

THE CONTRIBUTION OF ROAD TRANSPORT TO SUSTAINABILITY AND ECONOMIC DEVELOPMENT

A PIARC SPECIAL PROJECT

STATEMENTS

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THE CONTRIBUTION OF ROAD TRANSPORT TO SUSTAINABILITY AND ECONOMIC DEVELOPMENT WHY ROADS ARE SO IMPORTANT

Road transport and road infrastructures are keys to the evolution and prosperity of modern society. Connecting people and places, goods and services in safe, efficient and sustainable way is essential for creating and maintaining sustainable and inclusive growth across society and the economy.

This report introduces a constellation of known literature and studies that underline main points, while it refers to a series of interviews with key stakeholders and influencers from the road transport industry. These interviews translate into valuable case studies from both high, middle- and low-income countries and they are testimonials to how roads contribute positively to local, national and international challenges, and how strategic goals have been met by road-related projects.

Although challenges might be different, the need for road infrastructure is constant and a ground pillar for mobility. Well built and maintained infrastructure allows vital societal functions to flow and interact across sectors, demographic boundaries and national borders.

Roads enable us to commute to work, send our children to school, get to the hospital and transport goods between manufacturers and to the end-users. Roads have a positive effect on economic growth and societal development.

The construction of roads to support commerce and communication between people and countries has increased living standards and economic activity and it has been a driver for peace and prosperity.

Investments in road infrastructure provide value for money; not only as a way to consolidate and improve trade and economy but also as a resource for inter-cultural understanding, exchange of knowledge and regions integration.

Some of the most important benefits of roads are:

- Stimulating economy and **increasing productivity and GDP via reducing the cost of producing and trading goods, improving access to more productive jobs and encouraging inward investment.**
- Reducing poverty **through improved access to education, healthcare and jobs, and fostering a more healthy and productive society.**
- **Crossing borders and** creating regional synergies **through trade and mobility.**
- Reducing rural isolation **and boosting development.**
- Increasing society wellbeing and sustainability through improved access to services – health, education, culture.

These outcomes can be achieved through adoption of sustainable planning practices that deliver improvements that last for the long term. Decisions makers can use the following principles to ensure sustainable and long term returns on investment that maximises outcomes:

- Undertake **socio-economic analysis**.
- Monetise **non-financial costs and benefits** wherever possible, including **direct and indirect costs and benefits**.
- Use **transparency** and public consultation.
- Integrate road safety and environmental standards in **roads design**.
- **Integrating roads** with other transportation modes to ensure maximum connectivity for all.
- **Using asset management** methods to ensure reliability can be maintained throughout the lifetime of the road infrastructure **optimizing the maintenance** works and costs.

In a world with climate crisis, resource scarcity and multiple other challenges, sustainable development is a must - and roads contribute to this in so many ways. This short report describes but a few.



Image source: Hakan Nural, Unsplash

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1. ROADS & OTHER TRANSPORT MODES

Most of what is presented in this report is relevant for road transport but also for transport in general. Other transport modes also impact the economic and social development of society, but roads offer some unique advantages.

The obvious complement to roads as inland transport is rail, as sea transportation typically is concentrated to goods, quite often intercontinental and does not include door-to-door delivery. The environmental performances of rail are well known, in interurban as well as in urban settings. This is primarily due to the great passenger capacity and the high electrification of rail, which ensures a low carbon footprint per passenger or tons. Bus transport has a somewhat similar advantages and in addition more flexibility (near door-to-door, change of itineraries...), and much lower infrastructure investment.

In terms of personal freedom, individual mobility, convenience and efficiency, cars are usually the most popular solution, followed by busses, air and rail. Put together, cars and busses account for, more than 80% of all transport modes used by citizens in the European Union.¹

Bus transport, which is a widely used form of public transport, relies on road infrastructure.

Looking at freight and passenger transport, rail is widely used in America, Asia and Europe, while not so much in Russia and Africa. Interestingly, rail is used almost exclusively for freight in the USA, while in Asia & Oceania, passenger transportation by rail is predominant over freight transport by rail.²

It is interesting to compare rail and road transport in the food chain as an example³:

Globally, the demand **for mobility will grow over the next 3 decades from about 44 to 122 trillion passenger-kilometers between 2015 and 2050**. Private vehicles will remain the preferred mode of personal travel, according to OECD. **The global demand for freight will equally triple**, with most of the tonnage being carried by ships. Urban roads will remain highly used as means of both freight and passenger transportation, whereas the urban transportation probably will shift towards rails and other local modes (metro, busses, bicycles) and more carpooling. However, due to the overall growth in the global population, **roads and private cars will be dominant in the big picture with the number of passenger cars growing from 1 billion in 2015 to 2 billion in 2030 and 3 billion in 2050**.

Source: ITF (2019), *ITF Transport Outlook 2019*, OECD Publishing, Paris, https://doi.org/10.1787/transp_outlook-en-2019-en.

¹ EU transport in figures. Statistical Pocket Book, 2000, European Commission, Directorate General for Energy and Transport

² RAILISA (RAIL Information System and Analyses). <https://uic.org/support-activities/statistics/#Rail-transport-in-the-world>

³ ECA Special Report No 8/2016 "Rail freight transportation in the EU: still not on the right track"

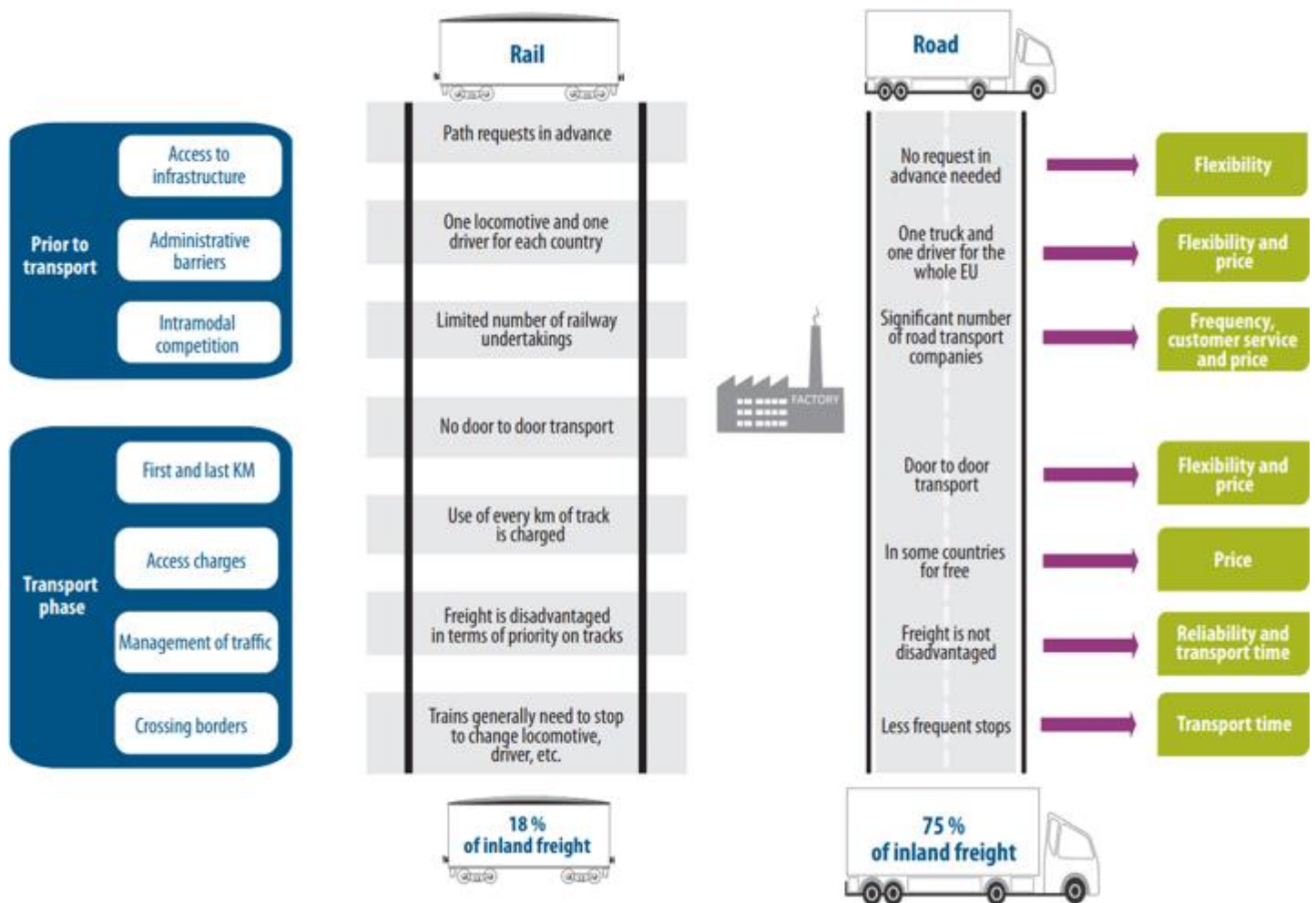


Image source: Special Report Rail freight transport in the EU: still not on the right track, EUROPEAN COURT OF AUDITORS, European Union 2016.

This figure refers to the situation in EU, but also in the USA and other places. In particular, road transport offers unique solutions for the door-to-door/last mile problem, both for passenger and freight transport.

An additional aspect is that road transport also offers high reactivity compared to rail, since one truck needs limited cargo to be ready to go, while a train needs 50 to 100 times more cargo to be efficient. Road transport is way more suitable for cargo on demand and rapid and reactive deliveries which are developing fast over recent years.

Regarding the pricing, it is important to highlight that even if the use of the road infrastructure is free in some countries, road users pay consequent taxes through fuel taxes. In most of the European countries, these taxes are higher than the total investment on the road sector. As an example France collected 33 billion Euros from fuel taxes in 2018, while the total investment on roads including national, regional and local authorities was estimated at around 13 billion Euros in 2018. On the other hand the pricing of the rail infrastructure to road operators often includes electricity.

Also, the economic challenges of establishing a rail network as compared to building, maintaining or expanding an existing road network are quite different. In many cases, connecting and improving roads, including interurban and rural roads, is an important and affordable step for LMIC's.

Intermodality between rails and roads and other modes of transport is however essential. The transport system should be analysed as a whole, and optimum solutions identified.

2. THE ROAD TO SUSTAINABILITY

The concept of sustainability when it comes to roads has at least two significant meanings;

1. Sustainable infrastructure that is safe, reliable and environmentally friendly (preferably built with reusable and/or local materials, protecting flora and fauna). This kind of sustainability also refers to affordability for the society, as roads are a very valuable asset that needs resources to be built and maintain, but also delivers vital support to modern society that is worth at least the investment, which brings us to the second meaning;
2. Sustainable development, driven by road infrastructure, where the road network contributes positively to achieving societal goals and mitigating societal challenges, to the benefit of all stakeholders - road users, consumers, businesses and less tangible elements like wildlife, nature and the environment. This kind of sustainability also refers to affordability to the users and inclusiveness for all sectors of the society (women, children, elderly users, and users with disabilities).

The UN 2030 Agenda for Sustainable Development lays out 17 goals that support societal aims, spanning from abolishing poverty and hunger to gender equality, peace and partnerships. As a simple example of how well-designed transport policy can help to deliver this agenda, a case study from the Danish Bicycle Federation shows how cycling (and cycling infrastructure) supports 11 of the 17 goals. Other case studies achieve multiple goals as well. Much of the success of the Danish case study can be contributed to the low cost and carbon footprint of bicycles, but more importantly, to health, education, markets and new possibilities - in short; mobility and accessibility.

The same mobility is critical to achieving higher living standards and flexibility, whether you live in California or Chile and whether you drive an electric car or ride on a school bus. The cases from Contra Costa in California and Caminos Basicos in Chile show that the challenges and solutions often begin and end with the road infrastructure itself.



A sustainable road is a road that contributes to societal goals and it is cost neutral. It is then up to politicians, the industry and the communities to make the best use possible of the roads, like introducing transportation modes that have a lower carbon footprint such as bicycles, buses or electric vehicles, while they remain affordable and inclusive for the users.

3. ECONOMIC BENEFITS OF ROADS

The main purpose of road transport is to provide access between locations for business and people.

For the business sector, this means easy access to suppliers, markets and clients. For citizens, it means access to work, education, shops, healthcare facilities, cultural activities, family and friends.

Road infrastructure provides benefits for both direct users and indirect users. Without good road infrastructure, transportation of goods and people are limited and inefficient. Even a citizen that never takes the road, will receive goods and services that used the road transport. Road construction and maintenance also provides both skilled and unskilled job opportunities⁴.

As approximately 15% of the GNP is spent within road transport and infrastructure in industrialized countries⁵, these huge investments must be preserved in a sustainable way to the best of our ability for future generations. Road infrastructure usually represents the most valuable public asset of each country⁶. Asset management techniques that do not provide the needed maintenance and induce loss of value to road assets are not sustainable over the time. The value of a road should also be viewed from a socio-economic aspect. Such a value is often far greater than the pure monetary aspect. Both monetary and socio-economic aspects require well-planned maintenance and operations to maximise socio-economic benefits.

Filling in a missing road link or a missing connection from road transport to another transport mode can improve passenger and freight transport through improved accessibility. This enables people and freight to travel further at reduced costs. Improvements in capacity means less congestion, less CO₂ emissions and improved reliability. Good access may encourage businesses (such as logistic companies) to locate nearby.

Reduced transport costs may help new companies enter the market. More companies will increase competition as the market price decreases and the output produced increases. In this way, consumers will benefit from more services and cheaper goods.

People are more likely to work and enter the jobs market where they have access to employment. Transport investment in areas where there are significant transport barriers to accessing work can help development in less developed regions. There are also opportunities to increase productivity through better matching of skills to jobs, supporting workers to access more productive jobs through improving transport commuting links.

Countries in less developed regions experience rapid economic growth when they are able to trade in international markets, and transport networks and particularly road networks are fundamental in providing this access.

Low-income countries, which often lack basic transport networks, but also middle-income countries stand to make significant economic gains by improving their road transport infrastructure.

Global studies⁷ of how highways contribute directly to economic development show that particularly Low- and Middle-Income Countries (LMICs) will benefit from improved export of

⁴ Aschauer, David Alan (1990). "Why is infrastructure important?" Federal Reserve Bank of Boston, New England Economic Review

⁵ Grennberg T., Olsson U., (1996). "Funktions-entreprenad på väg – Restvärdes bedömning vid avlämnandebesiktning". Teknisk Rapport 1996:04, Tekniska Högskolan i Luleå (Swedish).

⁶ PIARC Technical Report "Preserve your country's road to drive development", 2016

⁷ Aschauer, David Alan (1990). "Why is infrastructure important?" Federal Reserve Bank of Boston, New England Economic Review

industrial goods, boosting local and national economies through trade and reduced overall production costs. An illustrative example is the Republic of Korea, that has moved from being a LMIC in the 1960's to a HIC in present day. This major change was intensively supported by road infrastructure development, with a good help from their extensive expressway construction, and the subsequent intelligent handling of maintenance and operations⁸

Studies of well-planned and designed infrastructure investments show that the revenue gained outweighs both the costs of building and maintaining these vital societal assets. On a global scale, the massive investments in road infrastructure by countries such as China, Norway and Singapore have proven to be national economy boosters, while other countries, for example in South America and Africa have suffered the consequences of only investing a few percentage of their GDP in roads and other important infrastructure⁹.

3.1. REDUCING POVERTY AND ENHANCING RURAL AREAS

Establishing and maintaining rural roads to decrease poverty.

Studies from the International Food Policy Research Institute have looked at the most effective use of scarce public budgets for reducing poverty in rural areas and found that next to agricultural expansion, investing in rural roads in many countries including China, India, Vietnam and Uganda is the most effective way¹⁰.



Image: Ministry of Public Works, Santiago

⁸ Shon, Eui-Young, University of Seoul, Professor, Expressway Construction and Management, 2013 by Ministry of Strategy and Finance, Republic of Korea

⁹ M. Nicolas Firzli & Vincent Bazi "Infrastructure Investments in an Age of Austerity : The Pension and Sovereign Funds Perspective".

¹⁰ Fan, S., Brzeska, J., & Shields, G. (2007). "Investment Priorities for Economic Growth and Poverty Reduction". Washington DC: International Food Policy Research Institute.

The World Bank¹¹ estimates that around 900 million rural dwellers, mainly in LMIC and mostly the poorest communities in each country, are without reliable transport access. Roads networks are in most of the cases the most suitable transport infrastructure to provide transport in these rural roads.

The Caminos Basicos - rural roads - programme in Chile has introduced new ways to maintain and improve local roads with the help of local work force and local materials, boosting local and national economy and providing value for money, while saving natural resources. The programme is a landmark and is being source of inspiration for many other countries in the region.

The Caminos Basicos program on top of providing resources to build and improve rural roads, it obtained visibility and public support for the rural roads program. Most of the individual road projects were just a few kilometers long and improving connectivity of limited number of users in a specific rural area. However, each time the whole program reached a milestone, for instance 3,000 km of rural roads improved through Caminos Basicos mechanism, there was an important communication event with national press and President of the country opening the new project a few kilometers long but that summed up to the 3,000 km milestone.

Numerous countries in Latin America from Bolivia to Nicaragua, have developed micro-enterprises to build and maintain rural roads. Local communities are given training and equipment to build and maintain rural roads, paying them for this work through micro-enterprises which increase the revenues of local communities as a first step of development. The second step for development follows immediately, since thanks to the new rural road infrastructure public authorities can provide support to develop agricultural and other micro-enterprises which will use the rural roads to access markets.

Some of these micro-enterprises have operated successfully with a specific social approach, employing only women, or widows, or some other social groups in need of support. The World Bank is currently exporting these principles to other regions in Africa and Asia.

Better roads in rural and isolated regions can increase the number of people engaged in economic production and reduce inequality. Farmers can sell more of their produce.

Public investments in rural roads provide some of the best returns on investment in terms of reducing poverty and promoting agricultural and non-agricultural growth.

Also, improved rural roads provide access to health care and may also have a positive effect on gender equality as more women gain access to education and other services.

Rural roads can also have an important impact on peace and country cohesion. The rural roads are believed to be a key element in finding the solution of national armed conflicts in Latin America, such as the ones suffered in Colombia or Peru. When the rural roads program entered regions controlled by the guerrilla, there was both a change of support from local populations to armed groups as they saw the government taking care of their regions, and easier access for military government forces to operate in those regions.

¹¹ The World Bank Group (2008). "Safe, Clean, and Affordable". Transport for Development. The World Bank Group's Transport Business Strategy for 2008-2012. Washington DC: The World Bank

4. ADDED BENEFITS OF ROADS

4.1. IMPROVED ROAD SAFETY AND CASUALTY REDUCTION

According to data from the World Health Organization, lack of road safety in the world is the leading cause of mortality in low-income and middle-income countries with 1,3 million deaths globally per year, and it causes between 20 and 50 million injuries every year. It is the leading cause of death among the 15-29-year-old, a key segment for the sustainability of our societies, and primarily causes the death of vulnerable road users: half of the people killed are pedestrians, cyclists and motorcyclists. Accidents are very costly to the economy and to the society. It takes up nearly 3% of the GDP of most countries and is likely to be the seventh most common cause of death by 2030. Conversely, increased *traffic safety* greatly reduces the burden of lives lost and healthcare costs. Low-income and middle-income countries account for 93 % of the number of deaths, while the same countries account for only 54 % of the global fleet¹².

The World Health Organization¹³ says that the risk of dying in a traffic accident in Africa is 26.6 in 100.000 inhabitants, whereas in Europe it is 9.3. African mortality rates are higher than in any other global region. 25% of all death related events in Africa come from road accidents.

4.2. HOW REDUCING TRAFFIC MORTALITY BOOSTS NATIONAL INCOME

In 2010 alone, the total economic cost of motor vehicle crashes in the United States alone was US\$ 242 billion. This represents the present value of lifetime economic costs for 32,999 fatalities, 3.9 million non-fatal injuries, and 24 million damaged vehicles¹⁴.

Reducing deaths from road traffic incidents (RTI) has a notable positive effect on economic growth. A World Bank Study shows that reducing fatal accidents by 50% over a sustained period of 24 years has the potential to produce an additional flow of national income as large as 7.1 percent of 2014 GDP in Tanzania, 7.2 in the Philippines, 14 in India, 15 in China and 22.2 percent in Thailand¹⁵.

The single element having more influence in the severity of a road accident is the road infrastructure¹⁶. All this alone can justify cost-benefits analysis (CBA) for more investments in a better and safer infrastructure.

Roads separated by travel direction has been proven to reduce traffic accidents remarkably with a not so big investment. An example from Sweden showed a reduction of seriously injured or killed road users by more than 50%¹⁷. The example had an investment cost of US \$2.7 million and showed a net gain (in traffic safety) of \$1.1 million per year. Even when including operational cost, the break-even point was reached after only 5 years while some of the road assets will provide services for decades.

¹² World Health Organization (WHO). "Global status report on road safety 2018". Geneva: World Health Organization; 2018. Licence: CC BY-NC-SA 3.0 IGO.

¹³ World Health Organization (WHO). (2015). "Global status report on road safety 2015". World Health Organization.

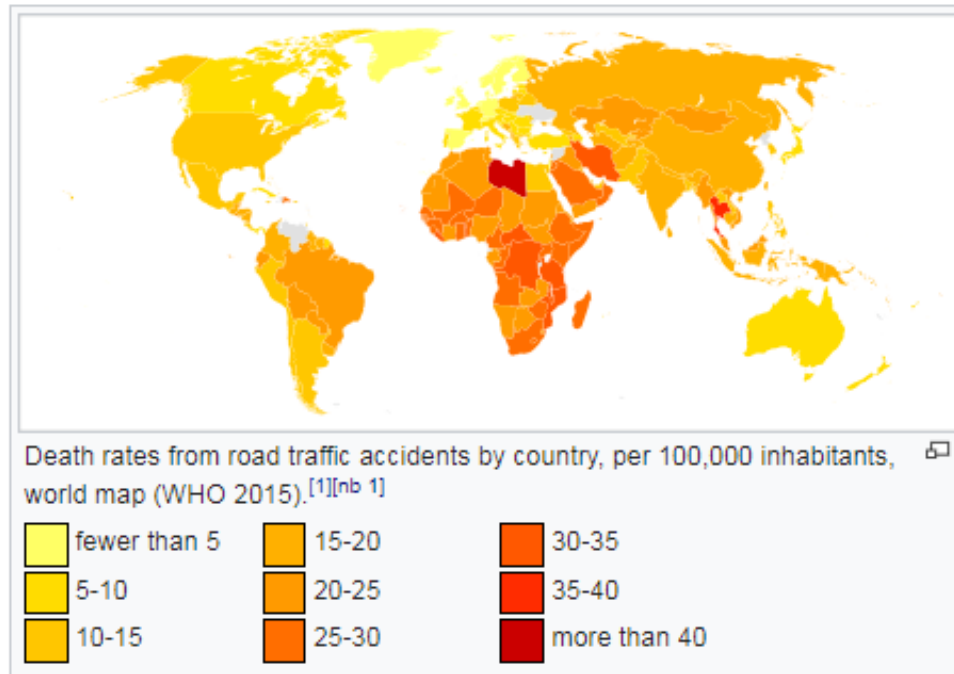
¹⁴ Blincoe, L. J., Miller, T. R., Zaloshnja, E., & Lawrence, B. A. (2015, May). "The economic and societal impact of motor vehicle crashes, 2010". (Revised) (Report No. DOT HS 812 013). Washington, DC: National Highway Traffic Safety Administration.

¹⁵ World Bank, 2017. "The High Toll of Traffic Injuries: Unacceptable and Preventable". World Bank

¹⁶ PIARC Online Road Safety Manual <https://roadsafety.piarc.org>

¹⁷ Vadeby, A., Anund, A., Björketun, U., & Carlsson, A. (2013). "Säker framkomlighet, sammanfattande resultat". Linköping: VTI.

This shows that evaluating the life cycle of construction, in relationship to the investment, makes it easier to justify decisions on road safety. A key to success is to understand that one must take the whole economic lifespan into account when doing the CBA.



Death rates from road traffic accidents per 100,000 inhabitants. WHO 2015. Mortality in Africa from road accidents is higher than anywhere in the world. As serious accidents are costly to every society, investments in safety measures like smooth roads, guard rails and signs are vital to maintain sustainability in society.

4.3. ROADS DRIVE AGGLOMERATION AND IMPROVE ACCESS TO SERVICES

One positive impact that follows from implementing road infrastructure is the agglomeration of economies alongside, and in close proximity to, the road.

The effects of lower transport costs are also transferred to non-transport markets as households and businesses change their behaviour. For example, a reduction in transport costs may lead to new firms entering the market due to lower overall production costs. More firms in one market will increase competition.

This will ultimately result in a more efficient market as the market price decreases and the output produced increases as a response to more competition. Consumers will then benefit from more services and goods to a lower cost.

Improved accessibility increases the attractiveness of a region and may lead firms to relocate closer to each other. More firms in one region leads both to more competition between firms, greater specialization and an increased industry diversity¹⁸. Cities or dense environments provide economic benefits, so-called agglomeration economies. The general relationship between economic density and productivity is very robust and strong, that is, actors in dense environments are much more productive than actors in sparse environments.

¹⁸ TENTacle (2016). "Impact analysis of the TEN-T Core Network Corridors in the Baltic Sea Region". TRV 2016/38557 Trafikverket

For people, improved connectivity will also provide access to more productivity jobs. Increased accessibility to a region may enable the possibility of commuting to other cities and regions. Improved accessibility in combination with increased industry diversity leads, not only to more workplaces, but also to a greater variety of occupational opportunities for more workers. This in turn increases the probability of a better match between the employer and the employee.

It is possible to calculate GDP increase for different road corridors when planning and deciding on investments. It is shown that better and new networks do affect GDP in terms of reduced transport costs which then increases revenue from products and therefore decreases poverty. In a Nigerian project described by Rubaba et al, a numerical model is created to estimate GDP increase per different road corridor options¹⁹. The World Bank²⁰ estimates that road improvements will positively affect crop and livestock revenue, and also increase in employment, poverty reduction and increased wealth.



Improved access to work and markets plays an important role in the sustainable development of LMICs and of regions. Image: UNSPLASH.COM

4.4. ENVIRONMENTAL AND HEALTH BENEFITS OF ROADS

Road investments and road maintenance saves resources, lives and preserves environment. With the contribution of ECRPD (Energy Conservation in Road Pavement Design, Maintenance and Utilization) it is possible to evaluate the energy needed for construction, maintenance and traffic on a road over the course of the life of the road. Energy savings with up to 47% from an LCC perspective can be achieved for the various stages of a road's life²¹.

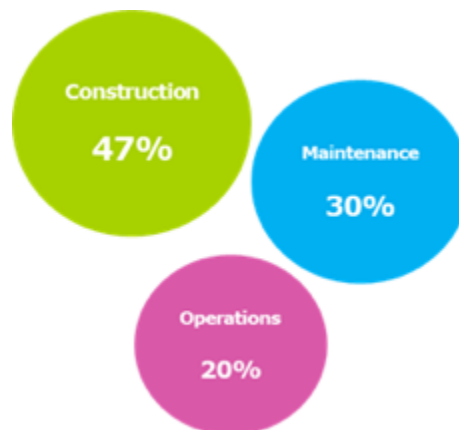
The biggest share of the carbon footprint from road sector is produced by the vehicles using the infrastructure. Having a pavement in good condition significantly reduces the carbon footprint of the vehicles by reducing the friction to their movement. One m² of highway pavement preserved in good condition over the 30 years, will have a carbon footprint for building and maintenance of 30

¹⁹ Rubaba, A., Barra, F., Berg, C., Dalmania, R., Nash, H., & Russ, J. (2015). "Highways to Success or Byways to Waste: Estimating the Economic Benefits of Roads in Africa". Washington: World Bank.

²⁰ The World Bank (2008). World development report 2008. "Agriculture for Development". Washington DC: The World Bank

²¹ Carlson, A. Mellin, A. "Life cycle assessment of a road investment – estimating the effect on energy use when building a bypass road". CTS Working Paper 2013:23. Stockholm: Centre for Transport Studies, KTH

to 50 CO₂ kg²², at the same time if it is kept in good condition it will reduced the carbon footprint of the vehicles using it in 2,350 kg of CO₂²³.



Potential energy savings (%) in various stages of a road life cycle

Road infrastructure, is critical to the economic and sustainable development of countries. At the same time, it is increasingly being recognised that the processes by which the infrastructure is designed, constructed, maintained and operated also need to minimise negative impacts such as pollution and greenhouse gas emissions. Improving all aspects of road infrastructure energy efficiency has become a key challenge for road administrations and managers.

Over the last few decades significant research has been undertaken to make reductions in the amount of energy used by roads and develop innovative systems to make roads into a potential source of energy. In 2019, PIARC developed a Special Project on Positive Energy Roads (PER) which can be found on the PIARC website.²⁴

PER have the potential to make a significant contribution to decarbonisation of road transport. Increasing global pressure on sustainable development in response to unfolding climate change impacts, and the growing capacity constraints on energy resources make it imperative to reduce use of fossil fuels. Depending on national strategies for renewable energy generation, PER can have an important role both in terms of reducing the overall energy consumption and increasing their potential for power generation that are less dependent on external sources of energy. The typical sources of energy for these applications, solar and wind, are renewable. The ultimate goal is to reach a stage where the road infrastructure is energy neutral or even becomes a net exporter of energy.

For these reasons PER have become an interesting approach to road administrations and managers, and bring an interesting complement to this report on Contribution of the road transport to economic growth and sustainability.

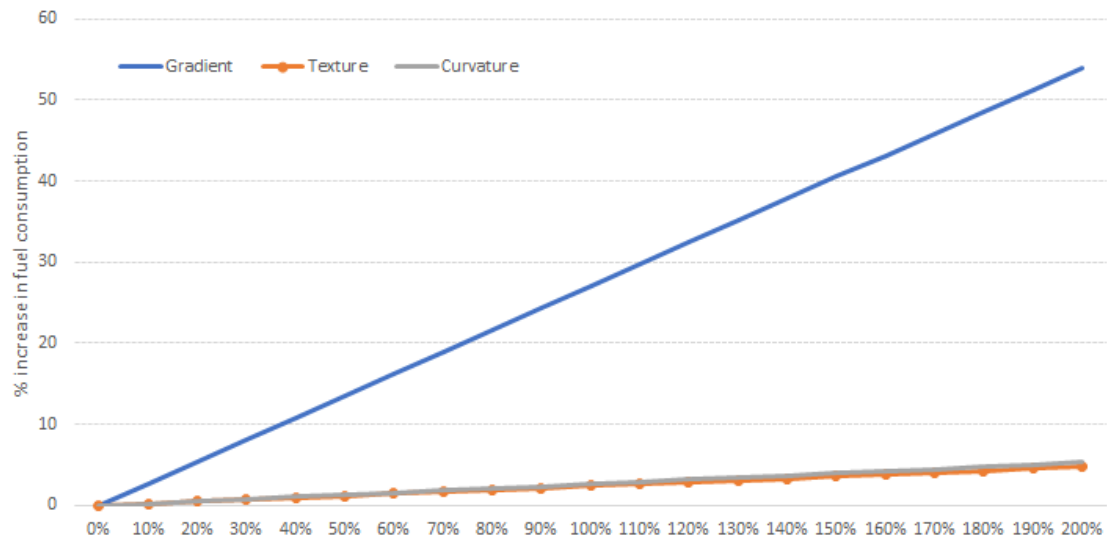
In high income countries (HIC) most of the roads are already in place, which means that we can make a big environmental impact through properly planned investments in the existing road network by considering energy and CO₂.

²² PIARC Technical Report "Reducing the Life Cycle Carbon Footprint of Pavements" 2019, available at <https://www.piarc.org/en/order-library/31426-en-Reducing%20the%20Life%20Cycle%20Carbon%20Footprint%20of%20Pavements>

²³ Road Maintenance Day cards available at <https://roadmaintenanceday.org/resources/>

²⁴ <https://www.piarc.org/en/order-library/31272-en-Positive%20Energy%20Roads>

Road condition and road geometry has a significant impact on the energy consumption (and thereby CO₂ emissions) for road vehicles. Hilly, curvy and poor roads lead to increased energy consumption no matter if the vehicles are electrified or using traditional fossil fuels. These road parameters are decided in early planning and design and may be considered when investing in roads for a better future climate.



Improvements in fuel consumption from changes in road condition and geometry²⁵

The influence from road characteristics is especially noticeable for heavy trucks, where fuel consumption may increase by a factor of 30 when going steep uphill compared to a flatter road with a different itinerary of a tunnel solution for instance.

²⁵ RoadERANet, 2013. "MIRAVEC - Models and methods for the estimation of fuel consumption due to infrastructure parameters. Deliverable 2.1: Models and methods for the estimation of fuel consumption due to infrastructure parameters". VTI, Sweden, 2013

Investments aimed at improving road altimetry or surface smoothness have an immediate effect on the CO₂ emissions from road traffic. The sooner actions are undertaken to improve these aspects, the sooner CO₂ emissions will improve in a lasting manner.



Improving road altimetry and surface smoothness is one of the most effective reductions of CO₂ emissions. Even after a full electrification of our vehicles the effect will remain in place, saving energy through improved roads. Image source: Ludovic Fremondiere, Unsplash

4.5. ACCELERATING SCHOOLING AND HEALTHCARE

A study from 2012²⁶ analyses the effects of providing all-weather roads to villages in a poor, drought-prone region of India. The study looked at effects in three domains: 'commercial' (output and trade), education, and health, with the following main results:

- 1) An all-weather connection measurably reduced unit transport cost.
- 2) Pupils in all three levels of the school system lost substantially fewer days of schooling, due to bad weather, in large part because their teachers had fewer such absences.
- 3) The acutely sick received more timely treatment and were more likely to be treated in a hospital than in the nearest primary health clinic.
- 4) The respondents ranked the ensuing benefits in the domains of health and education at least as highly as those in the 'commercial' domain."

²⁶ Bell, C., & van Dillen, S. (2012). "How does India's rural roads program affect the grassroots? Findings from a survey in Orissa". Washington DC: Policy Research Working Paper 6167, World Bank.



Improving road conditions improves the living conditions for the neighbours to the roads, due to less dust and noise. It also increases access to local businesses, schools, health care facilities and shopping. Applying thin layer asphalt and granular course stabilization has greatly improved the service level of the roads in Chile. Image: Ministry of Public Works, Santiago

5. SUSTAINING YOUR ROADS

Given the economic and added benefits of roads, described above, the prioritization of projects that support this is vital for sustainable development, no matter the economic level and status of the administration and society in question.

5.1. HOW TO DEFINE AND ASSESS ROAD ASSET VALUE

The figure below displays a way of defining the value of a road asset by using a combination of *four components*.

- 1) The components are connected to the *standard of the road* and to the *maintenance strategy*.
- 2) This definition is based on both the actual *monetary investment* and the *use of the road*.
- 3) A poor *road condition* means reduced usage and longer travels time.
- 4) This, in its turn, leads to *increased road user costs* and less possibilities for transportation of goods and people.



The road asset value - on a given network or project - can be defined and calculated by looking at these four key components. With regards to societal sustainability, all four items are connected to personal well-being as well as national economy.

The amount of resources allocated for investment and maintenance of the road network only constitutes a minor part of the true asset value for society. Road user costs and transport accessibility value highly exceeds investment and maintenance cost over time. Therefore, the positive effect on society from a proper road maintenance management is huge.

5.2. MAKING MAINTENANCE DECISIONS

What guides maintenance investments and operations?

The condition of the road is one of the key components influencing public costs of transportation. Parameters like vehicle operation costs, costs for extra travel, costs for extra CO₂ emission time and costs for accidents all depend on how we manage the road maintenance.

Regarding the most optimal maintenance strategy all studies point in the same direction, namely:

Preventive maintenance is always more cost effective for society in the long-term, compared to reactive acute repairs.

Modern road asset management includes a proper prioritization between options should be built on objective data about the road network, such as traffic and road condition. These data are then combined with other information such as budget and investment plans and socioeconomic aspects, in order to produce an asset management plan that embraces all factors. Such an analysis may also be modified in such a way that budget restrictions are replaced with a desired goal - for example a road standard or customer satisfaction level. The result will then be the budget needed to reach that goal.

When working with road asset management it is often useful to have a digital planning tool, in which all the data about the road network is gathered, including road condition surveys. These kinds of systems are often GIS based and data on the road condition (among many other things) may be easily visualized with colour scales, from red (poor) to green (good). PIARC produces the road asset management tool HDM-4 which is used in several countries and requested by the World Bank and other multilateral investment banks when evaluating road investments.

These tools exist in many forms with different analysis capabilities. Some of the systems offer advanced and automated maintenance optimizations and production of detailed work plans, while other systems are more of a modern database with plenty of possibilities for GIS-visualization of the actual road condition or other input data. All these tools contribute to a culture of objective road asset management and provide useful results to explain to decision makers and politicians the investments needed in the road infrastructure.

5.3. OTHER COSTS RELATED TO MAINTENANCE AND OPERATIONS

Other important planning topics are user costs and interference cost; what is the cost of delaying traffic, increasing journeys by re-routing, using more fuel? Roughly estimated, the total maintenance interference cost is 10 percent of the total cost of a project.

Every project leader and decision maker should be mindful of the socio-economic costs and benefits of building and maintaining roads. Overall, on the large scale, road building has positive CBA for society, so politically, it makes sense to allocate public resources to roads. With careful consideration to environmental issues and the road neighbours, the introduction of new and improved roads should always be welcomed.

6. GLOBAL CASE STUDIES

Six global case studies, specially made for this report, describe how roads:

- Provide **Value for money** using local resources in road building (Chile)
- **Support UN goals** through game changing introduction of classic technology (Denmark)
- Create **Sustainable and safe mobility** through innovation and collaboration (California)
- **Empower local communities and tourism** through micro enterprises (Peru)
- **Benefit LMIC countries** through improved planning and programming (Africa & Asia)
- **Secure societal investments** through best practices in road management (UK)

These case studies have been selected because they provide complementary approaches to - and evidence of - the contribution of road transport and sustainability in different regions. Each of them is representative for thousands of other projects developed all over the world.

The case studies, along with international studies and reports from various organisations and scientists show how road infrastructure brings substantial benefits to society and economy through directly stimulating growth and reducing poverty through job creation, improved mobility and access to vital societal functions.

Added benefits include "agglomeration" as cities and regions become better connected and grow together. For LMIC there are specific benefits in the way roads address rural isolation and lack of development, as well as improved safety and health, as roads provide better access to schools, hospitals and markets.

The following is a brief introduction to the Case Studies. The full case studies can be found on the appendix of this report.



The case study from United Kingdom Department for International Development mentions three important reports and four handbooks that guides maintenance with HDM-4 and that can form the basis for sound asset management. They can all be found on the PIARC website. Image source: Simon Zhu, Unsplash

6.1. CASE STUDY 1 ABSTRACT: CAMINOS BASICOS - RURAL ROADS, CHILE.

“Caminos Básicos” is the name of a very well-organized road development program in Chile, which has been running for more than 10 years, successfully bringing mobility and connectivity to rural areas.

Of the 82,000 km comprising the Chilean rural roads network, only 25% are paved. Apart from disturbances to road users and inhabitants close to the gravel roads in the form of noise and dust, a vision for overall better access to work, commerce, education and health care were the main reasons for the introduction of the Caminos Basicos programme. Improved road safety and roadside environment were other factors that were considered.

One of the big achievements of Caminos Basicos program has been the provision of media- and public attention to the rural roads, which are usually just a few kilometres long and link low populated areas. The program started with the 3,000 km target, when there was an opening of a small rural road section which summed up to the 3,000 km totally improved over the country, a major event was organised with Chile’s President and major media to showcase how the 3,000 km of rural roads brought prosperity to rural communities.

Choosing the right intervention strategies has had great impacts on life quality for the road neighbours and saved natural resources and money by using local materials to maintain and enhance roads. Caminos Basicos has become a role model for the entire South and Central América.



Mr. Ernesto Barrera, Ministry of Public Works, Santiago and coordinator of the strategic theme for Management and Finance under the PIARC Committee on Terminology.

The goals of the program are:

- Improve QUALITY OF LIFE by reducing or eliminating dust generated by traffic and mud in the rainy season.
- Reduce CONSERVATION COSTS caused by too frequent road repair
- Improve BEARING CONDITIONS, reducing the TRANSPORTATION COSTS.
- Promote LOCAL DEVELOPMENT through better conditions for transport of goods
- Improve ROAD SAFETY by reducing dust and improving road conditions
- Improve ENVIRONMENTAL CONDITIONS for agriculture close to the road
- Reduce the ENVIRONMENTAL IMPACT CAUSED BY ROAD INTERVENTIONS.

6.2. CASE STUDY 2 ABSTRACT: DANISH BIKING

Bicycling is a cost-effective, reliable, environmentally friendly and cheap mode of transportation and the bicycle could be the game changer, every transportation planner is looking for. But it is not a quick fix to (re) introduce bicycles; it takes time and care.

A global study shows that if potentials are fulfilled, cycling could save almost 6 Trillion USD worldwide over the next 15 years by way of reducing CO₂ emissions and impact and increasing public health. Cycling supports 11 of the 17 UN goals for sustainability. But upkeep and build out of networks are essential to make cycling a lasting success. And it might take a long time to create a sustainable cycling-culture. The rewards are big, though, and applicable both to developed and developing regions – and especially cities could benefit from more cycling as a mean to reduce congestion and enhance mobility.

***“Moving goods and people
around, creating innovation
and networking, is essential for
modern society and bikes are
one of the most sustainable
ways of securing this”***
Klaus Bondam, CEO Danish Cyclists
Federation, Denmark.

Image source: Søren Svendsen/Scanpix



Cykling meets 11 out of 17 UN goals for sustainable development



1: End poverty

- By enabling access to education, job, markets in an affordable way



2: End hunger

- By providing access to land, resources and markets



3: Ensure healthy lives

- By generating healthy life-styles and minimizing pollution



5: Achieve gender equality

- By providing access and equal transport opportunities for women and girls



7: Ensure access to affordable energy

- By using human power, efficient e-mobility and contributing to co-modality



8: Promote sustainable economic growth

- By including services, tourism, manufacturing and maintenance of bikes



9: Build resilient infrastructure

- By establishing cost efficient bike lanes with flexible traffic



11: Make cities inclusive and safe

- By integration of all kinds of people and by reducing car crashes



12: Ensure sustainable consumption

- By transporting people and goods across especially urban areas



13: Take urgent action to combat climate change

- By immediate integrating cykling into climate action strategies, education



17: Revitalize the global partnership for sustainable development

- By promoting partnerships, sharing data and introducing policies



Goals

Create and maintain a bike-friendly culture. More than 50 % of short trips covered on bikes.

Challenges

New generations want to ride a car. Building and maintaining infrastructure. Mind change needed with decision makers.

Solution

- Once the infrastructure is there, people will move towards biking.
- Prove benefits to politicians.

Benefits

Improved mobility, air quality, safety, health,

Cycling in Denmark

- (5,7 million inhabitants/temperate climate)
- On average Danes cycle 1.6 Km a day (In Copenhagen 3.0 Km a day)
- 49 % of all children aged 11-15 cycle to school
- There are more than 12,000 km of cycle tracks and lanes in Denmark.



6.3. CASE STUDY 3 ABSTRACT: CALIFORNIA SUSTAINABLE MOBILITY

Mr. Randell Iwasaki is the Executive Director of the Contra Costa Transportation Authority, which is a public agency in California. Before that, he was Director of CALTRANS, the California Department of Transportation, where he oversaw almost 20,000 employees and managed a billion dollar budget. He has also served as committee member of the ITS Program Advisory Committee and he chaired the National Freight Advisory Committee for 4 years.

“In my years as public servant, working with transportation and mobility, I have come to focus on two things; safe and efficient mobility and general liveability. The common denominator is the day-to-day contract between taxpayers and transport providers, that supports a society with opportunities to bring people to their destination, no matter their age, gender, social status or abilities.”, says Iwasaki. “We are all dependant on the service roads provide, either in the form of personal transportation or in the form of goods, sustaining our way of living”.



Mr. Randell Iwasaki. Image source: Contra Costa Transportation Authority

Goals

Provide safe and reliable transportation service to all segments of the population, without building out roads and without introducing more cars.

Challenges

Congestion increasing, due to too many cars on the roads, especially in the area between LA and SF. First-and-last-mile issue.

Solution

- *Connected and Automated Vehicles*
- *Car pooling*
- *ITS*

Benefits

- *More people get to pursue job openings.*
- *Older and disabled (and kids) can commute better*
- *Less miles travelled*
- *Cleaner air*
- *Reduced need for expansion of infrastructure*

Facts & figures, California

No. of Commuters

17,000,000

Driving solo 73 %

Carpooling 11 %

Mean travel time to work 26 mins

No of vehicles 14,500,000

No of Electric vehicles

Public Road Miles 175,000

Public Transport

6.4. CASE STUDY 4 ABSTRACT: SOUTH AMERICAN MICRO ENTERPRISES

Fighting crime and poverty. Improving public health. Empowering local communities. Connecting people and cities. Boosting tourism. These are just some of the developments that the micro enterprise model for roads have brought about in South and Central America.

**PERÚ**Ministerio de Transportes
y Comunicaciones

Micro enterprises in Peru – road maintenance creating local sustainability

Goals

To reduce poverty and increase safety, health, education, employment and overall mobility and connectivity.

Challenges

- Cultural barriers (rural boundaries for maintenance were very unflexible)
- Keeping up with World Bank requirements.
- Local lack of interest or faith in the project (uninformed, traditionalists)

Solution

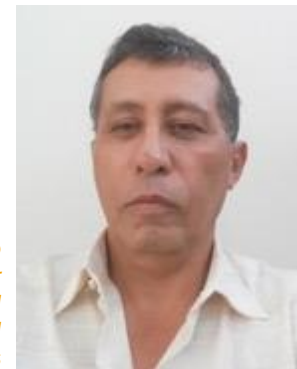
- Three socio-productive programs of Windows of Local Development (VDL) were initiated in the districts of Sauce, Lamas-Localidad de Pamashto and Juan Guerra of the San Martín Region.
- Local labor organizations participated as drivers of the development
- The World Bank establish micro-enterprises and build local companies with local workers

Benefits

Reports show a significant, measurable increase in the quality of life of the population involved with the VDL programme. This includes:

- Permanent local employment
- Higher income level
- Improved access to education
- Improved access to health and basic services

South America in the 1990'ies had several challenges, including terrorism, drug-related crime and poor living conditions in the rural areas especially. In Peru, Bolivia and El Salvador, the introduction of Micro Enterprises in the late 1990'ies proved a viable solution to many socio-economic problems. In this case study, Professor Victor Arévalo Lay, MDI Ing., shares his experiences with the VDL programme of Peru.



Professor Victor Arévalo Lay, MDI Ing., member of the PIARC Technical Committee D.4 Rural Roads and Earthworks

“The programme evolves around road infrastructure, where development is based on a vision to integrate security and sustainability, providing better health, food, education, access to technology and culture. In the 1990'ies the Ministry of Transport and Communication developed techniques and policies in a group with engineers, sociologists and anthropologists as a multi-disciplinary respond to a number of serious problems. One of the goals was to make people feel safe in their homes and workplaces by collaborating with local labor organizations on maintenance of roads”.

6.5. CASE STUDY 5 ABSTRACT: LMIC PLANNING FOR THE FUTURE

Jens Christian Helbech Hede, Senior Director, Management, Civil Works at Ramboll, has an impressively global experience in the field of asset management, including extensive hands-on experience with projects in Africa and Asia. His mantra for success in development is Good Governance. Also, he is an advocate for individual commitment to projects as a way of ensuring long term benefits of investments.

"From 2006–2010, I was team leader and coach for the DANIDA Technical Assistance team to the road administration, TANROADS", Mr. Hede says. "The task was to integrate their previous road management system with HDM-4 and with GIS, to improve road planning and programming. There was nothing unusual in this, but what was unusual and significantly contributed to the success of the project was, that TANROADS had built up an entire department around this project with 4–5 full time allocated employees. This helped immensely as we could rely on a long-term commitment to the project and because this helped to build trust and collaboration with the TANROADS, Tanzania Transport Ministry and Road Fund on annual funding agreements. You might say that we deployed the motor for good governance, but without individual competences and commitment, we would not have made it".

*Jens Christian Helbech Hede,
Sr. Director, Transport at Ramboll*



Image: Ramboll

Goals

- The Tanzania Road Authority, Tanroads, wanted to improve the condition of their roads and achieve the highest possible return on investments.
- They also wanted to revise their existing road maintenance system and procedures as well as contracting format and models.

Challenges

- Decisions had a tendency to be more political than based on objective criteria.

Solution

- A project was launched through DANIDA to develop a new computerized Road Maintenance Management System (RMMS), focusing on management tools for HQ and the regional managerial levels.
- The existing RMMS was improved/redesigned and integrated with HDM-4 and with GIS.
- Modules included Maintenance and Rehabilitation needs assessment, integration with HDM, Performance Budgeting System for routine and recurrent maintenance, Capital Investment Maintenance Programmes and Contract Monitoring System.
- Services included review of institutional arrangement including individual job descriptions and comprehensive training and support during system implementation and change management.
- TANROADS set up a separate department for asset management.
- The project reviewed institutional arrangements and included individual job descriptions and comprehensive training and support during system implementation and change management.

Benefits

- TANROADS are now able to perform objective decisions, based on HDM-4
- Improved road network - reducing costs of road users. Where road upgrading has been

6.6. CASE STUDY 6 ABSTRACT: UK - SECURING SOCIETAL INVESTMENTS

In late 1970's the governments of France, Germany and UK got together to produce a series of Road Maintenance Handbooks for United Nations Economic Commission for Africa (UNECA). By the early 1990s these proved very popular and needed updating. PIARC's Commission on Technology Transfer and Development (formerly the Committee on Roads in Developing Regions) undertook the review, updating and publishing in 1994 with funding from UK DFID, the original donor group and the World Bank. Those 4 x handbooks on Drainage, Unpaved and Paved roads, maintenance of structures are still popular and in use today.

Mr. Colin Gourley has been working for the UK Department for International Development (DFID) as Transport Leader for decades, and he vividly recalls the steps that has led to the successful roll- out of best practices in road upkeep in developing countries:

"Going back to the late 1970's DFID was one of the original donors supporting road management research that found its way into HDM-4 and predecessors. In early 1990s DFID along with the World Bank, the Asian Development Bank (ADB), the Swedish National Road Administration (SNRA) sponsored the International Study of Highway Development and Management Tools, ISOHDM", explains Mr. Gourley. "HDM is important for development – For example, in the last 10 years World Bank have, conducted over 200 road transport project appraisals, amounting to £35Bn of investment, using HDM-4."

"DFID has continued to support HDM and the research that is captured in its models. We have maintained close links with PIARC since 2005 on this and we supported the sponsors move to delegate responsibility for management of the IPR associated with HDM to PIARC. We retain a strong interest in ensuring the success and longevity of HDM-4 (and its successors)", says Mr. Gourley.



Goals

- Systematic and effective road building and management across regions
- Helping development along by securing communications locally, nationally and regionally
- Finding common systems approach to ensure common grounds and connect dots

Challenges

- Local and regional "business as usual" approach
- Lack of investments, in case of underdescribed needs
- Too much focus on already developed areas, as opposed to rural areas

Solution

- Introduction of policies that express needs and procedures to reach service levels
- Alignment of investments on basis on common measurements
- Asset management procedures and systems to align KPIs

Benefits

- Common challenges defined and explained
- Common language through common systems
- Increased investments and improved up-keep
- Better mobility, trade and commerce.

UNECA/ECA

The United Nations Economic Commission for Africa (UNECA or ECA) was established in 1958 by the United Nations Economic and Social Council to encourage economic cooperation among its member states (the nations of the African continent)[2] following a recommendation of the United Nations General Assembly.[3]

It is one of five regional commissions.

The ECA has 54 member states corresponding to the 54 member states of the United Nations that lie within the continent of Africa or in oceans nearby the continent.

APPENDIX – CASE STUDIES FULL PAPERS

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INTRODUCTION TO THE APPENDIX

This appendix presents further details on the six global case studies analyzed in the PIARC Technical Report “The contribution of road transport to sustainability and economic development”.

The six case studies describe how roads:

- Provide **Value for money** through the use of local resources in road building (Chile)
- **Support UN goals** through game changing introduction of classic technology (Denmark)
- Create **Sustainable and safe mobility** through innovation and collaboration (California)
- **Empower local communities and tourism** through micro enterprises (Peru)
- **Benefit LMIC countries** through improved planning and programming (Africa & Asia)
- **Secure societal investments** through best practise in road management (UK)

Through these cases, you will learn more about the economic benefits of roads and how roads can be instrumental in reaching both strategic national and international goals, like the UN goals.

CASE STUDY 1: CAMINOS BASICOS - RURAL ROADS, CHILE

"Caminos Básicos" is the name of a very well organized road development program in Chile, which has been running for more than 15 years, successfully bringing mobility and connectivity to rural areas.

This program for unpaved roads, arose in the 90's, due to the need to address the large number of existing roads in this condition, which caused dust and mud that affected the quality of life and safety of different users as well as increasing operational and conservation costs. It was necessary to protect the granular layers to maintain the investment made and control the aforementioned effects.

The first important experiences were made in the northern part of the country, using salt as a stabilizer of the granular layer, a material of great abundance in the Atacama Desert, and in the central area of the country, with the so-called thin asphalt protection layers in order to give adequate protection to the platform and control the aforementioned negative effects. With these experiences, which began to expand to other regions, at the beginning of the 2000's, the program of basic roads with a national coverage was put together.

Mr. Ernesto Barrera is a civil engineer, from the University of Chile. He has worked in the government since 1993, first in the national road laboratory and then with road design and as head of the management department. In 2008, he became head of department of maintenance. He is in charge of the national conservation program, both for own administration and for contracts and in particular for the supervision and control of the basic roads program at the national level.

A vision of quality and quantity

Of the 85,200 km comprising the Chilean rural roads network, only 25% are paved. Apart from disturbances to road users and inhabitants close to the gravel roads in the form of noise and dust, a vision for overall better access to work, commerce, education and health care were the main reasons for the introduction of the Basics Roads program. Improved road safety and road side environment were other factors that were taken into account.

"The unpaved roads network is maintained through cycles of surface course layer replacement where the cycle's period is about 3 to 5 years. However, despite all our efforts, the level of service provided to users is not what it is expected of a modern society", says Ernesto. "We have had to combine quality, quantity and creativity by providing solutions to as many citizens as possible with improved roads and subsequently better access to work, health, commerce and other activities. Through qualitative interviews before and after applying basic asphalt solutions or improving gravel roads, we have found that people are grateful for the new situation and we also experience a growing demand from citizens who are not yet part of the program and want their basic road".

Choosing the right intervention strategy

Different tactics to increase the service levels on the Chilean roads were undertaken already in the mid-90ies, but it wasn't until 2003 that the government program "Basics Roads 5000" was introduced. The goal was to improve surfaces of 5,000 kms of roads, applying stabilization and/or asphalt on unpaved roads or existing gravel roads.

As the program continued on to encompass more than 15,000 kms, so did the challenge of choosing the appropriate methods and strategies for the specific roads. "Along the way, we had to adjust our strategy and be innovative in our approach", says Ernesto. " There are different solutions from road to road and we found that we had to include factors like demography as well as the closest natural resources for road construction, to keep costs and environmental impacts low. The idea is to use the

materials closer to the road or recycle the existing road material. We found that with the correct recipe, the durability is very good and the roads will function for 5-6 years practically with no or very low maintenance", Ernesto explains.

One example of utilizing local materials is how the Ministry of Public Works introduced salt from the mines of the Atacama Desert in the north in local roads, which reduces dust problems and is much cheaper than any other method of maintenance. But this is only possible as Atacama is the driest place on earth.

In the center and southern parts of Chile, like Patagonia, the ministry is applying draining asphalt to mitigate water in the roads in some places and thin layer asphalt sealing to protect the granular bases in other places.

Impacts in life quality

"The benefits of the Caminos Basicos program are mainly in the quality of life with the road users and the road neighbors. With this program we have managed to improve the connectivity of people to schools and hospitals and other basic services, like banks and shopping. We have decreased travel time and the operation cost for vehicles, due to fewer potholes. So although these benefits are different from traditional key performance indicators, the service levels have certainly gone up", says Ernesto.

Besides the advantages for the local communities, the improvements have also supported the development of activities like agriculture and forestry that are important for all of Chile.

A national public relations success

It is not always easy to promote and raise funds for road maintenance. But in the case of Basic Road, the program has been a great success for local and national politicians and decision makers. As the citizens in rural areas are normally very appreciative of the road improvements, the road program has created a positive dialogue between all interested parties.

"We have worked with specific milestones for the program, like 3,000 kms, 5,000 kms, etc. and we have made sure to celebrate those milestones with inaugurations of new road stretches by important national authorities and even the President of the Republic of Chile", Ernesto explains. "It's a great event and an excellent way to strengthen relationships and spread the benefits of these public policies".

Great promises

Asked about the future of the Basic Road Program, Ernesto Barrera is positive: "The program holds great promise", he says. "We still have a lot of unpaved roads and the program can continue to improve these, with the support of our authorities and politicians. In Peru they have begun doing something similar 9 - 10 years ago. In Colombia they are applying it too. Costa Rica and Honduras are very interested too. I went to Cuba recently myself and they too are enthusiastic, as they can solve a lot of problems with their roads for a limited amount of money. Our goal in Chile is to improve on average 2,000 kms per year. The program is very strong and I think it will continue on for many years", Ernesto says.

To sum up, Ernesto provides the three most important success factors, he has identified from the program.

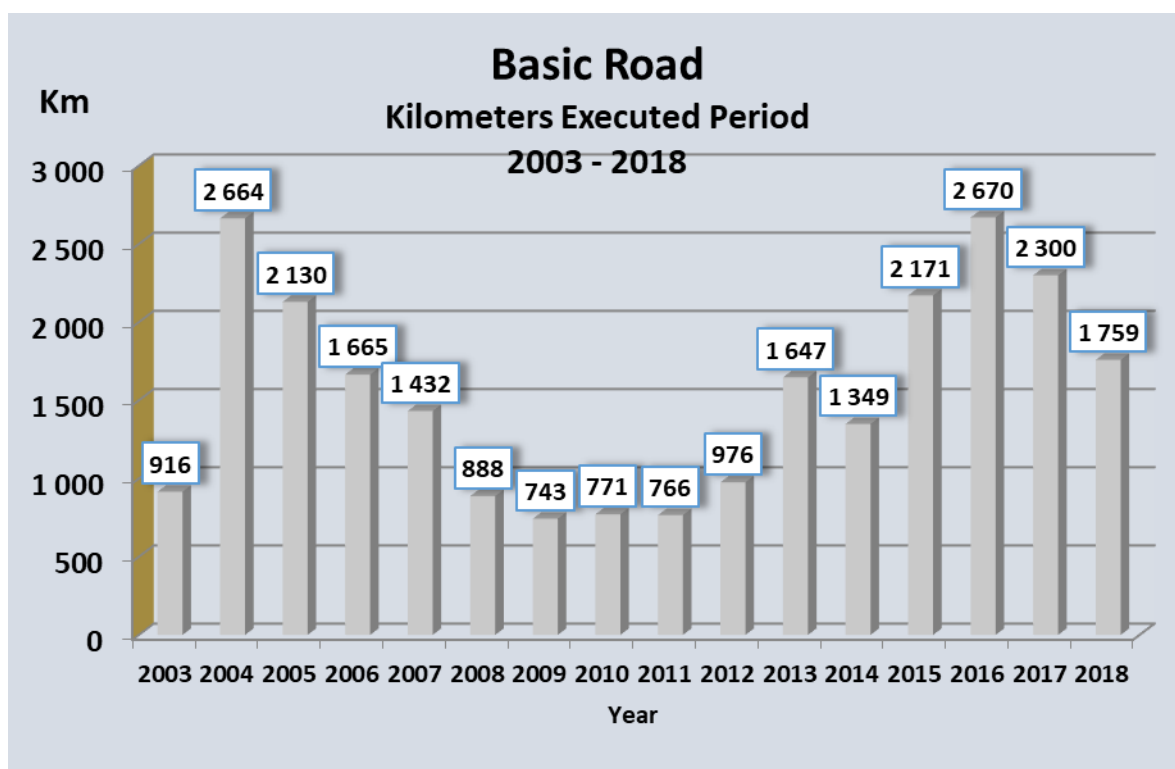
"First of all you need a powerful and dedicated authority to drive the program, with a strong stakeholder commitment and support from the public sector. Secondly, you need to identify and explain the benefits of the program to the citizens, not just locally, but nationally. And thirdly you need to be creative to apply new technical solutions, like using local materials, to get the best value for money", Ernesto concludes.

"First of all you need a powerful and dedicated authority to drive the program, with a strong stakeholder commitment and support from the public sector. Secondly, you need to identify and explain the benefits of the program to the citizens, not just locally, but nationally. And thirdly you need to be creative to apply new technical solutions, like using local materials, to get the best value for money", Ernesto concludes.

The following graph shows the kilometers executed in the country since 2003.



Mr. Ernesto Barrera, Ministry of Public Works, Santiago and coordinator of the strategic theme for Management and Finance under the PIARC Committee on Terminology.



Graphic N°1. Kilometers of rural roads executed with basic solutions in the country since 2003.

FACT BOX Caminos Basicos Program:

The Chilean rural road network is 85,200 km's long and only 25% of this roads are paved. Traditionally, the unpaved roads network has been maintained every 3 to 5 years, typically by replacing or just grinding the surface. But since the mid-90s, the road authorities have implemented new surfacing solutions and since 2003, a new program, called Basic Roads 5000", have rolled out new and improved roads, reaching about 15,000 kms of treated roads today.

The goals of the program are:

- Improve **QUALITY OF LIFE** by reducing or eliminating dust generated by traffic and mud in the rainy season.
- Reduce **CONSERVATION COSTS** caused by too frequent road repair
- Improve **BEARING CONDITIONS**, reducing the **TRANSPORTATION COSTS**.
- Promote **LOCAL DEVELOPMENT** through better conditions for transport of goods
- Improve **ROAD SAFETY** by reducing dust and improving road conditions
- Improve **ENVIRONMENTAL CONDITIONS** for agriculture close to the road
- Reduce the **ENVIRONMENTAL IMPACT CAUSED BY ROAD INTERVENTIONS**.



Improving road conditions also improves the living conditions for the neighbors to the roads, due to less dust



and noise. It also increases access to local businesses, schools, hospitals and shopping.

Results: Before and after



Road conditions are critical for safety, comfort and connectivity. Applying thin layer asphalt and granular course stabilization has greatly improved the service level of the roads in Chile.



Without Salt (Bischophyite)



With Salt (Bischophyite)

CASE STUDY 2: DANISH BIKING

Bicycling is a cost-effective, reliable, environmentally friendly and cheap mode of transportation and the bicycle could be the game changer, every transportation planner is looking for. But it is not a quick fix to (re) introduce bicycles; it takes time and care.

A global study from ITDP and UC Davis, 2015, shows that if potentials are fulfilled, cycling could save almost 6 Trillion USD world-wide over the next 15 years by way of reducing CO2 emissions and impact and increasing public health. Actually, cycling supports 11 of the 17 UN goals for sustainability. But upkeep and build out of networks are essential to make cycling a lasting success. And it might take a long time to create a sustainable cycling-culture. The rewards are big, though, and applicable both to developed and developing regions – and especially cities could benefit from more cycling as a mean to reduce congestion and enhance mobility.

Mr. Klaus Bondam is CEO of the Bicycle Federation in Denmark and an international advocate for the Copenhagen way of cycling. A modern city with app. 1 mio. people, Copenhagen is world famous for its cycling culture, where everybody has at least one bicycle and nearly half of the daily commutes take place on a bicycle. In this interview, Klaus provides some insight into how come so many Danes are cycling in a country that is also known for rain, snow and gusty winds.

Roads and bikes

“Roads are essential for developing modern society”, says Mr. Bondam. “In Copenhagen and in most Danish cities, bicycling is key to use the road infrastructure in the most efficient way. It is a political reality and priority to keep bike lanes in good condition, and keeping bike traffic flowing is a must, if you want to maintain a decent level of mobility. Internationally, we are known for our Copenhagen Lanes, which separates motorized traffic from the bicycles. This of course adds to the safety and comfort of the cyclists, but only if those lanes are maintained properly. A pothole is annoying for a car owner, but can be lethal for a cyclist, so I always emphasize maintenance, when I am asked about the Danish success”, says Mr. Bondam.



Supporting UN goals

In 2015 the 193 UN member states adopted 17 vital global goals for sustainable development on the planet, the Sustainable Development Goals– known as the SDGs. The European Cyclists' Federation, ECF, has examined the goals and announced that the bicycle can help achieve as many as 11 of them (see illustration on the following page).

Arguably, bicycling can play an important role at several levels, including helping raise prosperity in developing countries, mitigating pollution and congestion in cities, reducing CO₂– and particle-emissions in traffic and reducing noise and rutting.

Specifically for Lower and Middle Income Countries, according to the ECF, bicycling will contribute to reducing poverty by providing affordable means of transport, which again will provide access to schools, jobs and markets. Small scale food producers can transport their goods further and female bicyclist can be part of the development as well, which raises gender equality and the empowerment of women and girls. With the coming of electrical bicycles, the introduction of affordable and sustainable technology to developing countries will be speeded up.

As it is much cheaper to build and maintain bicycle infrastructure, biking also supports the out-build of resilient infrastructure, which again supports industrialization and innovation. Manufacturing and maintaining bikes is big business in many countries, as is renting out bikes to tourists. This supports goals for economic growth and employment.

Words of advice

When asked about good advice for anyone who want's to introduce more bicycling, Mr. Bondam has 3 points, he always try to convey when he is sharing the Copenhagen success:

"The foundation is infrastructure", says Mr. Bondam. "As safety and security is a top priority for any traffic planner, and as bikes are so-called "soft" traffic users, you need to separate them from the "hard" traffic; cars and trucks. And you also have to designate a part of the road solely to bikes, not just for sharing with pedestrians. And you have to have a hard shoulder or another kind of obstacle for the vehicles. And you have to have that along all major roads. And you have to make sure that these bike lanes are well-connected to institutions, shopping, train stations and so on", says Mr. Bondam.



"Moving goods and people around, creating innovation and networking, is essential for modern society and bikes are one of the most sustainable ways of securing this"

Klaus Bondam, CEO Bicycle Federation, Denmark.



Cykling meets 11 out of 17 UN goals for sustainable development



1: End poverty

- By enabling access to education, job, markets in an affordable way



2: End hunger

- By providing access to land, resources and markets



3: Ensure healthy lives

- By generating healthy life-styles and minimizing pollution



5: Achieve gender equality

- By providing access and equal transport opportunities for women and girls



7: Ensure access to affordable energy

- By using human power, efficient e-mobility and contributing to co-modality



8: Promote sustainable economic growth

- By including services, tourism, manufacturing and maintenance of bikes



9: Build resilient infrastructure

- By establishing cost efficient bike lanes with flexible traffic



11: Make cities inclusive and safe

- By integration of all kinds of people and by reducing car crashes



12: Ensure sustainable consumption

- By transporting people and goods across especially urban areas



13: Take urgent action to combat climate change

- By immediate integrating cykling into climate action strategies, education



17: Revitalize the global partnership for sustainable development

- By promoting partnerships, sharing data and introducing policies



Goals

Create and maintain a bike-friendly culture. More than 50 % of short trips covered on bikes.

Challenges

New generations want to ride a car. Building and maintaining infrastructure. Mind change needed with decision makers.

Solution

- Once the infrastructure is there, people will move towards biking.
- Prove benefits to politicians.

Benefits

Improved mobility, air quality, safety, health,

Cycling in Denmark

- (5,7 million inhabitants/temperate climate)
- On average Danes cycle 1.6 Km a day (In Copenhagen 3.0 Km a day)
- 49 % of all children aged 11–15 cycle to school
- There are more than 12,000 km of cycle tracks and lanes in Denmark.



“Secondly you have to create political consensus around bicycling”, he says. “Biking is not for the poor and it is not communism – it is sound business! With so many benefits and very few downsides to it (you might get a little sweaty), biking is in my mind the perfect transport solution for modern cities and rural development alike. And I am working on a daily basis to provide that insight to politicians, planners and decision makers world- wide”, Mr. Bondam says.

“And then we have to remember that buying and/ or using a bicycle is a personal choice, that we can only encourage. It requires an active attitude and you need to embrace it. In our comfortable part of the world, we might be challenged with over- protection of our kids, who normally learn to bike almost before they can walk, and perhaps too many young people are now driving, instead of biking. So our goal is to keep up the good culture of biking in a constructive, yet firm way”, says Mr. Bondam.

A game changer

That the bicycle can be a game changer is clear to Klaus Bondam:

“Mobility is equal to freedom, and biking is freedom”, he says. “The car industry has succeeded with having us believe that cars are the ultimate freedom, but I vote for the bicycle – at least as one of the options for transport. You are not just a driver or a passenger in a secluded car, but an equal cyclist, along with other members of society. Biking, in this way, is also democracy and integration - while a great solution for the majority of traffic and transport challenges: carbon, climate, mobility, health, safety”, says Mr. Bondam.

“In Denmark we see that some cities have embraced bicycling earlier than others and that those who have have strategies for biking, also are the cities or municipalities with the biggest population of bicyclists. But it may have required a whole generation to make that happen and that’s why we see cities like London, Paris, Berlin, New York and Chicago only developing slowly. Perhaps it is a matter of psychology or mentality or it requires a mind shift to move from cars to bikes, but Beijing is doing just that these years and I think and hope this tendency is growing”, says Mr. Bondam.

“The Bicycle is part of the technological development and it will contribute to Mobility- As-A-Service, Smart Cities and the general growth and well-being of our societies. Moving goods and people around, creating innovation and networking, is essential for modern society and bikes are one of the most sustainable ways of securing this” says Klaus Bondam.



CASE STUDY 3: CALIFORNIA SUSTAINABLE MOBILITY

Mr. Randell Iwasaki is the Executive Director of the Contra Costa Transportation Authority, which is a public agency in California. Before that, he was Director of CALTRANS, the California Department of Transportation, where he oversaw almost 20,000 employees and managed a billion dollar budget. He has also served as committee member of the ITS Program Advisory Committee and he chaired the National Freight Advisory Committee for 4 years. Iwasaki is a pleasant and smiling man, but when it comes to transportation and societal welfare, he is dead serious:

“In my years as public servant, working with transportation and mobility, I have come to focus on two things; safe and efficient mobility and general liveability. The common denominator is the day-to-day contract between tax payers and transport providers, that supports a society with opportunities to bring people to their destination, no matter their age, gender, social status or abilities.”, says Iwasaki. “We are all dependant on the service roads provide, either in the form of personal transportation or in the form of goods, sustaining our way of living”.

Connected and automated vehicles

“If we want to build a better future, we need a well-functioning infrastructure. In California, this means mainly roads – and we have 175,000 miles of those. But it does not have to mean that everybody should drive – or even own – a car. In Contra Costa, we are working intensively on the introduction of connected and automated vehicles, or; CAVs, to the transportation sector. We cannot build our way out of congestion. With more than 14 million cars in California, we need to be smart and introduce new technology to increase capacity, without jeopardizing safety and the overall efficiency of driving”, says Iwasaki.



Cleaner air through CO₂ reduction

California and specifically Los Angeles and San Francisco are constantly in the top 5 of the most congested places in the United States, which probably translates to very long commuting times.

“Our challenge in Contra Costa is to bring down the commuting time, and at the same time prevent traffic from increasing and emissions from climbing. We have basically three major challenges in front of us: Safety, mobility and the environment. And I believe we can solve these through technology”, Iwasaki says.

“The good news is that California is leading the way for the rest of the US when it comes to introducing sustainable vehicle types like Electric and Hybrid vehicles. We are close to a market share of 10 % and expect to reach 20 % by 2020. This is great for the environment (provided we get electricity from renewable sources) and especially good for the people, living alongside roads in California”, says Iwasaki.

Safety and mobility

When it comes to mobility and safety, CCTA is one of the frontrunners. By linking advantages of connected and automated vehicles to safety and mobility goals, they have been able to project how to fit in up to 30 % more vehicles on the same road, because cars can drive closer together if you remove the human reaction time from traffic.

“This translates to billions of dollars in savings if we can reduce the need for building out our transportation infrastructure”, says Iwasaki. “With more intelligent transportation solutions, such as



The Contra Costa Transportation Authority (CCTA) is a public agency formed by Contra Costa voters in 1988 to manage the county's transportation sales tax program and oversee countywide transportation planning efforts. With a staff of twenty people managing a multi-billion dollar suite of projects and programs, CCTA is responsible for planning, funding and delivering critical transportation infrastructure projects and programs that connect our communities, foster a strong economy, increase sustainability, and safely and efficiently get people where they need to go. CCTA also serves as the county's designated Congestion Management Agency, responsible for putting programs in place to keep traffic levels manageable.

More information about CCTA is available at
ccta.net

“What we want is to help the underserved in our community, including the elderly, poor, and disabled. With autonomous vehicles, they can have the ability to visit family or commute to work with less effort or expense.”

Randell H. Iwasaki, P.E.



connected and automated vehicles, we are able to tweak traditional thinking and introduce a more comprehensive mobility service for a wider spectrum of California citizens” he says.

“What we want is to help the underserved in our community, including the elderly, poor, and disabled. With autonomous vehicles, they can have the ability to visit family or commute to work with less effort or expense. In the long run, trucks will be automated too, as we actually are in need of more truck drivers in America, and because trucking accidents often are very dangerous. Environmentally, intelligent driving, combined with new technology, including electrification, is definitely the future”, Iwasaki underlines.

Research and development collaboration

The research, development and testing that is the foundation for introducing the new technology takes place at GoMentum Station, an old naval base in Concord, California. “We discussed how to transform the place into a living research laboratory for autonomous and connected vehicle technology, and in a short time we got several stakeholders onboard and created the largest secure testing facility on this issue in the US. We managed to bring together thought leaders from the auto industry, communications and technology companies, as well as public agencies under one umbrella”, Iwasaki explains.

“One of the key features about our research and development environment is that we can replicate real life topography and traffic patterns, which greatly supports the implementation of this game changing technology”, says Iwasaki. “Private and public collaboration is key to success and I will strongly encourage decision makers to include all relevant entities in the introduction of any new technology”, says Iwasaki. The first CAVs are now driving in real life at the Bishop Ranch, a large mixed-use business community in the San Ramon Valley, in Northern California.

Goals

Provide safe and reliable transportation service to all segments of the population, without building out roads and without introducing more cars.

Challenges

Congestion increasing, due to too many cars on the roads, especially in the area between LA and SF. First-and-last-mile issue.

Solution

- Connected and Automated Vehicles
- Car pooling
- ITS

Benefits

- More people get to pursue job openings.
- Older and disabled (and kids) can commute better
- Less miles travelled
- Cleaner air
- Reduced need for expansion of infrastructure

Facts & figures, California

No. of Commuers

17,000,000

Driving solo 73 %

Carpooling 11 %

Mean travel time to work 26 mins

No of vehicles 14,500,000

No of Electric vehicles

Public Road Miles

175,000

Public Transport



Easy Mile is an autonomous vehicle that solves the so-called “first-and-last-mile” challenge of helping people connect to their respective transit centers and their destinations.

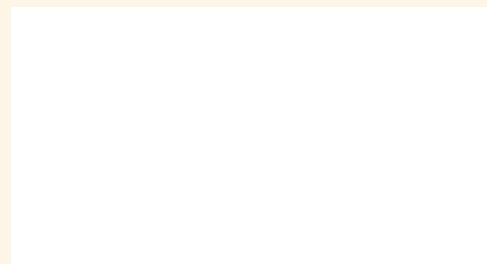
The research, development and testing that is the foundation for introducing the new technology takes place at old naval base in Concord, California.



Contra Costa’s countywide transportation plan goals

- Goal 1:** Support the efficient, safe, and reliable movement of people and goods using all available travel modes.
- Goal 2:** Manage growth to sustain Contra Costa’s economy, preserve its environment, and support its communities.
- Goal 3:** Expand safe, convenient, and affordable alternatives to the single-occupant vehicle.
- Goal 4:** Maintain the transportation system.
- Goal 5:** Continue to invest wisely to maximize the benefits of available funding.

Battery Electric Vehicles sold June 2018-June 2019 by state.



Credit: The Alliance of Automobile Manufacturers.
<https://autoalliance.org/energy-environment/advanced-technology-vehicle-sales-dashboard/>

CASE STUDY 4: SOUTH AMERICA MICRO ENTERPRISES

Fighting crime and poverty. Improving public health. Empowering local communities. Connecting people and cities. Boosting tourism. These are just some of the developments that the micro enterprise model for roads have brought about in the Middle Americas.

South America in the 1990ies had several challenges, including terrorism, drug-related crime and poor living conditions in the rural areas especially. In Peru, Bolivia and El Salvador, the introduction of Micro Enterprises in the late 1990ies proved a viable solution to many socio- economic problems. In this case study, Professor Victor Arévalo Lay, MDI Ing., member of the PIARC Technical Committee D.4 Rural Roads and Earthworks, shares his experiences with the VDL programme of Peru; Ventana de Desarrollo Local.

Rural challenges in Peru

The region of San Martin in Peru, is located in a jungle area of 51,000,000 km². Here, a population of about 800,000 experienced very high levels of poverty, immigration, infant mortality and malnutrition (INEI, 2005). The area of San Martin consists largely of jungle and mountains and products are corn for food for the animals, but also cocoa and cocaine – which is why it was extra important to monitor the development. Other (potential) sources of income include eco-tourism and “feel- local” tourism. San Martin was therefore an obvious choice as a pilot project for VDL, as problems were plenty, but also as the development potential was great.

Originally a military civil engineer from the army of Peru, Mr. Arévalo is now retired, but still active within PIARC and still teaching at the University for Peru.

“Having a Master in construction and asset management, I also studied public politics and national security and development. That is why I got engaged in the VDL programme, which is really a special project under the Ministry of Transport and Communications, that provides a window to local development (VDL) and which is very broad in its scope. The VDL programme combines national goals for connectivity and security with local and rural needs for education, health, gender equality and economic growth”, Mr. Arévalo explains.

“Ventana de Desarrollo Local” (VDL is a programme of the Special Project of infrastructure of decentralized Transport (PVD) of the Peruvian Ministry of Transport and Communications, designed in 2001 to give sustainability to the road investments made in the country since 1995, by promoting the complementarity of infrastructure departmental road, and rural, with economic-productive and other initiatives (gender, social inclusion) within a development policy aimed at eliminating poverty, and especially extreme poverty, in the rural communities of the country.

Safety and security

“The programme evolves around road infrastructure, where development is based on a vision to integrate security and sustainability, providing better health, food, education, access to technology and culture. In the 1990ies the Ministry of Transport and Communication developed techniques and policies in a group with engineers, sociologists and anthropologists as a multi-disciplinary respond to a number of serious problems. One of the goals was to make people feel safe in their homes and workplaces by collaborating with local labour organisations on maintenance of roads”.

“While Peru – and San Martin – was a pilot project, we had some similar products in Bolivia and Ecuador, since the cultural patterns are quite similar. All countries have an ancient culture for infrastructure development and maintenance. Since the Inca times, people have come together to maintain the infrastructure channels, piping and buildings of the communities. This includes small public health facilities and meeting facilities.”

World Bank requirements

“With the help of the World Bank, we organized the communities around the projects to make little local companies for maintaining the roads with local people and workers, trained to do this work. Following World Bank guidelines, periodical maintenance is done by bigger companies and also, as part for the project, national and local roads had to be interconnected. What is important, though, is that the regions have taken responsibility for their own development through the micro-enterprises. So it is a win-win, where the WB sees both good condition of roads, but also the enabling of local development and economical development. In this way, the road become an instrument to achieve development – because with the roads what happens is that you connect the basic schools with superior schools, and the same with health and trade. Simply put, the local produce can become bigger, if you can find customers in the bigger cities.

Added benefits

Apart from evolving the local areas in terms of employment and improved mobility, the VDL programme has provided reduced travel time and costs of travelling, which again has opened up for more tourism.

“Normally, foreigners want to go to Macchu Pichu, but now, with improved access, tourism is growing in other areas, for trekking and eco-tourism, but also for understanding and exploring ancient culture”. Also, studies, show, more women are being empowered as part of the communities, by participating in business activities”, says Mr. Arévalo.

“This story shows that the need for micro- enterprises is very big. About 80 % of our roads are local and mostly unpaved. And much of the maintenance is difficult for big companies, either because the roads are in difficult to reach areas or because the it makes more sense to use local, ancient technique and community culture to maintain these sections. But the story also shows the need to think holistically and how road building and maintenance affects all stakeholders in a country. I always try to explain this connection to my students at the university”, says Mr. Arévalo.





PERÚ

Ministerio de Transportes
y Comunicaciones

Micro enterprises in Peru – road maintenance creating local sustainability

Goals

To reduce poverty and increase safety, health, education, employment and overall mobility and connectivity.

Challenges

- Cultural barriers (rural boundaries for maintenance were very unflexible)
- Keeping up with World Bank requirements.
- Local lack of interest or faith in the project (uninformed, traditionalists)

Solution

- Three socio-productive programs of Windows of Local Development (VDL) were initiated in the districts of Sauce, Lamas-Localidad de Pamashto and Juan Guerra of the San Martín Region.
- Local labour organisations participated as drivers of the development
- The World Bank establish micro-enterprises and build local companies with local workers

Benefits

Reports show a significant, measurable increase in the quality of life of the population involved with the VDL programme. This includes:

- Permanent local employment
- Higher income level
- Improved access to education
- Improved access to health and basic services



Professor Victor Arévalo Lay,
MDI Ing., member of the PIARC
Technical Committee D.4 Rural
Roads and Earthworks

IN NUMBERS

Income/poverty :

The social context before VDL has been one of extreme poverty. But through the VDL's 3 socio-economic intervention projects, this situation has changed.

Employment/unemployment :

Agricultural occupation and forestry activity in the district of Sauce, San Martín, has descended, while in the Populated Center of Pamashto and in the District of Juan Guerra employment has evolved positively after the intervention of the VDL.

Trade on average has increased by 2.55 % and Tourism has had a slight growth, mostly in the localities of Sauce from 12 % to 14.4 % and in Pamashto of 1.6 to 2.5 % Forestry has declined from 3.25 % to 2.46 %, consistent with the intense deforestation that occurs in the area. Artisanal fishing has had a significant increase in the town of Sauce from 24 % to 48 %.

Unemployment overall fell significantly from 40 % in 2006 to only 10 % at the end of the sixth year of application of VDL. In this sense, it can be said that a metamorphosis of work is taking place.

Literacy/education :

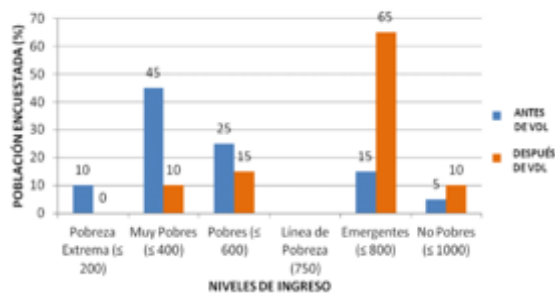
In the education sector, before the application of VDL projects, illiteracy had high percentages of approximately 18 to 24 %.

With the VDL program, these percentages fell considerably, with percentages presently ranging from 2.5 to 5 % of illiteracy. Likewise, the educational level in the VDL program reflects an increase of both primary and secondary education levels, raising the schooling index at all levels. ile development (Berry, 2003).

Health/illness :

The results show a tendency to improved health as acute respiratory diseases and acute diarrheal diseases as well as rheumatic and deficiency diseases have decreased considerably by 43 %. All this influences sustainable development, maintaining a balance in the biological, psychological and social wellbeing.

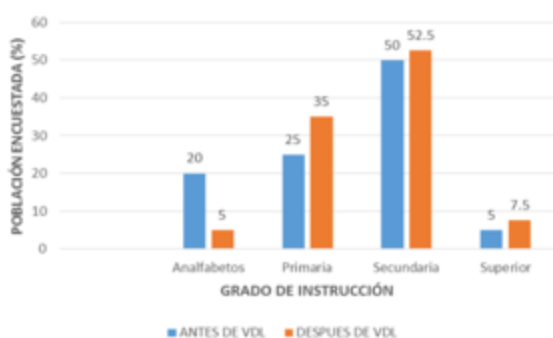
In general, there is less presence of diseases compared to before the application of VDL. It was possible to decrease diseases such as diarrhea, respiratory, parasitosis, anemia and malnutrition by 5.74 %, 3.87 %, 2.55 %, 1.41 % and 6.61 % in the VDL evaluation period.



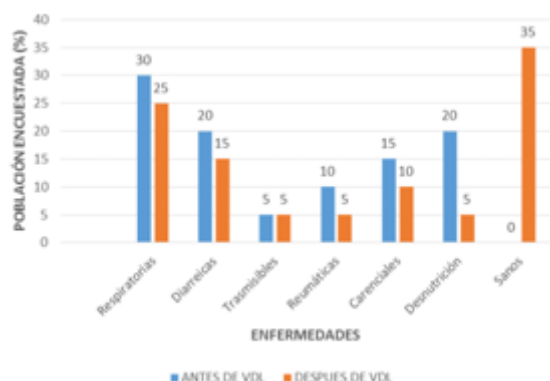
Levels of economic income and poverty in the district of Sauce, before and after VDL, according to the survey of the inhabitants of the district of Sauce 2011.



Economic activities of the Sauce district, before and after VDL, according to the survey of the inhabitants of the district of Sauce 2011.



Level of education in the district of Sauce, before and after VDL, according to the survey of the inhabitants of the district of Sauce 2011.



Frequent illnesses of the district of Sauce, before and after VDL, according to the survey of the inhabitants of the district of Sauce 2011.

Projects generated by VDL:

- S.A. Cumbaza Tourist hostel for recreation purposes
- S.A. Cumbaza Grape industrialization system for the production of dry red wine
- Willow Tourist lodge for rest at Lake Sauce
- Sauce Development of coffee production based on production systems for export
- Sauce Aquaculture development and repopulation of Lake Willow
- Cuñumbuque Production of hides (tannery)
- Shanao Industrial production of banana chifles
- MR. de Cumbaza Industrial production of grape wine
- Rumizapa Installation of a paprika pepper dehydration plant
- Tabalosos Installation of 200 hectares for the production of organic coffee
- Zapatero Production of organic coffee for export
- Agua Blanca Installation of a dairy processing plant for the Sisa Valley
- San José de Sisa Installation of a brick production plant
- Shatoja Installation of a rice pillator mill
- Picota Production and commercialization of granulated panela (chancaca)
- San Martin de Alao Installation of 200 hectares of cocoa with banana use as a temporary shade and guaba as a permanent shadow
- Juan Guerra Pasteurized and bagged milk production line
- Juan Guerra Installation of 70 hectares of tobacco for export
- Juan Guerra Installation of a rice pumper mill
- Morales Production of giant shrimp and tropical fish

CASE STUDY 5: LMIC PLANNING FOR THE FUTURE

A Danish native, Jens Christian Helbech Hede, Sr. Director, Transport at Ramboll, has an impressively global experience in the field of asset management, including extensive hands-on experience with projects in Africa and Asia. His mantra for success in development is Good Governance. Also, he is an advocate for individual commitment to projects as a way of ensuring long term benefits of investments.

Mr. Hede has been working with traffic and transport for his entire career. He has been with Ramboll – a leading Scandinavian consultancy – for about 20 years, but also managed to take on a position at the World Bank for 3 years, 2014–2017. Here, as well as in Ramboll, Mr. Hede worked with international projects in Africa and East Asia.

In 1997, Mr. Hede was introduced to international road transport development through a project in Benin. “I was part of a specific introduction for new-starters, under the Danish Development Programme, DANIDA, where we upgraded a transport corridor from gravel to asphalt. The work included a lot of on-site hands-on work, but also I was introduced to the HDM tool, that originally was developed by the World Bank, but which is now under the auspices of PIARC. I soon came to see the enormous impact, improvements in roads and transportation, can have on a developing country, and I really enjoyed being part of that progress, and working with local experts and decision makers on realizing their potential to become more self- sustaining through better mobility”, says Mr. Hede.

“Although asset management projects are often born out of a pressure from the donors (the International Finance Institutions) under the device that you have to have an asset management system in place, before you get the money, there is still a big learning curve to it, including moving from quick wins to long term results. And this is where local and personal commitment is key”, says Mr. Hede.

“The World Bank and other investors in road transportation of course have a certain set of rules and requirements, that have to be met, before investments are made. To me it is important the output of tools applied is actually also adopted into the decision-making. Too often it is seen that output from for instance asset management systems are not actually adopted in the maintenance plans later approved. There need to be a better correlation between technical data driven analysis and actual prioritization of scarce funds. Of course there can always be political goals and changing circumstances, but the asset management system should be a key component in guiding the road administrations strategic road operations and maintenance”, says Mr. Hede.

CASE: Tanzania Road Authorities – upgrading of Road Maintenance Management System

Mr Hede acted as Team Leader/Technical Planning Coach and Road Management Systems Specialist

When asked to mention one specific project that was a specific success, Mr. Hede does not hesitate to bring up Tanzania. "From 2006–2010, I was team leader and coach for the DANIDA Technical Assistance team to the road administration, TANROADS, Mr. Hede says. "The task was to integrate their previous road management system with HDM-4 and with GIS, to improve road planning and

About Tanzania roads

Road transport in Tanzania, carrying over **90 %** of the passengers and **75 %** of the freight traffic in the country. The road network include **86,472 km** of roads, of which **12,786 km** are categorised as trunk roads and **21,105 km** as regional roads. The remaining **52,581 km** is district, urban and feeder roads under the responsibility of Prime Minister's Office Regional

Administration and Local Government (PMO- RALG).



Goals

- The Tanzania Road Authority, Tanroads, wanted to improve the condition of their roads and achieve the highest possible return on investments.
- They also wanted to revise their existing road maintenance system and procedures as well as contracting format and models.

Challenges

- Decisions had a tendency to be more political than based on objective criteria.

Solution

- A project was launched through DANIDA to develop a new computerised Road Maintenance Management System (RMMS), focusing on management tools for HQ and the regional managerial levels.
- The existing RMMS was improved/redesigned and integrated with HDM-4 and with GIS.
- Modules included Maintenance and Rehabilitation needs assessment, integration with HDM, Performance Budgeting System for routine and recurrent maintenance, Capital Investment Maintenance Programmes and Contract Monitoring System.
- Services included review of institutional arrangement including individual job descriptions and comprehensive training and support during system implementation and change management.
- TANROADS set up a separate department for asset management.
- The project reviewed institutional arrangements, and included individual job descriptions and comprehensive training and support during system implementation and change management.

Benefits

- TANROADS are now able to perform objective decisions, based on HDM-4
- Improved road network - reducing costs of road users. Where road upgrading has been implemented additional benefits are achieved, including environmental improvements (less dust exposure to people living along the road).
- Better return on investments
- Improved planning and programming processes and maintenance works implementation procedures.

programming. There was nothing unusual in this, but what was unusual and significantly contributed to the success of the project was, that TANROADS had built up an entire department around this project with 4–5 full time allocated employees. This helped immensely as we could rely on a long term commitment to the project and because this helped to build trust and collaboration with the TANROADS, Tanzania Transport Ministry and Road Fund on annual funding agreements. You might say that we deployed the motor for good governance, but without individual competences and commitment, we would not have made it. Especially one guy, Eng. Ephata L. Mlavi from TANROADS stood out as a local ambassador, and I think we need more like him", says Mr. Hede.



“Working with projects in many countries, including Australia, Austria, Benin, Botswana, Cambodia, China, Denmark, Egypt, Ethiopia, Ghana, India, Indonesia, Lao PDR, Liberia, Madagascar, Malaysia, Mozambique, Nepal, Portugal, South Africa, Spain, Tanzania, Thailand, United Kingdom and Zambia, there are some very clear common denominators which in themselves form a basis for sustainable asset management.”

*Jens Christian Helbech Hede,
Sr. Director, Transport at Ramboll*

Apart from Tanzania, Mr. Hede has enjoyed working with projects on development in countries like Benin, Botswana, Cambodia, China, Egypt, Ethiopia, Ghana, India, Indonesia, Lao PDR, Liberia, Madagascar, Malaysia, Mozambique, Nepal, South Africa, Tanzania, Thailand and Zambia. And although there have been great varieties in scope and content of the projects, there are some very clear common denominators, which in themselves form a basis for sustainable asset management.



“The procedure normally involves an investor – more than often a development bank – and a recipient – more than often the national road administration”, says Mr. Hede. “Then, based on a feasibility study and depending on the specific project scope and size and the level of complexity, the project team will help ensure the transition towards improved planning and managing of national, local and urban roads and assets. In some cases the project will include data collection to assess inventories and conditions, which again will form the basis for a central data base, often based on HDM-4 or a combination of the local system with HDM-4. This is just the basics.”, says Mr. Hede.

“Then, depending on how advanced current road maintenance and operations are in the country in question, there are many beneficial add-ons to asset management, starting with GIS for exact positioning of assets, and continuing with more advanced programming processes, to include multi-year analysis of budget needs for projects, that often will form the basis for political allocation of funds”, he says. “Finally, there is the matter of staff training and coaching and technical assistance during the first years of implementation. And perhaps – and this to me is important – a follow up review of procedures and programmes after a few years. This can include socio-economic impacts and perhaps lay the ground for further improvements and updates that will bring even more prosperity to the country”, says Mr. Hede.



CASE STUDY 6: UK - SECURING SOCIETAL INVESTMENTS

In late 1970's the governments of France, Germany and UK got together to produce a series of Road Maintenance Handbooks for United Nations Economic Commission for Africa (UNECA). By the early 1990's these proved very popular and needed updating. PIARC's Committee on Technology Transfer and Development (formerly the Committee on Roads in Developing Regions) undertook the review, updating and publishing in 1994 with funding from UK DFID, the original donor group and the World Bank. Those 4 x handbooks on Drainage, Unpaved and Paved roads, maintenance of structures are still popular and in use today.

Mr. Colin Gourley has been working for the the UK Department for International Development (DFID) as Transport Leader since 19xx, and he vividly recalls the steps that has led to the successful roll-out of best practises in road upkeep in developing countries:

"Going back to the late 1970's DFID was one of the original donors supporting road management research that found its way into HDM-4 and predecessors. In early 1990's DFID along with the World Bank, the Asian Development Bank (ADB), the Swedish National Road Administration (SNRA) sponsored the International Study of Highway Development and Management Tools, ISOHDM", explains Mr. Gourley. "HDM is important for development – For example, in the last 10 years World Bank have, conducted over 200 road transport project appraisals, amounting to £35Bn of investment, using HDM-4."

"DFID has continued to support HDM and the research that is captured in its models. We have maintained close links with PIARC since 2005 on this and we supported the sponsors move to delegate responsibility for management of the IPR associated with HDM to PIARC. We retain a strong interest in ensuring the success and longevity of HDM-4 (and its successors)", says Mr. Gourley.

"We undertook three studies for PIARC in 2016/17 on what was needed to ensure that HDM-IV remained fit for purpose. These were presented at a side event of the World Bank/WRI Transforming Transportation event in Washington. Currently we are supporting a piece of work with PIARC Secretariat that will develop a forward looking HDM-IV business case. The idea here is that the business case will attract other international and development bank funding for the update work needed and will also set out how HDM is managed in future", says Mr. Gourley

DFID has also co-produced two policy documents with PIARC – Keep Death Off Your Roads (2002) and Save Your Country's Roads (2000). DFID and PIARC updated the latter document – now Preserve Your Country's Roads for Development in 2016 and on the PIARC website.

Between 2000 and 2004 DFID was actively supporting PIARC's work in support of developing countries. This support assisted developing country representatives to attend various PIARC Technical Committee meetings and participate in the work of the committees. It also provided support for the establishment of PIARC Technology Transfer Centres in developing countries and supported a number of international seminars on issues relevant for developing countries.

"Through the years, we at the DFID have had a very good working relationship with the past PIARC President and Secretary General and the current Secretary General sits on our High Volume Transport Research Steering Group. The close collaboration between many stakeholders from different sectors have proven very valuable in securing a common approach to road condition assessment and management. The introduction of common tools

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Colin Gourley, UK Department for International Development (DFID).

not only helps with showing how roads contribute to development and sustainability, but also provides a common language, across nations and regions, that ensures we can identify and fundraise the necessary investments to keep trade and commerce flowing.

Goals

- *Systematic and effective road building and management across regions*
- *Helping development along by securing communications locally, nationally and regionally*
- *Finding common systems approach to ensure common grounds and connect dots*

Challenges

- *Local and regional "business as usual" approach*
- *Lack of investments, in case of underdescribed needs*
- *Too much focus on already developed areas, as opposed to rural areas*

Solution

- *Introduction of policies that express needs and procedures to reach service levels*
- *Alignment of investments on basis on common measurements*
- *Asset management procedures and systems to align KPIs*

Benefits

- *Common challenges defined and explained*
- *Common language through common systems*
- *Increased investments and improved up-keep*
- *Better mobility, trade and commerce.*



UNECA/ECA

The United Nations Economic Commission for Africa (UNECA or ECA) was established in 1958 by the United Nations Economic and Social Council to encourage economic cooperation among its member states (the nations of the African continent)[2] following a recommendation of the United Nations General Assembly.[3] It is one of five regional commissions. The ECA has 54 member states corresponding to the 54 member states of the United Nations that lie within the continent of Africa or in oceans nearby the continent.



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