras are usually installed outside the travel portion of the road so that all segments of the highway system are within view. As a minimum, there should be CCTV coverage of carriageway traffic (including underpasses), emergency stop exits, entry and exit ramps and associated intersections. Finding a good CCTV site requires an extensive investigation of proposed camera locations.

CCTV PLAN IN A HIGHWAY APPLICATION



Road weather monitoring

Weather monitoring stations (RWS) provide valuable information regarding the state of road weather conditions and are an important element in improving the safety of travelers. Road weather stations monitor conditions such as road temperature, precipitation level, wind speed and wind direction. This information can be transmitted to a Traffic Management Center (TMC) and/or in a warning message displayed on the selected VMS. Speed limits may change accordingly in response to precipitation, wind speed or other conditions monitored by environmental sensors.

EXAMPLE OF A ROAD WEATHER MONITORING STATION

As physical elements that make up the weather monitoring system, we can mention:

- Weather detector, with components on or off the road superstructure
- Mounting post
- Field cabin
- Sewers for energy and communication as needed
- Access to maintenance

Phone helplines

Purpose

Drivers involved in an accident or trapped by a damaged car may require help or assistance. Helplines play an important role in improving passenger safety and protection. They provide a means of establishing direct communication with traffic management center operators.

In both cases, rapid and efficient dispatch of resources is critical to reducing traffic congestion and improving public safety. In the urban / highway environment, the location of the helpline should be secured with CCTV surveillance.

PHONE HELPLINE

Phones and help for use:

Call everyone about the road environment, Growing pole/structure, Access to the telecommunications network , Emergency lane, in which a vehicle can stop safely.

Variable message signals, vms

VMS are an essential element of passenger information systems and are used to provide advanced information to drivers. VMS can be placed at the start of steep slopes or at tunnel entrances to attract attention when safe passage may be compromised.

VMS messages are advisory rather than regulatory and typically relate to: • *accidents/incidents, heavy traffic, road work, weather conditions, special events,* road safety messages general transport messages.

A VMS implementation can consist of: contour of signage, maintenance holder, Support structure and foundation, equipment holder, field cabinet and base , Display of VMS, Electricity supply, communications, electrical systems, control systems, access to maintenance.

Signage size

The size of the sign usually depends on the speed of traffic on the road, the distance of sight and the stability along the road.

Type	Speed (km/h)	Dist min e VIEWING	Length min Font	The width of periphery
A	<60	100 m	150 mm	125 mm
B	60÷90	160 m	330 mm	158 mm
C	>90	250 m	440 mm	220 mm

Character size about speed and sight distance

Information signs on road conditions

Road condition information signs (RCIS) are a variant of CMS and/or VMS. They are placed in strategic places on the road network and show the condition of passing road segments of interest to the driver. These routes may be subject to occasional flooding or load restrictions.

Each sign may consist of several VMS or modules where each module indicates whether a part of the road is open, closed or subject to conditional access such as load limits that may be imposed due to environmental conditions.

An RCIS implementation may consist of:

- a table complete with variable message tokens
- Support structure and foundation
- field cabin and foundation
- energy supply including solar energy
- communications
- electrical systems
- control systems
- access to maintenance.

Variable speed limit / lane control signals

Speed limits can be changed in accordance with weather conditions etc., as well as to allow for maintenance activities or as a way of relieving overload on adaptive speed control systems.

Periodic speed limit changes are required in school zones. These SIT applications have increased the need for active variable speed limit signs (VSLS).

A VSLS can have a dual function in that it can be a VSLS as well as a lane control sign (LCS).

A VSLS / LCS installation can consist of:

- an outline of the signage
- Support structure and foundation
- Maintenance and access for signs and installations
- Field cabin construction group controller as required and other equipment.

Rampash measurement systems

Traffic congestion occurs when travel demand exceeds capacity. This congestion is a common occurrence on parts of the motorway network. Ramp metering aims to limit the number of vehicles entering the highway from the entrance ramp at certain time periods so that the flow on the highway is kept under control.

Ramp metering uses three aspects (red, yellow, and green) of traffic signals on freeway ramps to control the rate of vehicles entering the freeway.

Weight measurement systems, weigh-in-motion (WIM)

Weigh-In-Motion (WIM) systems improve the efficiency of processing commercial vehicles at inspection stations. A WIM system uses sensors installed on a road to measure the weight of moving vehicles as they pass.

The WIM system can provide truck inspection station personnel with the data to selectively focus on trucks that are potentially at risk of being overweight. This reduces the compression and accumulation lengths of trucks entering the truck inspection station. WIM systems typically consist of:

- mat or piezoelectric tape-type sensors (can be used in both permanent and temporary installations)
- Lower speed lane (the technology for WIM systems is relatively mature, however, they are required to be installed in places where trucks travel at lower speeds)
- special WIM zone road layer construction to maximize accuracy and layer life
- Variable Message Signaling (CMS) for truck diversions
- a sewer system for energy and communication
- Controllers cabinet
- access to maintenance
- CCTV for monitoring
- Heavy vehicle inspection station (optional).

Automatic plate number recognition systems

Automatic number plate recognition (ANPR) systems use optical character recognition to capture number plate information.

ANPR provides an accurate method through which travel time monitoring and overall network performance can be verified. ANPR can be used for enforcement in WIM applications and other police tasks.

ANPR systems may use inductive detector loops, lasers, or other sensors as part of their image capture mechanism.

POLE-MOUNTED AUTOMATIC WIRELESS LICENSE PLATE NUMBER CAPTURE SYSTEM

The equipment required to implement an ANPR may consist of: equipment that provides infrared illumination, video capture, sewers for energy and communication, access to maintenance, lightning protection, loop/detection sensors as needed, field cabinets, pillars and gantries.

Principles for the specification and deployment of SIT

Approval of specifications, issuance of mandates for standards and selection, and deployment of SIT applications and services shall be based on a needs assessment involving all stakeholders and shall be consistent with the following principles. These measures should:

- **(a)** **Be effective** - make a tangible contribution towards solving the main challenges affecting road transport in Europe (e.g., reducing congestion, reducing emissions, improving energy efficiency, achieving high levels of safety and protection including dangerous road users).
- **(b)** **To be cost-effective** – optimizing the ratio of expenses in relation to outputs in relation to the achievement of objectives.
- **(c)** **be proportional** - provide, when appropriate, for different levels of service quality and accessible placement, taking into account local, regional, national and European specificities.
- **(d)** **supporting continuity of services** - to provide connected services throughout the territory of the country, in the trans-European network, and where possible in its external borders, where its services are located. Continuity of services must be ensured at a level adapted to the

characteristics of transport networks in the connection between countries, and when appropriate, regions with regions and cities with rural areas.

(e) **distributor interoperability** - ensure that underlying business systems and processes have the capacity to exchange data and share information and knowledge to enable their effective service delivery.

(f) **backward compatibility support** - to ensure, where appropriate, the ability for its systems to work with existing systems that share a common purpose, without impeding the development of new technologies.

(g) **respect for the characteristics of the network and the existing national** infrastructure - considers the inherent differences in the characteristics of the transport network, in the sizes of traffic volumes and road conditions.

(h) **promote equality of access (right)** - do not hinder or discriminate against access to SIT applications and services by vulnerable road users;

(i) **mature support** - demonstrates, after appropriate risk assessment, the new capabilities of SIT systems, through a sufficient level of technical development and operational exploitation.

(j) **provision of positioning and time quality** - use of basic satellite infrastructures, or any technology that provides equivalent levels of accuracy for applications and services that require globalization, continuity, timing and positioning of accurate and guaranteed SIT services -'s.

(k) **facilitates intermodality** - takes into account the coordination of different modes of transport, when appropriate, for the deployment of SIT;

(l) **respect for coherence** - takes into account existing rules, policies and activities of the EU, which are important in the field of SIT, in particular in the field of standardization.

Factors causing delays in the deployment of SIT in Albania include:

- Lack of strategy and policy approach regarding the implementation of SIT
- Lack of funds.

The strengths for the status towards the increasing deployment of SIT in Albania are listed below:

- Albania can create suitable conditions for the acceleration and coordination of the deployment of SIT
- Preparation of updated legislation for the establishment of SIT
- lan and integrate the general components into a realistic scheme
- Use "best practices" for designing up-to-date technologies to support SIT deployment

The following issues should be addressed on behalf of the responsible actors:

- Ensuring an adequate legislative framework for the establishment of SIT, laws, and Government decisions for this purpose, in coherence with the EU Legislation and the SIT Action Plan and the SIT Directive in priority areas
- Establishing a strategy for the deployment of SIT by the EU Directive 2010/40
- / EU of the European Parliament and of the Council of 7 July 2010, EU documents on the subject.
- Creation of an administrative structure/department at the national level, which will promote, support, develop and monitor the deployment of SIT
- Initiation of projects for the deployment of SIT in cities, especially in Tirana in the first place
- Promotion of cooperation between central and regional authorities and between public and private organizations with defined roles and responsibilities
- Financial support for projects aimed at establishing SIT
- Promotion of public-private partnership for research and deployment of SIT

Sites in road transport

The only SIT platform in Albania, for road transport, is the Urban Traffic Control Management System for the city of Tirana.

The main goal of the system is to implement an advanced architecture of SITs, capable of managing the complexity of the traffic situation in Tirana, implementing optimal control of the main traffic lights of the city of Tirana, ensuring traffic surveillance of the main roads and an info mobility platform (via variable message panels, Web, SMS).

MAP OF THE INSTALLATION OF TRAFFIC LIGHTS IN THE CITY OF TIRANA

MAP OF THE INSTALLATION OF VARIABLE MESSAGE PANELS (VMS) IN THE CITY OF TIRANA

MAP OF THE INSTALLATION OF CAMERAS IN THE CITY OF TIRANA

Road safety

Road safety is the foundation of accident prevention, which unfortunately in Albania have a constantly increasing trend and are more than 2 times higher than in developed countries. This is a major social concern and road accidents are an important health and economic problem facing our country.

Spending on road safety should be seen as a high priority and as an investment but not a cost so we all need to work together to solve this urgent issue.

Road safety represents a key component of this responsibility, which is directly related to KNSRr's vision of "Simple and safe transportation for all."

Number	Year	Road incident	Killed	Wounded
1	1992	574	372	449
2	1993	591	375	547
3	1994	559	421	535
4	1995	399	306	333
5	1996	381	257	258
6	1997	370	266	319
7	1998	434	308	339
8	1999	468	274	383
9	2000	429	280	336

10	2001	400	297	250
11	2002	328	250	228
12	2003	363	267	250
13	2004	804	315	804
14	2005	850	308	875
15	2006	1018	277	1051
16	2007	1254	384	1344
17	2008	1208	303	1256
18	2009	1465	378	1455
19	2010	1564	353	1716
20	2011	1876	322	2150
21	2012	1870	334	2235
22	2013	2075	295	2503
23	2014	1914	264	2353
24	2015	1992	270	2422
25	2016	2033	269	2510
26	2017	1978	222	2389
	Shuma	27197	7967	29290

SWOT analysis for Albania

In order to see the impact and validity of the application and use of Intelligent Systems in our country as well, following the tabular data above as well as those in the Annex, by asking their question, we will develop their analysis. SWOT with control as below.

Strengths

- There is a National Transport Plan.
- All classic modes of transport are carried out in the region: land, sea, rail, and air; Basic transport infrastructure exists.
- The intersection of the two most talented Corridors: North-South and East-West; The connection of this corridor with the Pan-European Corridors of transport.
- Increased mobility in the region.
- Increasing private sector services in all modes of transport; Expansion of interurban and urban bus lines.
- Many sea and land transport companies.

Disadvantages

- Unsatisfactory management of urban traffic and signage.
- The poor condition of rural and urban roads and their maintenance; Lack of opening for parking/parking in the second row.
- Lack of roads for pedestrians and lanes for cyclists.
- The inefficiency of freight carriers with pick-up trucks, vans, and trucks; Not high standards of road doctors, the large number of accidents,
- average driving skills, pedestrians in crosswalks; Limited access in rural areas to public transport.
- Education at low levels with traffic rules.
- A small number of exchanges of transport modes.
- High level of environmental pollution from old and heavy vehicles; High and unnecessary number of heavy vehicles in urban areas.

Opportunity

- The best combination of transport types (road, sea, rail, air).
- Improving connections between the main elements of transport: port-railway, airport-highway.
- Improving traffic management at all levels; Incorporating transport planes into new urban plans; Improving public transport at all levels; Removal of unnecessary heavy vehicles from urban areas;
- Insurance policies for motor vehicles that consider the degree of environmental pollution and the encouragement of more ecological means and ways.
- Training for traffic management and road safety; a better combination of transport modes.
- Improving the financial management of public transport (price-subsidy); Increasing the participation of private business in transport investments.
- The use of Intelligent Transport Systems for the coordination of different modes of transport, for increasing road safety and traffic management

The Risks

- Increasing the number of traffic jams; Lack of plans and their implementation; Increase in the number of tools by about 30% per year; Insufficient parking;
- Failure to improve safety, reduce accidents, fuel quality, and pollution levels (health costs);
- Failure to improve the road network.

- Failure to improve public transport (in quantity and quality), abandonment of railway transport.
- Investments in transport may not be compatible with development plans.
- Increasing the number of unnecessary heavy vehicles in urban areas.

Recommendations

Based on the SWOT analysis, these main factors for the successful development of transport in the Region and the implementation of the SIT result

- Improving public transport between cities and municipalities, especially high-speed lines.
- Encouraging the use of bicycles and discouraging the use of heavy vehicles that increase environmental pollution.
- Redesigning the road network, with the shortening of the main internal and external lines and the displacement of heavy vehicle traffic outside urban areas.
- Better integration of traffic management, improving the use of existing transport networks, with the implementation of Intelligent Transport Systems.
- Improving road safety and educating the community about it.
- Improvement of urban parking lots.
- Improvement of road maintenance.
- Improving connections between different modes of transport.
- Improvement of rural roads
- Review of transport policies focusing on SIT

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