Success-Factors for urban ropeways in Africa

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The aim of this study is to analyse which factors are contributing to the success of urban ropeway systems in Africa. As there is no system working at the moment we cannot just evaluate, but will have to anticipate which criteria a ropeways will have to fulfil in order to be successful.

It is obvious, that what is a success from one point of view, might be a complete failure from another. So to achieve this task, the study needs to analyse the different fields affected and identify the key-areas before defining the factors to consider during an evaluation of future systems.

It is equally obvious, that this task can only be work in progress, the results of which will change over time. Still for various reasons we consider it important to start the work now.

- The definitions of success for sustainable Transport-modes are still not sufficiently established, and the study will contribute to this task.
- Ongoing and future planning processes may use it as a guide through the process of planning and implementation, drawing attention to aspects that might have been underestimated so far.
- Once working, It is important for the systems to be comparable from the beginning. This study will help to establish a set of indicators before the start of the operations, in order to provide a better base for future evaluation.

The study will first determine the special and rather unique role and conditions of sub-Saharan Africa as one of the poorest regions in the world having to adapt to an unprecedented scenario of sustained rapid urban growth, which dictates sustainability as a condition for planning in an ecological, social and economic way.

In a second part it explains the role the cable car can play amongst the main public transport modes, and in tourism. It mentions the typical African question of energy supply and then names different examples of ropeway planning processes in different phases in Africa. It also explains the reasons for considering ropeway transport in the respective state of affairs in the different cities.

In addition to African examples the second part presents best practice examples from Latin America and goes through typical issues and best case scenarios of planning, implementation and evaluation of cable car systems. It finally comes up with a commented list of the potential key factors for success of cable cars in Africa, identified in the different chapters.

Content:

1 Towards Sustainable Transport in Africa

1.1 Skip a Step – Don't learn from bad examples

All over the world, unsustainable mobility and urban planning increasingly becomes a limiting factor for socio-economic development. The growth of motorized traffic has reached levels which start to hinder the function of the cities' transport systems. In Europe a growing number of cities like London or even Stockholm are starting to introduce congestion charging in order to avoid the inner-city traffic collapse. These cities obviously need efficient public transport systems to be able to offer an alternative which is cheaper and more effective than motorized transport. However, the supply with public transport alternatives is poor in the outskirts of a city. This leads to congested suburban motorways and access roads.

European and U.S cities suffer their self-imposed planning paradigm, which leads into a vicious circle of a very-hard-to-escape vehicle-culture. In simplified terms one could say that more vehicle traffic generates more demand for infrastructure, and more infrastructure generates more vehicle traffic. Whereas the first part may be understood with pure common sense, there is wide scientific evidence for the second part, well compiled by Todd Litman in "Generated Traffic and Induced Traffic" *(Litmann 2014)*. Not only does new road-infrastructure generate more vehicle traffic, it also induces new urban developments further away from the city centres with their main economic areas and work-spaces, generating - again - more and longer trips.

There are multiple risks related to this current mobility paradigm which has developed during the 1960ies and 70ies in the industrialized countries of Europe and the U.S., but is now being exported to the whole world. The mobility paradigm based primarily on road transport is - above all other things - very dangerous for people.

It causes about 1.3 Mio. fatalities by road accidents/year and accounts for another 200,000 deaths /year due to diseases attributable to motorized transport. *(WHO 2014)*

That makes motorized Transport far more dangerous than War! Armed violence accounts for about 525.000 deaths/year *(Geneva declaration; Global burden of armed violence, 2011)*

Mobility should be a key pillar to economy. A well functioning transport system can make an urban economy work more successful saving time and transport costs.

Unfortunately, reality is a little different. Only Congestion has cost the EU economies over 1% of the *gross domestic product (GDP)*/year for the period from 1998 to 2008. Since then road traffic has continued growing *(EU, 2011).*

But there are other external costs related to motorized transport, which are even more expensive for the economies. *"The socioeconomic cost of road traffic injuries is estimated to be about 2% of a country's GDP. For EU countries alone, this means about €180 billion – twice the annual EU budget (2004)."* (*http://www.euro.who.- Economic cost of transport-related health effects).*

For Germany´s capital Berlin the total external costs of IMT (Individual Motorized Transport) reach about 800.000 €/day or 290 Million €/Year [1]. For Germany they account for about 54 Million €/day or about 20 Billion €/year [2].

In 2009 the International Energy Agency IEA has published a prognosis, according to which transport will account for 46% of the global greenhouse gas emissions in 2035 making it the single largest emitter. Without a clear paradigm change it will even continue to grow and account for 80% of the global emissions by 2050. This is not only due to sustained traffic growth but as well due to the fact, that all other big emitters like private households or industry are doing far better than transport in avoiding greenhouse gas emissions. That makes their shares shrink while the share of transport still grows. Strangely enough alternative solutions are not being developed in a proper way.

Road-freight for example has grown by about 400% since 1970 in Germany, while rail freight has diminished by about 25%. Trip distances of commuters in Germany have steadily grown. They are now at about 300% of the average distance travelled in 1970.

The reason for this has already been mentioned above. Transport development is not a stand alone process. It is closely linked with urban development and land use. If we want to change the mobility paradigm in Europe today - and we will definitely have to - we must turn around the whole process of urban development planning in order to base it on proximity and the avoidance of motorized trips and trip distances. We must generate a new urban development and mobility paradigm which does not create trips, but helps to avoid them.

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*1 [3.501.872 (Pop) * 88,4% (Mobile Pop.) * 3,4 (Av. Trips * 7 km (Av. Trip Distance) =73.676.585,4 km / day (distance total)]*
*[73.676.585,4 * 31% (modal share IMT) = 22,839,741,46 (Person Km)] , [22,839,741,46 * 0,035 € = 799,390 € / day]*
Data: http://data.un.org/Data.aspx?d=POP&f=tableCode%3A240;
http://www.stadtentwicklung.berlin.de/verkehr/politik_planung/zahlen_fakten/download/Mobilitaet_dt_komplett.pdf;
http://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/hgp_umweltkosten.pdf

2 [80,5 Mio (Population), 90% (Mobile population), 3,4 (Av. Trips), 11,5 km (Av. Trip Distance), 55% (Modal Share – IMT)
Data: MID 2008

In this field Africa has a huge advantage. Its transport systems and planning paradigms are not yet so rigidly defined as is the case in Europe. Big cities in Africa still have the chance to become a showpiece for the rest of the world on how to deal with rapid growth in population and transport in an economically, socially and environmentally sustainable way.

They should not loose time importing obsolete strategies from Europe and the U.S. but use worldwide knowledge and experiences to achieve

- Multicentric urban growth, based on proximity, density and short distances, in order to avoid trips
- Mobility-systems shifting from individual motorized transport towards an efficient mix of economical mass transit and high capacity feeder systems including non motorized modes
- Technical improvement of the transport system by decreasing the dependence on fossil fuels and using alternative sources of energy.
- Regulations to make transport affordable and accessible even for the poorest, in order to provide people with access to economic opportunities and services. Poverty reduction needs equal and equitable access to mobility.

A system that achieves these goals will be at the same time environmentally sustainable, economically affordable and socially balanced. On the following pages, this study will analyse and describe the potential of urban ropeways within this process.

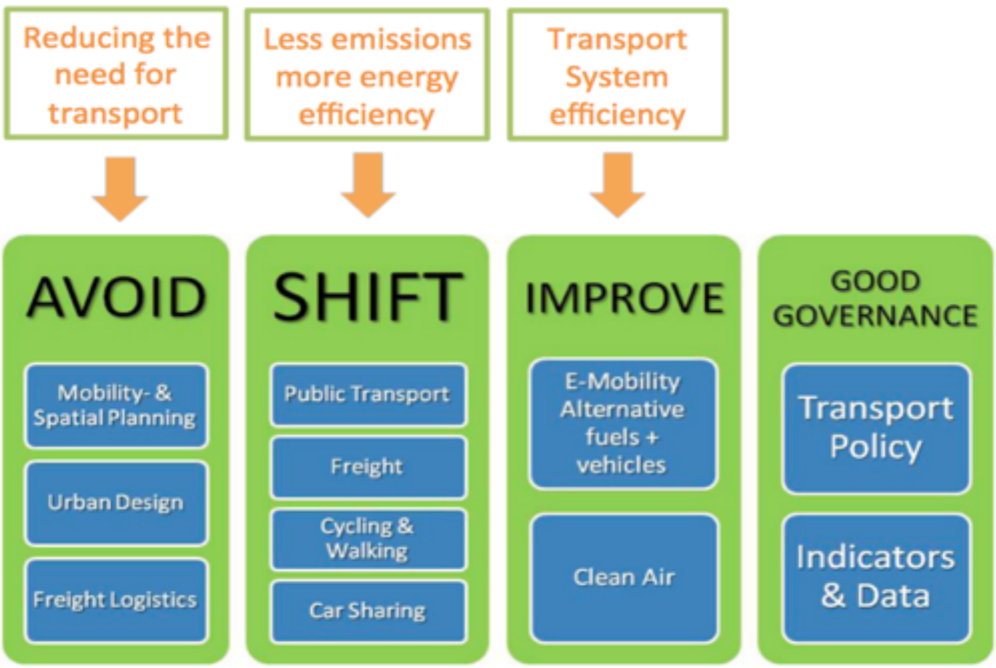

Fig. 1: Avoid, shift, Improve Paradigm, Eurist 2012

1.2 Settlements & Urban growth in Africa – the potential of urban ropeways

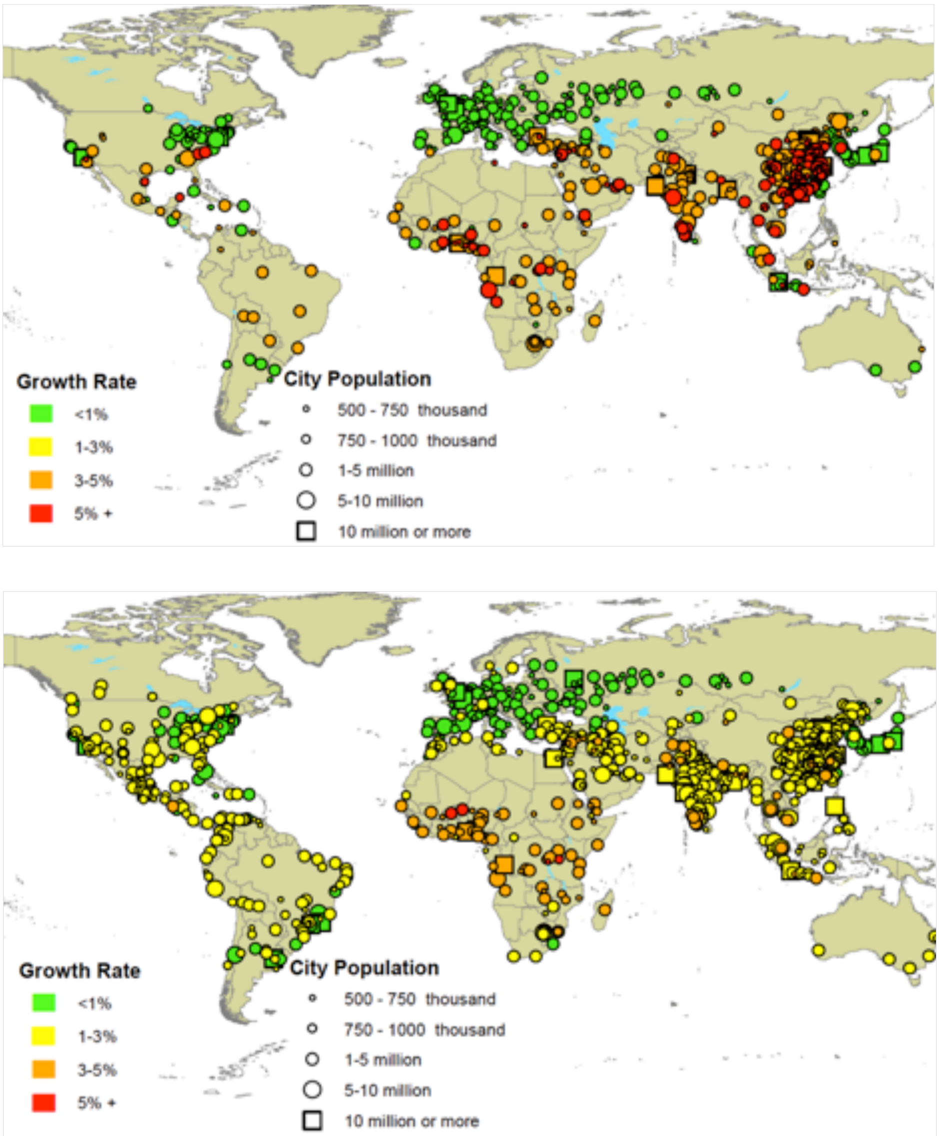

Fig. 2: Global city-Growth until and beyond 2014 (http://esa.un.org/unpd/wup/Maps/CityGrowth/CityGrowth.aspx)

In Africa urban growth happens faster than anywhere else and traffic is growing at least at an equal speed.

In most big cities the traffic collapse is reached already. In the rush-hours vehicle traffic literally stops working at all. Short trips take hours to complete. But unlike in Asia and India, where the growth rates until 2014 were comparably high, the growth will not yet cease. Africa will go on growing at only slightly reduced rates even beyond 2030

In this sustained rapid growth scenario, cities change at an incredible pace, which makes planning very difficult, especially where built infrastructure is needed.

As an example, an elevated ringroad can end up in the middle of a residential area after only a few years. The character of its environment has drastically changed. Still, due to its definitive character the road cannot or can only slightly be adapted to the “new” environment. Had the planners built the road in this new environment, they would have done it completely different, not elevated, with crossroads and more possibilities to access and exit.

A ropeway can be changed. It may be slight changes, like extensions or the introduction of a new intermediate station, but the systems can as well be completely dismantled and erected at another location.

For temporary events like EXPOs or horticultural shows in Europe ropeways are the transport mode of choice for exactly this reason. In Koblenz for example, the ropeway with the biggest passenger-capacity to date, was originally built for an operating time of only three years. No other infrastructure with comparable capacities is so adaptable to changes in an urban environment. No other public transport mode needs less urban space and is therefore better adapted to dense neighbourhoods. The ropeway is the only mode (besides the active ones) that offers immediate transportation, literally without waiting times, like an extension of walking space or a direct link between two or more urban locations of high demand.

In a new planning paradigm of multicentric cities with multiple, dense, mixed use centres, where most city functions are accessible within a short walk or bike ride, cable cars may be an interesting way to link those centres to each other in an efficient way, silent, accident-free, without any direct emissions[3], without depending on the traffic conditions on the ground, and almost without consuming urban space.

This study does not intend to create a competition between different public transport modes, it intends to analyse the potential urban ropeways have for the use in multimodal public transport networks on the African continent and to identify success factors for an effective planning process.

3 A Cable car does normally not work completely emission-free, but the vehicle has no direct emissions, affecting the urban Space beneath it. The emissions are produced where the electric energy for the operation is generated. It is possible however to run a Cable car on alternative energy like solar power.

2 Accidents and Safety

2.1 The sad situation of road-safety in Africa

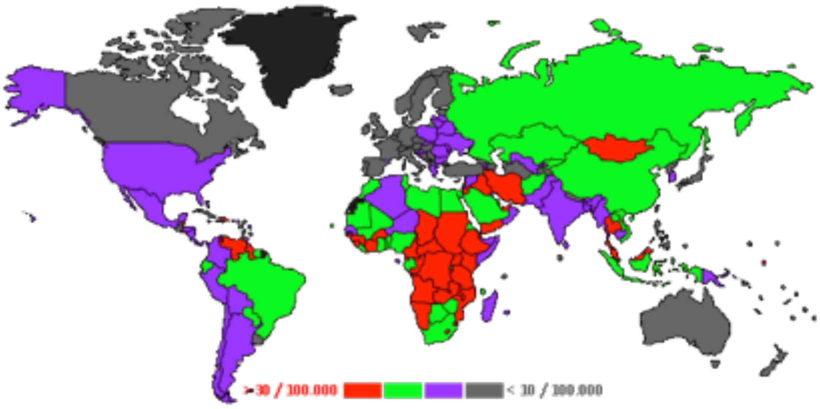

Fig 3.: Road Safety in Africa - http://www.worldlifeexpectancy.com

Of the 1.3 Million fatalities in road accidents mentioned in the introduction, about 90% account to low and middle-income countries.

Africa has by far the joint highest average road accident fatality rate of all global regions at 32 per 100,000 population.

It is estimated that by 2030, road crashes will be the fifth leading cause of death globally, putting it ahead of lung cancer and HIV AIDS. Currently it is the eighth leading cause, ahead of diabetes, tuberculosis and malaria.

	Ischemic heart disease	Stroke	COPD	Lower respiratory infections	Lung cancer	HIV / AIDS	Diarrheal diseases	**ROAD INJURY**	Diabetes	Tuberculosis	Malaria	Cirrhosis	Self-harm
Western sub-Saharan Africa	12	7	24	2	54	3	4	8	16	11	1	15	48
Central sub-Saharan Africa	8	7	17	3	41	5	2	12	19	6	1	18	30
Eastern sub-Saharan Africa	10	5	23	2	52	1	4	9	15	6	3	16	20
Southern sub-Saharan Africa	7	3	10	2	20	1	5	14	6	4	17	18	22
Central Europe	1	2	5	9	3	60	80	15	10	43	119	8	11
Global	1	2	3	4	5	6	7	8	9	10	11	12	13

	Hypertensive heart disease	Preterm birth complications	Liver cancer	Stomach cancer	Chronic kidney disease	Colorectal cancer	Other cardio & circulatory	Protein-energy malnutrition	Falls	Congenital anomalies	Neonatal encephalopathy	Neonatal sepsis
Western sub-Saharan Africa	30	10	21	42	26	57	34	5	20	19	13	6
Central sub-Saharan Africa	23	9	37	45	29	51	28	4	35	11	13	15
Eastern sub-Saharan Africa	25	8	35	38	28	44	31	7	26	22	13	12
Southern sub-Saharan Africa	9	12	39	40	13	36	16	35	58	26	19	34
Central Europe	4	54	20	12	18	6	7	78	17	38	77	83
Global	14	15	16	17	18	19	20	21	22	23	24	25

1-10 11-20 21-30 31-50 51-90 91+

Fig. 4: leading causes of death, The world Bank 2014

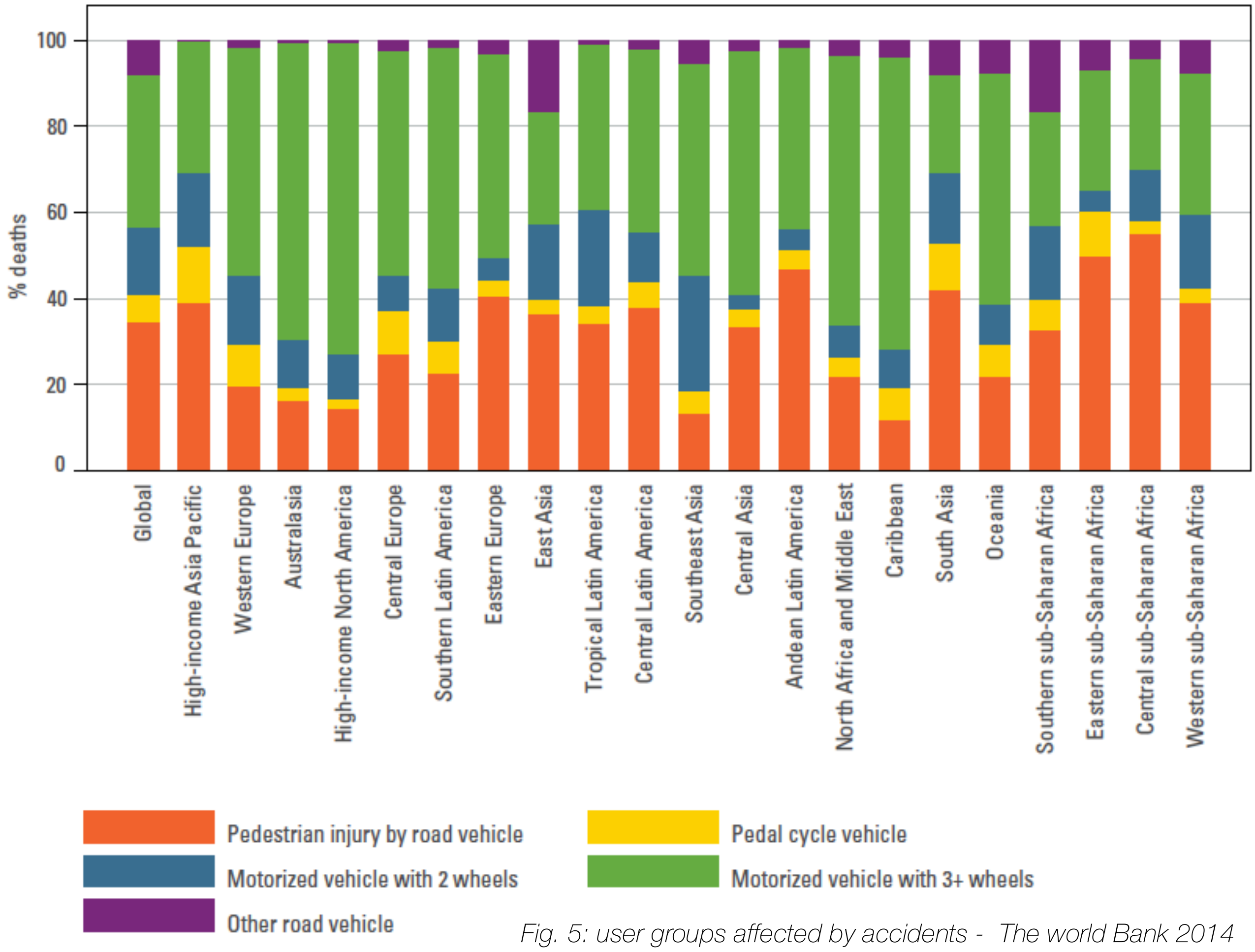

Fig. 5: user groups affected by accidents - The world Bank 2014

Globally about half of the fatalities are amongst pedestrians, cyclists and public transport users, whereas in Africa, especially in Eastern and Central sub-Saharan Africa, the share of killed pedestrians alone reaches 50% and more. Killed pedestrians and cyclists combined are accounting for shares of 60% and higher. Since the public transport users in Africa are normally not accounted for in a separate category and so form part of the other three groups, it has to be estimated that in these regions, the combination of the three most vulnerable groups (pedestrians, cyclists and public transport users) accounts for 70% to 75% or an even higher share of persons killed in road accidents.

The three mentioned modes are at the same time the modes of the poor. They are used by people who can´t afford a car. This means, that in Africa, even more than globally, the poor are at a clearly higher risk to die or get hurt in a road accident.

This is especially severe, because it means that the group that gets the least out of road traffic, is the group that suffers most from it. The fact that the majority of road accidents are avoidable and that we even know how, makes matters even worse.

2.2 Main Categories of safety measures – How can modern public transport contribute?

The main categories of road safety policy intervention that can produce dramatic reductions in death and injury have been known for many years *(Whitelegg, 2011)*:

- Reducing the exposure to risk focusing on land use policies and traffic reduction;
- Make safety intrinsic to all aspects of the design process of urban space with attention to details in the physical environment.
- Speed reductions (e.g. 30 km/hr limit zones)
- The elimination of poor quality bus services with replacement of old vehicles, improved regulation and safety checks and a highly coordinated and integrated bus service network

The underlying policy concept for the first measure is a paradigm shift towards an urban development and a land use policy based on proximity and density. This is a necessary step in order to reduce traffic, because the basic city functions will then become accessible by walking or cycling. Car traffic must be restricted in its increasing tendency to demand urban space, because urban space is very limited in dense cities, and at the same time public space is urgently needed to make them liveable places.

It becomes clear that the car will nor be able to serve these fast growing cities in a satisfactory manner. So public transport is the only answer to the requirements of this new planning paradigm, because it generates the urgently needed alternatives to IMT. From a safety point of view, public transport should be separated from road traffic.

The more space of an urban environment is used for active transport modes and public space, the safer it gets in terms of road safety. This means, the best way to increase road safety is to decrease road-traffic. But since reducing road traffic in the urban reality can not (yet) be the only way to go, other safety measures are necessary. Safety must be introduced as a general planning aspect, which affects all decisions taken in planning and transport legislation. This includes measures like clear separation of different speeds or traffic directions, separation of public transport and individual traffic, stricter technical regulations for vehicle-safety, stricter requirements for any transport infrastructure and traffic regulations like general speed limits or the priorization of pedestrians and cyclists.

But the simple fact of giving safety its deserved significance will boost the already expensive cost for road infrastructure even more, while modern public transport modes include these safety features from the very beginning.

Traffic regulations in Western countries have proven to be one of most efficient ways to improve road safety, but their success obviously depends on the efficiency of the enforcement of these regulations. Rules like speed limits, stop signs, traffic lights, or prioritizations are worth nothing if they are not enforced and fined consequently. Traffic regulations are necessary where vehicles can interfere with each other. The more vehicles are interfering the more discipline is required from the drivers and the more rules they will have to respect.

Private drivers or drivers of informal transport modes have their own reasons to drive. For them the vehicle is a tool they use to achieve a personal goal. A goal, they have to subordinate to regulations that, in Africa, are not even likely to be enforced. This puts every driver in a conflict whether to follow the personal reasons or respect the rules.

Modern public transport, takes the responsibility away from the private drivers and gives it to trained personal, who´s job it is to respect the rules. They are much easier to control than private drivers. Moreover public transport has less or even no interference with other vehicles.

All the improvements of public transport depend on the last of the four points. If we compare private transport and public transport in Africa in the actual situation, we will probably not find a lot of differences in road safety. But it is important to understand why investments in public transport are more adequate in order to solve the current transport issues than any others.

In the situation found today in many African cities a safe, well organised, affordable and high quality public transport service can really make a big difference and present a better alternative to car traffic.

2.3 Safety in urban ropeways

Cable cars are the safest means of transportation known today, with no fatal accidents at all and availability rates of about 99%.

The reasons are, first of all, that the vehicles are all attached to the same rope, which does transmit any movement to all of the vehicles. This completely rules out crashes between vehicles. Disturbances occur very rarely and are rather related to the drive system than to the vehicles themselves.

Secondly, the modern systems are equipped with various automatic monitoring systems. In case of a disturbance, these can either intervene directly in the operation of the system or provide the manager with important information for a correction.

Thirdly, ropeways have several degraded levels of redundancies, especially for the relevant operational systems. It will be guaranteed by the manufacturer, that with any kind of disturbance the passengers can always leave the vehicles within the stations and will not have to be rescued from them during the trip.

In general the high safety and durability of ropeways is, due to the fact, that they have their origins in high mountain areas, where they have to endure extreme conditions like enormous variations in temperature, extreme winds and heavy rain and snowfall. In the mostly milder conditions of the city, this represents a very large operational reliability and as a result permits the highest possible availability.

3 Public Transport in Africa: Ropeways as competitor or complement?

The paradox of many African cities is that, on the one hand, a large proportion of the population depends on public and private transport services for their daily mobility. On the other hand, most African cities lack the traditional mass public transport systems such as commuter trains, underground, light rail or even BRT. Smaller vehicles such ordinary buses, para-transit, taxi and even moto-taxi collectively generate considerable transport capacity and "do the job", but at a considerable individual and collective cost: the system is very slow at peak hours, unreliable, unsafe and polluting.

The questions are why African cities generally do not yet have mass public transport systems and whether ropeways have better chances to succeed in providing African cities with mass public transport than the traditional mass public transport systems have so far. In order to respond to these questions, we propose to analyse the advantages and handicaps of four modes (para-transit, BRT, rail, ropeway) in a SWOT analysis and then discuss the crucial issues of governance and financing of these modes.

SWOT	*Internal*	*External*
Positive	Strength	Opportunity
Negative	Weakness	Threat

3.1 Swot Analysis

3.1.1 Para-transit

The strengths of para-transit is its resilience: it requires relatively little specific infrastructure : para-transit bus stations only require more or less drivable parking space and basic amenities. The vehicles are inexpensive and easy to maintain and repair.

The weakness of the system is that when successful, the numbers of vehicles necessary to meet demand become impressive and the capacities of basic infrastructures become tight and flow over, resulting in jammed streets, crowded stations and parking spaces. Para-transit is indeed the most space consuming mass transit system. The first victim of the congestion created are the para-transit operators and passengers themselves, who's operating and travelling conditions are degraded drastically when the system is operating at too high traffic density.

Para-transit's other inherent strength is its wealth of opportunities: new neighbourhoods are integrated in the para-transit networks before the roofs are finished or the blacktop roads built. Para-transit creates a large number of direct and indirect jobs and business opportunities linked to vehicle operations (reparations, recycling) and customer service (trade at para-transit stations).

Due to their tight, competitive and for-profit business case, para-transit operations do generate considerable externalities, many of which can be expressed in terms of infrastructure and threats, such as heavy air pollution, poor road safety, traffic jams and, every now and then, complete traffic breakdown (following an accident, for instance).

Para-transit	Internal	External
Positive	Ability to operate with little and inexpensive dedicated infrastructure	Ability to respond to demand quickly and independently from infrastructure
Negative	Inefficient use of parking and road space in high density environments	Competition for road capacity with other road users may lead to drastic outcomes

3.1.2 BRT

The strength of the BRT concept – that has laid the basis for its economic model in the first place – is, as compared to rail alternatives, the relatively low cost and convenient technical feasibility of its infrastructure and vehicle fleet: in order to start a BRT, all you need is a reserved bandwidth on the road, basic boarding platforms and a fleet of reliable standard to high capacity buses.

The weakness of the BRT is that the low cost of infrastructure is compensated with quite considerable need for corridor width and priority over other road users: priority over cars and trucks, but also over walking and cycling who can of course not use the dedicated BRT lanes, but who also cannot cross it, except at rare, specifically designed flyovers, tunnels or crossroads. As a result, BRT is easy to implement on existing motorways and large avenues. It is difficult to implement anywhere where road width is a problem because of urban or landscape features.

BRT is a great opportunity for adjusting over-dimensioned road infrastructure. It also provides the opportunity for incremental implementation: it is easy to increase capacity by adding additional vehicles and to extend the system by adding additional portions of corridor.

BRT infrastructure requires constant attention and investment. If it can be occupied by other users, or if maintenance is not impeccable, BRT services will gradually decline, due to loss of safety, operating speed and life expectancy of vehicles using the infrastructure. This is of course true for any kind of infrastructure, but the nature of BRT infrastructure makes it particularly prone to neglect (like much of the rest of road network), as maintenance is rather expensive and operations remain possible even under degraded conditions.

Similar threats apply to BRT operations. Para-transit buses operate in a largely self-regulated manner, with drivers and managers of small fleets knowing exactly how to regulate operations and manage incidents (and creating relatively limited damage for the larger system, if they don't). BRT can operate on the same mode, but it definitely should not: efficient high capacity BRT requires sophisticated traffic management, scheduling & vehicle tracking, passenger information and passenger flow monitoring, contingency procedures, etc. It will still function if these elements are failing, but only at the expense of gradually falling back to typical para-transit operations.

BRT	Internal	External
Positive	Provide high performance public transport with infrastructure and vehicles similar to existing ones.	Opportunity to restructure and improve capacities of the road transport sector.
Negative	Risk of « falling back » to para-transit type operations.	Requires high densities of demand in the vicinity of large avenues and close cooperation with feeder services operated by competing Para transit and taxi companies.

3.1.3 Rail

Most, if not all, Rail infrastructure in African cities between the Sahara and South Africa date back to the colonial era and were not designed as modern urban rail at all. A strength of this heritage is that these railway lines most likely still form corridors of high interest for mass public transport, because

- the railways pass by important traffic generators
- the city has evolved with or along the railway lines; or
- simply the railway was built in accordance with determining physical landscape features that also determined the expansion of the cities.

This provides the opportunity for the development of a high capacity mass transit line along one corridor that, in many cases, is most likely to coincide with the longest and densest axis of urban development.

The weakness of the existing railway corridors is that they do not serve the sections of the city that are not situated along the historic corridor. Furthermore, the historic railways were built to historic standards and low intensity traffic and, besides derelict tracks and signalling, feature single track, narrow gauge, tight curves, low crossing bridges or tunnel ceilings. In order to make them effectively exploitable for modern urban rail, their infrastructure should (must) be rebuilt entirely. This is of course still easier than the construction of an entirely new corridor, but may entail quite important investments, not only in terms of railway material, but also for the partial enlargement of the corridor. The high cost and virtual impossibility to create new railway corridors in the already built up urban areas is another, fundamental, weakness of railways in urban transport. Only underground rail or light rail on large avenues may offer (very expensive) possibilities.

The revival of the railway for urban transport also opens opportunities for longer distance passenger transport that could benefit from the same modernised infrastructure. In regard to tracks, this of course requires the corresponding additional investment. The opportunities reside in economies of scale in railway operations and the function of the main railway stations as true transport hub for short, medium and long distance transport.

Threats to the use of the main corridor for the operation of urban trains will arise from the success of the railway revival: the capacity of the newly refurbished urban train corridors may be quickly outgrown by urban trains, commuter and long distance passenger trains and freight trains.

Railway	Internal	External
Positive	Existing corridor on likely main development axis	Railway revival, also for longer distance passenger traffic
Negative	Cost of refurbishment and immense difficulty to create additional corridors	Competition with long distance and freight traffic for limited infrastructure capacity

3.1.4 Aerial Ropeway

The strengths of ropeway technology reside in its fundamental differences compared to bus and rail:

- Aerial: the aerial ropeway does not compete with other modes of transport or other urban functions for space and privilege “on the ground”. By definition, the ropeway has its own dedicated corridor in the air and it is physically quite impossible for anyone to squat this corridor.
- Ropeway: between two supports, the infrastructure consisting of only one or three ropes per direction. is absolutely minimal and inexpensive, yet utterly effective. The fundamental advantage of the ropeway, however, is that all moving parts form an independent closed systems and traction depends on a single, stationary electric engine. As a result, all mechanical risks can be tightly controlled and effectively excluded.

The aerial ropeway also has its specific weak, or more precisely: ambivalent, points. In comparison to basic BRT or rail stations, ropeway stations are relatively expensive installations and the corridor must be straight between two stations (no left or right turns allowed). As a result, although the aerial ropeway can fly over many obstacles that block terrestrial modes, the aerial corridor cannot easily go around physical obstacles such as high rise buildings and chimneys or more virtual obstacles, such as terrestrial property owners reluctant to aerial traffic.

The aerial ropeway travels at lower speeds than BRT and rail: 25 km/h, as opposed to, theoretically, 50+ km/h. In urban areas, the slower travel speed is more than compensated by the absence of traffic interference, straight travel lines and absence of waiting time. As a result, aerial ropeway trips are actually faster than alternative services. On longer, suburban corridors, however, BRT and rail are likely to make full use of their higher travel speeds, making ropeways increasingly uncompetitive, due to their speed limits.

The threat analysis of aerial ropeways is very different from bus and even rail based systems. Bus and rail vehicles are exposed to high individual risks of traffic accidents and mechanical failure, but incidents only affect individual vehicles, while the rest of the system continues to operate more or less unimpeded (although broken down BRT or rail vehicles can disrupt service on entire sections for some time). For an aerial ropeway, being a single machine, any incident on one of its elements directly affects the entire system. It therefore is crucial to ensure the flawless functioning of all parts of the system. Technically, this objective is achieved by the protection of the system from outside hazards (road conditions, weather conditions, etc.) and redundancy of all essential elements.

Ropeway	Internal	External
Positive	Totally independent corridors	Create connections that are otherwise impossible
Negative	Specific planning constraints Practical line length limited due to speed limits	Operate only under fully compliant conditions

3.2 Governance

The governance implications of the technical characteristics of the various transport modes are considerable and condition to a great extent their respective roles in the urban transport system.

3.2.1 Para-transit

In most African cities, taxis and privately owned and operated mini-buses are the dominant public transport service. They are usually operated from publicly regulated bus stations and organised through the trade's own private and cooperative institutions. Para-transit is not subsidized. On the contrary, the sector pays taxes and fees as well as dividends to the fleet owners, at the expense of staff's wages and working conditions, passengers' fares, transport conditions and the general public environment and road safety.

It is commonplace to criticise para-transit for its shortcomings and various externalities it imposes on its users and the urban system. While these criticisms are largely justified, it must also be acknowledged that para-transit is the only mode that can transport numbers of persons without massive government intervention and that it has intrinsic qualities in terms of market responsiveness, robustness, resilience, economic viability and social rootedness.

Therefore, it is rather risky to reform and develop urban transport systems by simply replacing the para-transit network by any form of supposedly better and more efficient mass transit. The intended improvement may well prove to provide a more comfortable, reliable and cleaner service, but can also be costly and ineffective in comparison to the para-transit system it was meant to replace.

Any BRT, urban rail or aerial ropeway project should not attempt to replace para-transit, but to complement it by taking over certain functions in the multi-modal transport network that indeed are not served effectively by para-transit and by increasing the opportunities for para-transit to develop on corridors and in areas where its own strengths are actually superior to any alternative public transport service.

3.2.2 BRT

Bus Rapid Transit is the mass transport system most similar to (bus based) para-transit. This bears the greatest risk of direct competition – if not confrontation – with para-transit over road space (traditional or BRT typical right-of-way) and the privilege to serve profit-making corridors.

BRT requires the bold intervention of public authorities in order to create and administer the BRT bus ways. The actual operation of the buses can be given to the most professional private bus enterprise in town, be it public or private, well established, newly created or, possibly, a newly created public-private partnership based on cooperation among already established organisations.

The equation is complicated and only LAMATA's BRT Lite in Lagos, Rea Vaya in Johannesburg and DART in Dar es Salaam seem to have solved it (or almost) so far (in very different ways and with different issues still to be resolved).

BRT schemes tend to turn out complicated governance structures. Public authorities are responsible for the infrastructure and market regulation. Actual operations are sub-contracted to a number of private operators according to procedures that have been negotiated in great detail with representatives of the local para-transit sector who agree to move into the BRT business.

3.2.3 Rail

Some local passenger services or regional and intercity services with sparse schedules have survived over the last decades in sub-Saharan Africa. Urban rail with permanent service for trips within metropolitan areas has been totally absent from countries between the Sahara and South Africa. However, several projects are currently being studied, planned or implemented in Kenya, Abidjan, Yaoundé, Kinshasa, Addis Ababa (Light rail) and Nigeria (Lagos, Abuja, Port Harcourt). If only half the projects are implemented, they will outnumber BRT projects.

Regarding governance, urban rail's advantage over BRT is the reduced potential for conflict with para-transit. On one hand, road and rail corridors operate separately and do not compete for capacity. On the other hand, urban rail's superior transport performance over longer distances is largely undisputed (and if rail does not meet expectations, road transport quietly takes over market shares).

Furthermore, the governance of rail projects tends to be fairly simple, insofar as the public authority tends to trust the entire operation to a (carefully selected) potent international consortium in the framework of a public private partnership (PPP) established according to procedures well known in other public utility sectors.

The critical element of urban rail governance thus are the terms of the PPP agreement which, beyond the legal technicalities, largely depend on the partners' determination and ability to ensure the functional success of the rail corridor in metropolitan transport market and the entire urban system. Urban rail's line of business requires (very) large numbers of paying passengers. This can only be achieved if the private partner delivers impeccable service and the public authority organizes the inter-modal transport system as to make the best use of urban rail in inter-modal trip chains. For instance, they must ensure that urban rail stations are centres of urban development and of secondary transport systems, such as para-transit and … aerial ropeways.

3.2.4 Aerial ropeways

Regarding governance and intermodality, aerial ropeways strongly emphasize the advantages described for railways:

- With ropeways, it is impossible to distinguish infrastructure management from vehicle operation or to imagine several operators on the same line. Even more clearly than railways, ropeways are precisely limited, closed and exclusive systems. They are, therefore, particularly well suited for PPP.
- Physically, the "closed and exclusive" character of the ropeway means that the risk of disruptions due to interference or intrusion from the outside is very low and easy to manage. As a result, many critical and complex elements of BRT or rail PPP related to these risks can be reduced to a minimum: the technical availability and lifespan of properly designed and implemented ropeways can be forecast and guaranteed quite precisely by the private partner responsible for the implementation and operation of the ropeway. As a result, many costs linked to the management of risks linked to interference and physical intrusion can be limited or eliminated. Human resources can also be mentioned in this context: Ropeway systems are compact and their operation requires relatively limited, but well trained staff. Hence, selection and training of local staff is rigorous and commitment of the staff to their extraordinary transport system and customer service is high.
- Aerial ropeway corridors can be designed to compete with other existing services. But the great technical advantage of ropeways is the ability to provide direct connections where other modes can not operate at all or only with considerable handicaps. If this advantage is properly included in the planning process, the aerial ropeway will not be blamed for "taking away" business from para-transit and other established services providers, but, on the contrary, it will create new business for connecting services.
- Similarly to railways, the ropeway can and should be planned and implemented as a partner of all other transport modes. Unlike railways, ropeways depend less on intermodality due to their smaller transport capacity and unique selling points. However, the effective intermodal planning and cooperation between transport services is an important success factor for ropeway projects and associated PPP. While the "closed and exclusive" character of the technical ropeway system greatly helps to limit risks and costs, an "open and inclusive" urban design in transport planning and marketing strategy is possible and necessary to maximise opportunities and income.

As a result, aerial ropeways – if implemented at the appropriate location – are the best choice for mass urban transport services with the lowest technical risks, the highest probability for balanced books and greatest opportunities for stimulating additional business for other transport services.

3.3 Financing

The conditions for financing public transport depend on issues discussed in this chapter and throughout this paper:

- the life cycle costs of the system: level and predictability of expenditure per trip and/or per trip.km produced ;
- the market success of the system: how many passengers will it attract, at what price, taking into account the inter-modal competition or cooperation ;
- the governance of the system: limited number of stakeholders reduces direct and indirect risks.

3.3.1 Life cycle Costs

Like the physical set-up of the different modes of transport, their cost structure differs substantially. Generally speaking, aerial ropeways are far less costly to build and operate than BRT or Rail corridors. They also serve shorter trips, which further reduces the cost per trip. Moreover, a good proportion of the aerial ropeway investment is linked to extremely high safety and reliability standards. The physical set-up of the system makes it easier to protect it against human-related and natural deterioration (including climate: cold, heat, salt, sand, flora, fauna). As a result, the aerial ropeways' life cycle costs are not only lower, but can be calculated and guaranteed more solidly than those of any other transport mode.

3.3.2 Market success

The market success of any transport project depends on the corridor it is designed to serve: the number of potential customers and its competitive advantage in comparison to alternative modes of transport. If the aerial ropeway creates an entirely new mass transport corridor that is needed, but cannot be provided by other modes of transport, its competitive advantage is paramount. As a result, the number of customers will be high. In addition, they will be willing to pay a substantial fare per trip or km travelled, because the alternative solution would cost them much more in terms of travel time and multiple tickets for successive "cheap" transport services (not to mention the difference of value of "felt" travel time: enchanting aerial trip vs. rough para-transit rides).

Hence, if the aerial ropeway is properly installed on an important corridor where other modes are least effective, market success is almost guaranteed and instant.

3.3.3 Governance

As pointed out above, for their technical characteristics as independent, integrated and closed systems, aerial ropeways are particularly well suited for Public Private Partnerships, where the private partner is in a position to take on all technical risks on a relatively tight calculation. The public partner will be able to concentrate on providing good and stable operating conditions: urban integration of the ropeway stations, inter-modal transfer facilities, compensation of concessionary fares, etc.

As a result, a properly designed aerial ropeway offers a unique combination of:

- predictability of life cycle costs and market success
- favourable cost/revenue ratio
- the clear distribution of precisely defined responsibilities of a limited number of stakeholders

These are the criteria of highest importance for public and private financial institutions and make aerial ropeway projects particularly interesting for them.

4 Touristic potential of urban ropeways

«Aerial ropeways are only for tourism» is a judgment often heard when this technology is proposed for the solution of daily urban mobility problems. There is no doubt that aerial ropeways are great assets for scenic tourist regions :

- ropeways can go where no other mass transport can go – many tourist regions or sites often are difficult to access, which makes part of their charm.
- ropeways can provide scenic and enchanting views, which no other infrastructure or means of transport can offer in the same elegant and calm fashion.

As a result, tourist resorts in mountainous areas in Europe and elsewhere cannot develop mass tourism without aerial ropeways. Other tourist attractions, such as amusement parks, floral shows and universal exhibitions like to install aerial ropeways, because they can solve transport problems at very short notice and provide an attractive feature for the event at the same time. In Africa, too, the first ropeways South of the Sahara are tourist attractions: the Table Mountain cable car in Cape Town, South Africa and the Obudu resort cable car in Nigeria. In Algeria, on the contrary, virtually all cable cars installed have a primarily “daily” function, for all types of trip purposes.

Fig. 6: Use of Busses – Photos: Joachim Bergerhoff

Many sightseeing buses around the world are double decker buses. It would be wrong to conclude that double decker buses can only service tourist purposes. In London, Berlin or Hong Kong they are successfully used as regular public transport vehicles. But even when used on regular public transport service, passengers in a “tourist mood” enjoy the front row on the upper floor for the special view, while the majority of passenger also appreciate the transport capacity of the service, such as many more seats and a less shaky ride than in articulated buses.

The same applies to urban ropeways: they are excellent for tourist purposes, and even when on “ordinary duty”, they offer an enchanting experience. As a result, everyday aerial ropeway travellers actually enjoy their public transport trip, which is not always the case for bus or rail travellers. In addition, the ropeway also transforms the urban scenery into a tourist attraction and attracts new customers to the ropeway, and to the neighbourhoods that are connected to it.

5 Energy supply

For most activities power supply is a critical issue in most African cities,. Especially the electric grids are vulnerable to scheduled cuts or unplanned interruptions. Every activity that depends on constant electric power supply therefore must have a contingency plan. Aerial ropeway projects thus should carry out a detailed analysis of frequency and duration of power shortages and establish their back-up power strategy according to transport needs. As a matter of fact the aerial ropeway can operate without energy supply from the electric grid for days or indefinitely, provided a robust generator and a large fuel-reservoir exist. Depending on length, charges and types, aerial ropeways require a power supply between 100 kW and 1000 kW, 500 kW being a reasonable approximation for a typical urban aerial ropeway of about 3 km. Simple Industrial back-up power generators can easily provide this level of energy supply.

Fig 7: Manizales Colombia – Photo: Leitner

Examples: a small installation, such as in Manizales, Colombia, 705 m long, with 22 cabins and capacity of 2100 persons/hour is driven by an engine of 150 kW; whereas a large system, 2200 m long, with 520 m elevation, 74 cabins and a capacity of 3000 persons per hour may be equipped with a 900 kW engine, in order to ensure good performance even when passengers are mainly travelling up-hill.

In comparison, a single light rail vehicle carries 4 engines of about 100 kW. The power requirements for a light rail system with several vehicles operating simultaneously are much higher than for aerial ropeways, not only because their overall consumption is higher, but mainly because of peaks of power demand during acceleration after each stop. When several light rail vehicles accelerate at the same time, power demand can reach several thousand kW. As a result, the fluctuating demand and power peaks make it much more difficult (virtually impossible) to operate a light rail network depending on an ordinary industrial diesel generator. For instance, the only operating hybrid diesel-electric light rail carries two 350 kW diesel generators in each vehicle.

6 Examples from Latin America

Since currently there are only very few working urban ropeway examples in Europe and the U.S., and since the conditions in Africa are in many ways more comparable to the conditions in Latin America, than to those in Europe, we will concentrate on examples from Latin America, where not unlike in Algeria, ropeways have started to play a mayor role in urban transport.

6.1 Columbia

Fig. 8: Santo doming Savio: http://blog.educastur.es/bibliotecabaudilio/files/2010/03/santo_domingo_savio.jpg

In Columbia Cable Transit started in Medellin, when the city was still something like the world drug capital. A city with extremely high crime-rates, and some areas almost inaccessible for security even for the police or paramilitary troops.

In the beginning of the new Millennium suddenly Metro Medellin proposed to connect one of the worst Barrios, Santo Domingo Savio, to the metro by a gondola system along Andalucía Street, right into the heart of crime and violence.

The thoughts were not taken seriously at first, but little by little the plan started to gain credibility and after four years finally a positive decision was made.

The results were unbelievable. Within a few years, the area, turned into a relatively peaceful place. The cable-car and the related social measures had initiated a habit of self-control within the “barrio”, whose inhabitants finally had a proper, positive identity which was worth defending. The following development process the area underwent was based on this new confidence. The results were truly unprecedented and have initiated a change in the whole nation. Today the J Line is one of the most busy cable-car lines of the world with about 30.000 passengers/day. Where people before had had commuting times of over two hours a day, now they need about 20 to 30 minutes for a trip to the centre.

6.2 Venezuela

Venezuela is the place on earth with the lowest prices for gasoline. A gallon of gasoline costs about 0,12 CT/USD. With these prizes it is no surprise, that Caracas is one of the most congested cities on the planet as well. Short urban trips can take hours to complete. The city traffic has completely collapsed.

Fig. 9: San Augustín, W. Auer UCC Workshop 2014

Public transport is the only solution for this situation, and to be a solution it needs to be extremely cheap in order to be able to compete against the gas prices.

Within this setting, Caracas has a lot of informal settlements on the hills surrounding the city. Here the terrain is too steep to build roads or any other transport infrastructure, so the people who live here do not own cars, because they just wouldn´t serve them here.

Until 2010 the only way for them to be able to get to the city of Caracas was descend one of the narrow trails from the steep hill to one of the metro stations down in the valley. This alone would take them at least 45 minutes. The way up was obviously about double the time.

Because of their isolation many of these Favelas step by step turned into lawless areas, with high crime rates, drug traffic and the others like that.

Fig. 10: San Augustín, W. Auer UCC Workshop 2014

In 2007 the situation in San Augustín, one of the favelas, became unbearable for the government and plans were made to make it accessible by a serpentine road leading up the hill. For the road, about 15% of the housings would have had to be demolished.

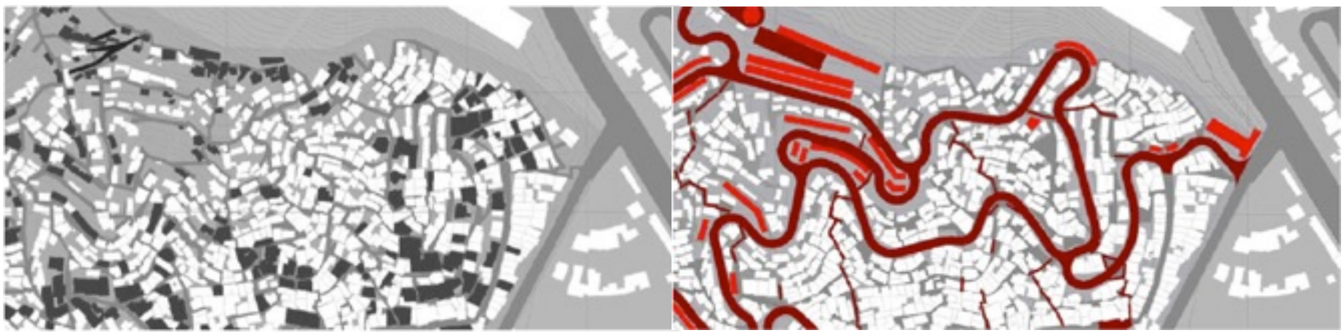

Fig. 11: Road for San Augustín? Presentation W. Auer UCC Workshop 7/2014

A big opposition formed against this road project and with the help of urban planners a counterproposal was presented. It consisted in an urban ropeway, connecting the favella to the Metro-lines in the valley. The proposal was finally accepted and the Metro-Cable was built.

It was much more than a pure transport project - the metro-cable is a connection between the formal and the informal city. As a catalyst it was conceived to improve the conditions in St. Augustin by introducing social and sanitary equipment into a once isolated informal and underserved environment.

Fig. 12:
Caracas Metrocable,
Doppelmayr

The stations include services, like water-supply and sanity and offer public facilities like educational institutions, libraries, health-centres, and sports infrastructure, as functional improvements to the informal area. This created international attention amongst planners and architects.

Metro-cable accesses the hilly San Augustín area starting from two transport hubs in the valley, introducing three intermediate stations within the informal area. The project includes an adaptation of the walkways throughout the barrio in order to facilitate quick access to the three stations. It introduces accessible urban functions into the informal space but manages to keep it car-free in a city with the lowest fuel-prize in the world! It creates a car-free city within the traffic collapse.

When San Augustin was completed there where already other Plans for more Systems coming up.

As a consequence the public transport map of caracas shown below shows currently nine urban ropeway systems. The newer ropeways in Caracas are mostly traditional feeder systems or extensions for the the growing Metro-System. Some follow the example of San Augustin, reaching out into the informal settlements surrounding the city.

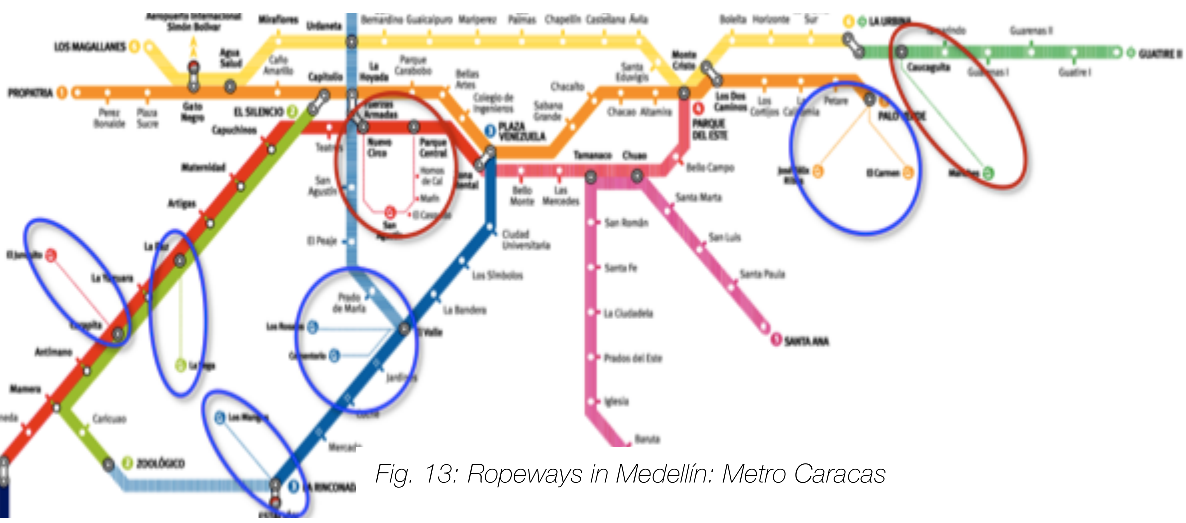

Fig. 13: Ropeways in Medellín: Metro Caracas

6.3 Bolivia

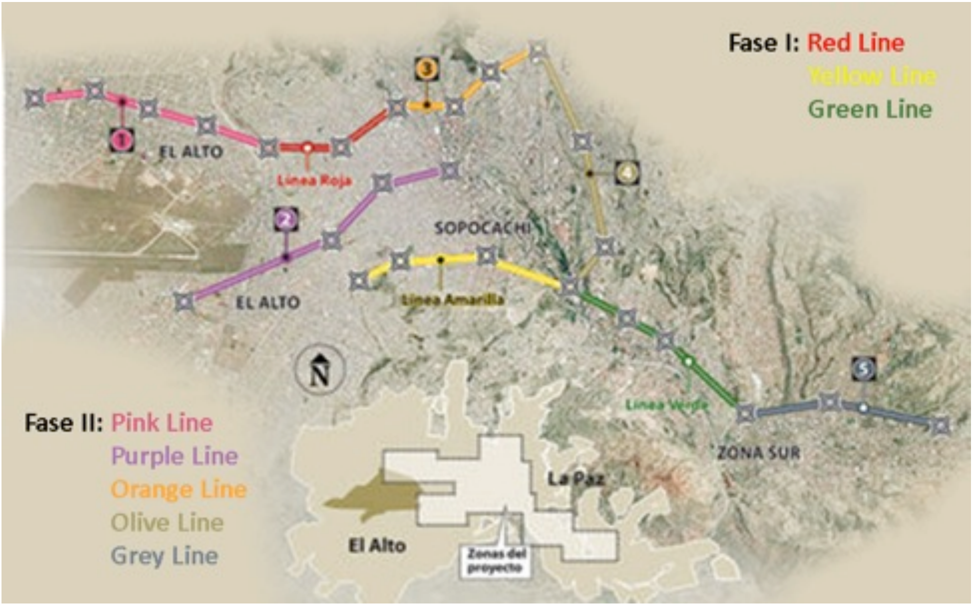

Fig. 14: Phase I and ii La Paz. La Razón (Edición Impresa), 15 de julio de 2014

After the examples of Medellin and Caracas, where the ropeways are mainly used as feeders to a higher capacity urban mass transit mode, The example of Bolivia´s capital La Paz marks another step ahead in the development of ropeway networks. Here the urban ropeways will soon be the backbone of the urban public transportation system and a long awaited regular connection to the city of El Alto, located on a plateau above La Paz. Together both cities and their surrounding metropolitain area have over 2,5 million inhabitans.

While the first phase is completed with the red line opened in May 2014, yellow line opened in September 2014 and the green line in December 2014, President Evo Morales has just announced the second phase of the project with five more lines complementing and extending the complete ones.

In the first phase the two twin Cities El Alto and La Paz have been connected along two important corridors. One of them even continued to the southern part of La Paz . Trips that traditionally have taken over an 1,5 hours, can now be made in about 20 minutes. With the new connections of Phase II, cable transport will really become the main transport mode in La Paz.

There will be a connection of La Paz with the important interdepartmental transport hub and the El Alto international Airport. Another corridor will extend the red line into the city of El Alto. A third and fourth line will connect the younger eastern parts of El Alto and La Paz with the main transport hub in the centre of La Paz and a fifth one will extend the cable service further into the southern part of La Paz.

7 Ropeways in Africa - yesterday, today and tomorrow

7.1 Yesterday

The history of cable cars in Africa began as a transport mode for freight. The Massawa – Asmara Cableway in Eritrea started working in the 1930s to carry freight from the red Sea up to the Eritrean and Ethiopian highlands, where roads where already in place to distribute the goods into the Hinterland. It was built as a key supplier for the Italian army when preparing their invasion of Ethiopia. A newly built narrow gauge railroad was able to climb the plateau but its capacity was too limited to keep up with the ever growing freight traffic. For this reason Italian engineers built a cableway over 75 Kilometres between the two towns of Massawa and Asmara, doubling the capacity of the railroad. It had over 1400 gondolas, 13 Stations and moved about 30 tons of goods per hour in each direction.

Fig. 15: Massawa – Asmara Cableway
http://www.trainweb.org/italeritrea/teleferica1.htm

7.2 Today

Not very long after the introduction of Cable transit for goods on the African continent French engineers built a first urban cable-car in Algiers in 1956. After its independence Algeria went on, developing urban cable cars: In the eighties, three cable-cars where built to facilitate easy access to 3 popular destinations in Algiers. In 2008 the first new-Generation Ropeways where really starting to play a significant role in the urban public transport systems.

The beginning of the new generation Ropeway systems was marked by the city of Constantine, the third largest city in Algeria, which is located on an extremely difficult terrain with big height differences and natural barriers to overcome.

In 2007/08 the first new generation cable-car connected the upper and the lower part of the city. Trip durations of over 2 hours by bus were cut to less then 25 %, when it was implemented.

Almost at the same time there were three more systems installed in Algiers, Tlemcen, and Oran. All of them were, entirely integrated into the public transport system and brought a big improvement for the accessibility within these cities.

Fig. 16: Quet-Koriche, Algiers – Foto: Doppelmayr

The implementation of these ropeways happened at a time when Algeria made big investments in its transport infrastructure. The idea was copied various times and today cable cars are always considered an option when transport systems need to be modernized.

Currently there are 11 cable cars in use in Algeria. Another 12 are at some stage of planning or construction. Ropeways have become almost a mainstream transport mode in Algeria.

7.3 Tomorrow

At the moment the urban cable cars of Algeria are the only ones in service on the African continent but this is about to change and it is one of the reasons that this study is conducted.

Especially in sub-Saharan Africa there are a few mayor cities at some stage of planning. In the following we will take a look at some of them in order to analyse the conditions of their transport systems, the potential of cable-cars in order to solve some of their problems and the mayor arguments to use cable-cars in the conditions to be found there.

Eurist was invited by a number of cities in order to hold workshops on the potential of urban cable-cars under the local conditions. For this reason short desk based studies on all of these cities were conducted to prepare the workshops. The findings of these studies, the results of the workshops and the status quo of the subsequent planning processes are displayed as follows.

7.3.1 Ethiopia

Addis Ababa is the largest city in Ethiopia with a population of 4,1 million in 2014, estimated to increase to 5.6 million by 2020. As in other African cities the need for transport, physical infrastructure, systems and public transport services is significant.

Traffic on the roads is increasing while the public transport system, comprised of the publicly-owned Anbessa bus service and the privately owned minibus taxi services, is insufficient. Walking, although unsafe, is an important component of daily transport. Cycling was a relevant mode of transport in the 1980s but lost its role in urban traffic and is now at very low level (below1%).

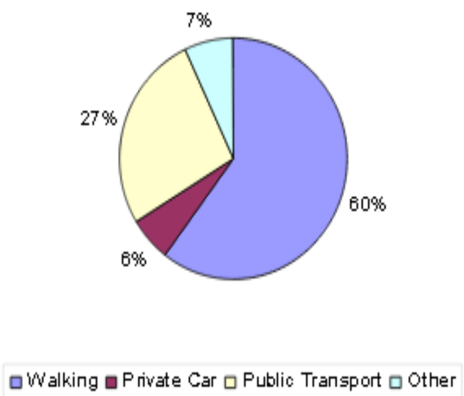

Fig. 17: Per Capita Household Modal Split in Addis Ababa M. NYARIRANWE 2008

Fig. 18: Light Rail under construction, pedestrian traffic in morning rush hour, C. Pardo 2014

Other features of Addis Ababa's transport situation today are[4]:

- Nearly 20,000 non-goods vehicles (excluding public transport) enter/exit the city on an average day.
- Large volumes of freight traffic (131,790 vehicles) enter/exit the core area daily.
- Demand for parking is increasing and is becoming a major problem.
- Most of the users of public transport belong to low- and medium-income groups.
- Work' is the predominant purpose of users
- nearly 50% are in the 20-30 year age group.
- Most of the minibus operators own a single vehicle (88%).
- The vehicles are small, with a carrying capacity of 11 passengers
- The average vehicle utilization per day is about 138 km and average number of trips is 15.
- There are over 12,500 minibuses providing service in Addis with over one million passengers per day, providing about 25,000 direct jobs.
- They operate at a small profit.
- ANBESSA operates with high capacity buses (carrying up to 100 people)
- They carry about 640,000 passengers per day.
- They operate at a deficit and the government subsidizes their operations.

The city's vision is to offer its citizens "affordable transport, enhanced access and mobility". In this regard urban ropeways – as an integral part of a multi-modal transport system can accelerate the realization of this vision.

Transport experts in Addis Ababa have already realized cable-cars in Cape Town and see many potential corridors in Addis Ababa for feeder systems or for connecting remote areas with centres of urban activities. Apart from this five other cities in Ethiopia may be suitable for ropeway systems as a backbone public transport technology but also for pure touristic purposes. The current transport projects in Addis include a BRT Project and a Light rail system. The BRT is actually in the planning phase, the feasibility study is about to be accomplished. The first BRT Line is expected to be operational in 2017. The LRT however is already under construction and the system (Capacity 20 000 pphpd) is to be opened in the course of 2015.

Until 2014 the city has not considered cable-cars as an alternative solution but has now identified ropeways as a good feeder systems for both MRTs in Addis. Due to the numerous settlement projects in the peri-urban region of the capital city – there is an enormous need for feeder systems in the coming years and decades.

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4 *GEF Sustran 2010*

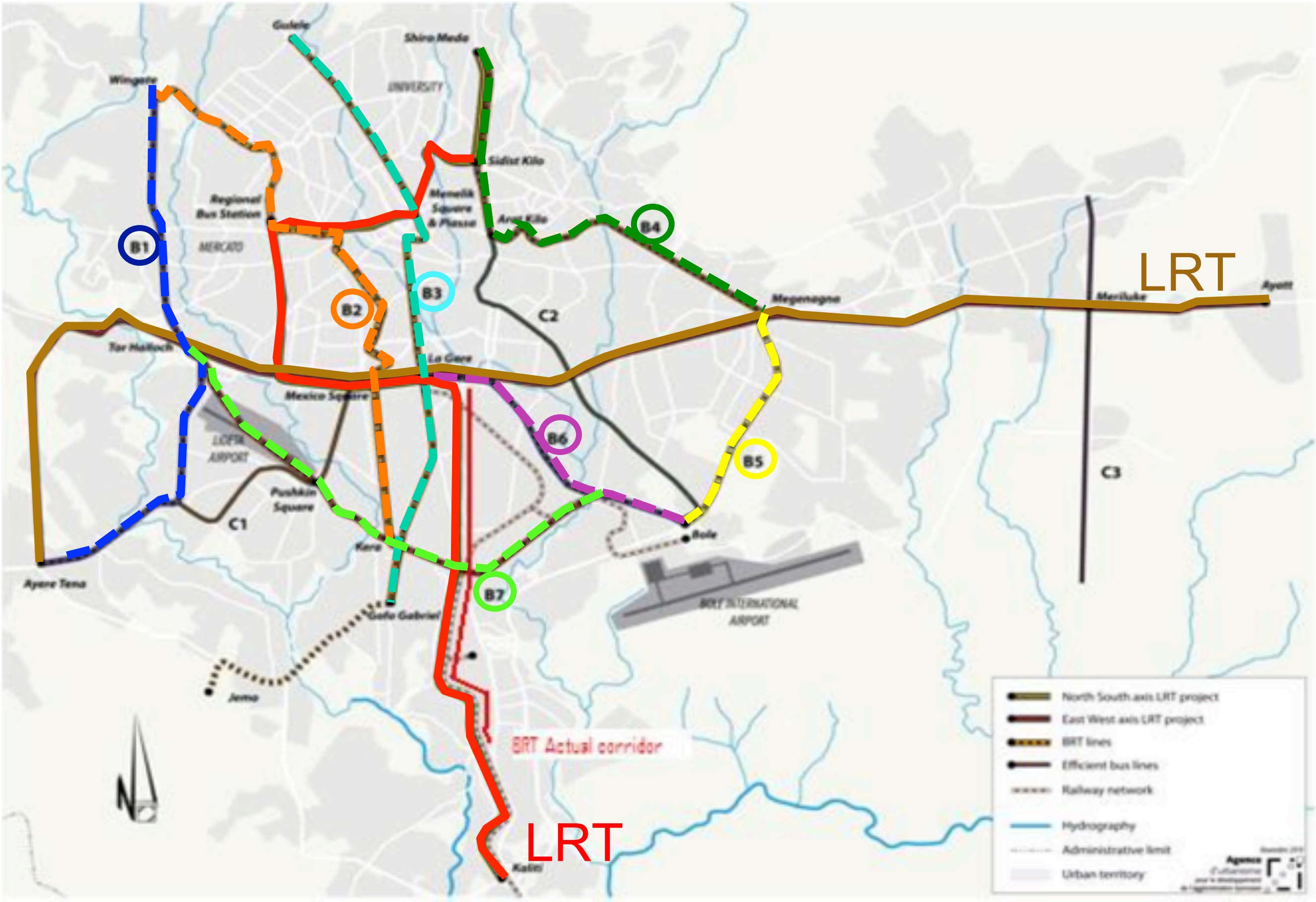


Fig. 19: Feasibility Study Public Transport Addis AFD 2010, Source: Yorgos Voukas 2012

Since Addis is the base of the African Union and of many other institutions, leaders are in general very keen to get lighthouse projects, which can stand as model systems for neighbouring countries and be adapted by other African cities. A ropeway project would be a prestigious new component of the cities public transport plans.

<u>First Ideas</u>

In ropeway workshops, held in early 2014 participants from different stakeholder groups came up with several ideas for ropeway projects in a both urban and touristic context.

Two routes were suggested. Both are feeders to future mass public transport modes, and both have a clear potential according to the results of the stakeholder-workshop. As the BRT is still in the planning phase whereas the LRT is already under construction LRT feeders should be of higher priority, than BRT-feeders.

7.3.2 Ivory Coast

Abidjan is the economic centre of a large part of French speaking West-Africa. The 7+ million city has grown very significantly beyond its original site on Plateau and Treichville. The functional specialisation of the various sectors of the town induces significant daily commuter flows between the large residential sectors of Abobo, Yopougon and Cocody towards the tertiary centre on Plateau, around the port, and secondary sector activities concentrated between Treichville and Koumassi.

Three modes of transport are currently available :

Fig. 20: Bateau-bus at Plateau station, by Willy Stephane Awaho

<u>Waterborne</u>

The lagoon Ebrié stretches more than 30 km East and West of Abidjan and has always been used for transport purposes. Since the 1980s, « boat buses », have been operating as formal urban public transport, principally the Southern shore of Plateau to Abobo Doumé and Blockhaus. These services offer significant shortcuts across arms of the lagoon.

However, the boats are relatively small and slow, boarding & alighting are time consuming and the stations in Abobo, Doumé and Blockhaus are at considerable distance from the large concentrations of Yopougon and Cocody, respectively. Provided appropriate investments to increase speed and capacities are available, waterborne transport will be able to significantly extend its operations, especially across the deep water port and on medium range connections to suburbs on the shores of the lagoon.

Rail

The port of Abidjan is the starting point of the meter gauge colonial railway line to the North and further to Ouagadougou. Services on the section Abidjan – Anyama started in 1905. Today, traffic is very low and commuter transport virtually non-existent. This historic railway line touches on all sub-centres of greater Abidjan that are situated on the South–North axis. Hence, this line plays a very considerable potential role as the backbone of mass urban transport. In Spring 2014, a French-Korean consortium was instructed to rehabilitate the corridor for providing regular urban transport services on the 37 km stretch between Anyama and the international Airport in Port Bouët. First services are expected to be operational in 2017.

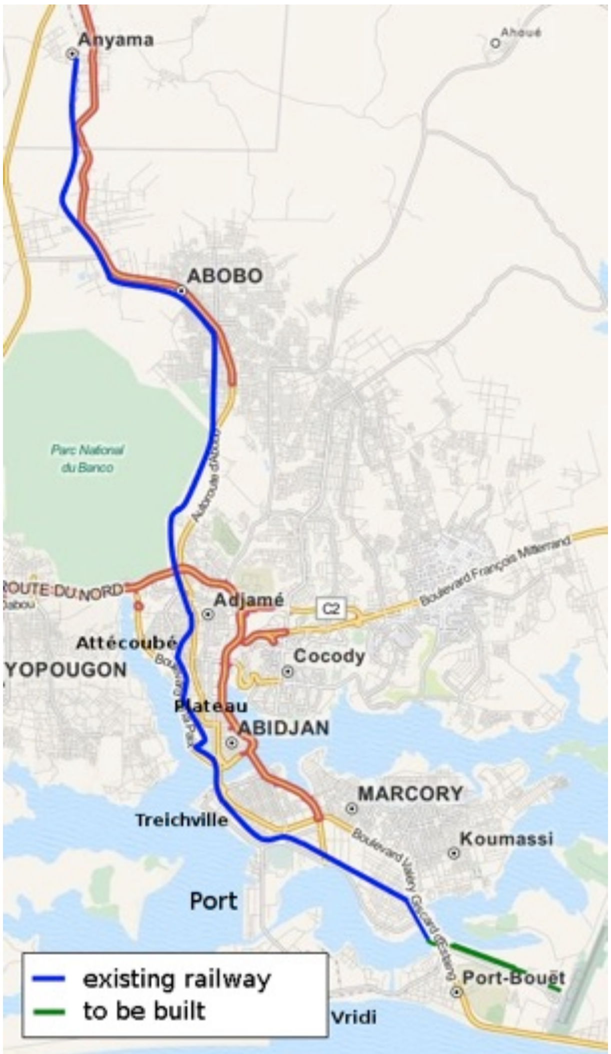


Fig. 21: Photo: Skiper, Tracé train urbain d'Abidjan

The project is reported to cost 500 million EUR and the challenge is big indeed. Although the existing railway line has contributed to structuring the development of Greater Abidjan for decades and is still (again) operating long haul freight and passenger trains, the rehabilitation will have to enlarge and rebuild the entire infrastructure, to ensure safe and regular operation of short and long distance freight and passenger transport. It will also be necessary to integrate the stations in their respective urban environments and local transport systems. Still, the project must succeed, as there is hardly any alternative.

An even greater challenge for rail will be the construction of an East–West corridor from Bingerville to Yopougon. It has been integrated in land use plans decades ago, but the corridor, has been largely occupied by other functions. Probably the necessary East–West mass public transport line will have to be planned and built through highly urbanised areas, with little support from historic planning provisions.

Road

The road absorbs virtually all transport in Abidjan. Standard 12m buses are the largest vehicles in operation. They are too few and too slow to absorb the demand. As a result, private transport services in form of automobile taxis and private minibuses provide the major part of public transport. The North–South and East–West motorways make off-peak cross-town trips pretty quick, but massive flows of commuter traffic in long morning and evening peaks clog up the network for several hours each day.

A new bridge from Cocody-Riviera to Marcory will temporarily ease traffic and make trips easier between the airport, the business districts of Koumassi and the middle class suburbs of Cocody. It is also planned to build a larger ring road around greater Abidjan that will absorb and divert from the city centre much of the freight transport linked to the port and adjacent industries. In the central districts, various proposals for BRT or Light Rail corridors have been discussed. In particular, a BRT or LRT corridor on the central North–South corridor of Plateau would certainly meet demand, provided it is effectively continued or connected to mass transit to Yopougon, Abobo, Cocody, Koumassi.

Opportunities for aerial ropeways in Abidjan

Abidjan offers three typical sets of opportunities for aerial ropeway solutions. This might lead to three different types of ropeway lines or to lines that combine several of these typical applications.

Across the lagoon

The lagoon divides the city of Abidjan into four large sections : Centre-North, East, West and South. The East–West motorway effectively connects three sections on a Northern route, but a central or Southern East–West connection requires passing two arms of the lagoon and especially the longer “Banco” arm (West of Plateau), which is part of the port area and makes headway for ocean going vessels. As mentioned above, waterborne transport is obviously part of the solution, but ropeways are an alternative because the principal traffic generators are not situated on the shore, where the boats depart, but further inland and even to some extent uphill, like Cocody University or the centre of Yopougon. Unlike a ferry, a ropeway could provide direct links between them.

The expected traffic will attain levels that make realizable a self-financing business of the aerial ropeway.

Feeder lines to rail or bus mass transport corridors

According to plans, the urban train of Abidjan will soon be reality. The smooth and efficient operation of a high-capacity primary transport corridor requires the connection to effective secondary transport systems that provide a sufficiently large and diversified load of potential users. Hence, it should be a good idea to connect the major urban train stations by aerial ropeway directly to the centres of their principal user loads and to existing bus stations, in order to ensure a larger area network effect. The same applies to several major bus (intercity) stations.

Accessibility

Abidjan does not have informal settlements of the same proportions as those of Latin American cities that have pioneered the integration of these settlements into larger urban networks by means of aerial cable cars. Nonetheless, the combined effect of natural topography, insufficient infrastructure and fast urban growth has created many neighbourhoods that do suffer severe accessibility problems. While it might not be indicated to create only special connections between these areas and the main transport networks, it could be considered to design multi-purpose aerial ropeway lines in ways to relieve poorly structured or overcrowded neighbourhoods from part of their accessibility challenges.

<u>Conclusions</u>

Abidjan is preparing to catch up with its rapid demographic and economic expansion. Large infrastructure projects are in the pipeline and recent realisations, such as new intercity bus stations and a third bridge across the lagoon build confidence that the forthcoming projects, namely the urban train and the greater ring road, will materialise quickly, too. Hopefully the primary road infrastructure will also be used by BRT style bus services or enhanced to additional urban train corridors, thus becoming part of the public transport network. The development of ferry transport and the improvement of urban bus services should also contribute to solving the urban transport challenge.

But the future transport system built on these foundations still yields to an urgent need for a network of secondary mass transport connections that other transport means - boats and buses - cannot fulfil and the urban train cannot satisfy in the foreseeable future. This is the realm of the urban cable car and it is vast. Hence, we should not be surprised if Abidjan will soon join the club of metropolises thriving with cable-cars.

7.3.3 Kenya

Mombasa is the second largest city in Kenya. Its very centre is loclated in an Island; the Port for ocean-going vessels being positioned in the south of this Island.

Everyday 200,000 commuters and a considerable number of tourists have to get on and off the island. The northern part of the island is relatively well connected by Nyali Bridge to Kongowea and Kisauni and Mombasa Road Damm to Chaani and Changamwe.

Fig. 22: Mombasa Island, Google Maps

Public and private Transport use both access roads. In the South the Harbour limits the possibility to build a Bridge or even a tunnel because very high and deep ocean-going vessels have to pass through this Channel. The only connection at present is a ferry service as ships enter the port of Mombasa at this side of the island. The ferry-service does not supply necessary capacities and in addition is not very reliable either, because ships passing through the channel are causing big delays. Waiting times often exeed two hours and moreover the ferry cannot operate in adverse conditions or at night. There are finally severe security issues of the ferry-service itsself. Several lifes were already lost in various incidents.

Fig. 23: Likoni Ferry: https://ssl.panoramio.com/photo/10287767

This limitation results in a retarded urban development of the whole area south of the Mombasa Island. Moreover, the access to and use of the health services located on the island become time-consuming for anyone coming from the southern areas

An uban ropeway-service has been proposed as a solution to this situation, offering the possibility to safely transport up to 5.500 passengers per hour over the channel in every direction. Providing a reliable and integrated high quality link to Mombasa Island, may considerably change the situation of the southern area.

Moreover it could lead to a rethinking of the actual public transport infrastructure on Mombasa Island, which suffers complicated traffic conditions at present that will get worse with the ongoing urban growth as seen in other African cities. Ropeways may well be able to solve some of Mombasas transport problems and offer an alternative to motorized tranport on roads. Especially the narrow streets of the old town would probably benefit from a total or partly ban of motorized traffic.

Fig. 24: Rendering of Likoni Cable Express, Doppelmayr

In Kenyas capital, Nairobi, interest in cable-cars is growing as well. There are ideas to install a high-capacity cable-car system with four independent sections and a capacity of 5.500 Pphpd in the city centre of Nairobi. Talks with the administration are in progress. Unfortunately, no information on corridors or stations are currently available.

7.3.4 Nigeria

Lagos has earned a questionable reputation for its traffic congestion, that literally paralyzes the centre of the city for hours every day. Motorized traffic is estimated to contribute more than 70 per cent of the air pollution in Lagos and over 50% in Nigeria. The traffic situation at present is absolutely chaotic, partly due to the complete nonexistence of an effective short-range public transport system in the centre.

Regarding long range mass transit, LAMATA, the "Lagos Metropolitan Area Transport Authority" has started operating a BRT-Light System along the 22km long "Mile 12 – CMS" corridor in 2008, leading north from Lagos island along the western shore of the Lagoon. This system has since transported over 400 million passengers, with a daily ridership of about 180.000. The existing corridor is presently extended further to Ikorodu, north of the Lagoon. In the coming decade and beyond, BRT is planned to be extended to a wide-spread network throughout all of the metropolitan area

Fig. 25: The Lagos BRT-Lite System
Dayo Mobereola

BRT and rail-based mass transit are major components of the Transport Masterplan.

The Masterplan proposes to build up in the next 30 years an urban commuter rail service on seven high demand corridors, within and beyond the metropolitan area.

On a big scale these connections are planned to link the mayor population and activity centres, taking advantage of existing transport corridors if possible. The network will be fully integrated with planned and existing BRT and water transport routes.

Fig. 26: The Lagos Commuter Rail Network Masterplan
LAMATA

But obviously Mass Transit can only directly serve a very small part of the population of a Mega-city like Lagos and will still be rather underdeveloped in the short/medium term. Once it is built, its development and efficiency need to be supported by complementary quality public transport modes for shorter ranges. A high capacity urban ropeway system will be built to address this task.

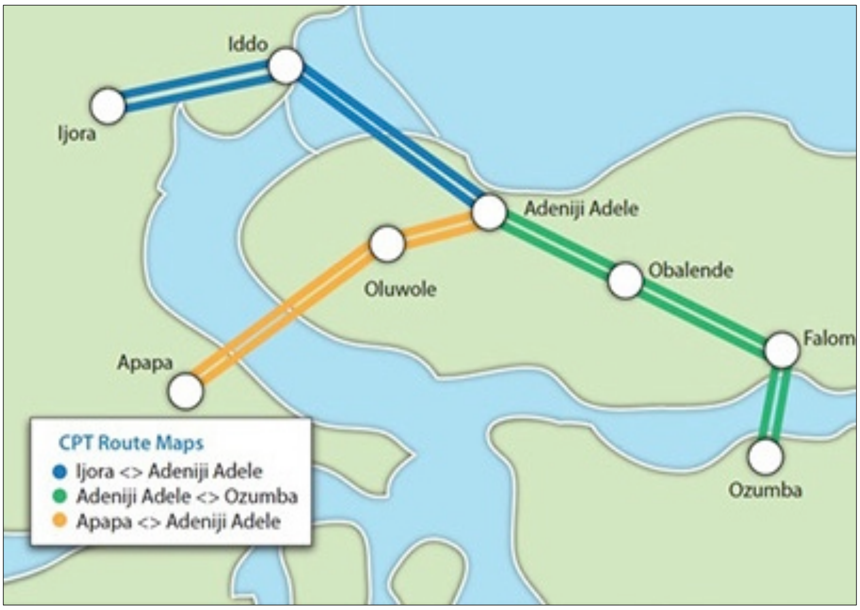


Fig. 27: The Lagos Island Ropeway System http://www.trico-capital.com

In the most mature project in sub Saharan Africa, the company "Ropeways Transport Limited" has already signed a 30-year Franchise Agreement with LAMATA and the Lagos State Government for the execution of the project which will be partly financed by the African Development Bank.

The system will consist of three independent ropeways with a total of 7 independent sections and 8 Stations.

All three lines will have a transport capacity of 5500 pphpd (persons/hour/direction), which is the highest ever achieved by a cable car in an urban setting.

On all three lines together the maximum transport capacity will be over 30.000 passengers/hour and clearly higher than the daily ridership on the existing BRT-Light corridor.

Fig. 28: Lagos Traffic. 2006, Kunle Ajayi

The connections will run right through the CBD of Lagos, linking Lagos island with both sides of the lagoon. This will finally provide a very effective transport alterative to the minibuses and the private car.

The fares, are expected by the Nigerian media to range between 100 and 300 Naira, (0,70 $ to approx. 2$). On the lower end this is comparable to the fare of a BRT trip, but at the top end it is considerably more expensive: a BRT trip currently costs 70 to 120 Naira. However, with the electronic payment option "Lagos Connect" the fare can be reduced to as low as 20 Naira.

It is still to be seen if the cable-car manages to really provide a transport-option at a price level of existing public transport in Lagos. This fact will to a great extent decide the benefit it will have for the city and its transport system.

The system is very well integrated in the urban bus-system putting literally all the stations onto existing bus stops or high profile areas, providing good accessibility of the system for commuters.

The stations themselves will most probably serve as social hubs. Their potential spacemaking effects should not be underestimated for the urban development of the city.

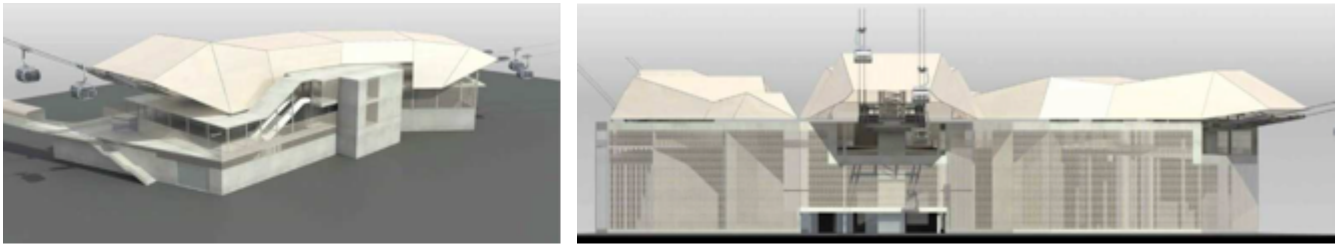


Fig. 29: Lagos Ropeway Stations, Doppelmayr

7.3.5 Tanzania

Dar Es Salaam like many other African cities is suffering from a traffic collapse throughout most of the day, especially at peak hours. Besides the obvious functional problems for the city, with their economic impacts, the situation does hugely affect public health as well.The problems are mostly caused by the following four reasons.

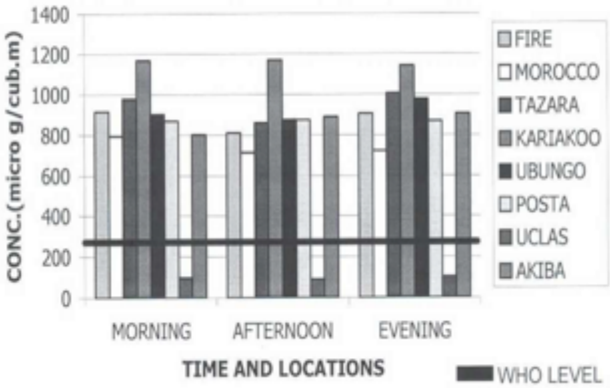
- Mismatch between an increase in motor vehicles and road network
- Lack of regular road maintenance, (inadequate capital investment, poor management and a huge backlog of road infrastructure maintenance and service provision)
- Inefficient public transport services
- Faulty vehicles on road & careless driving

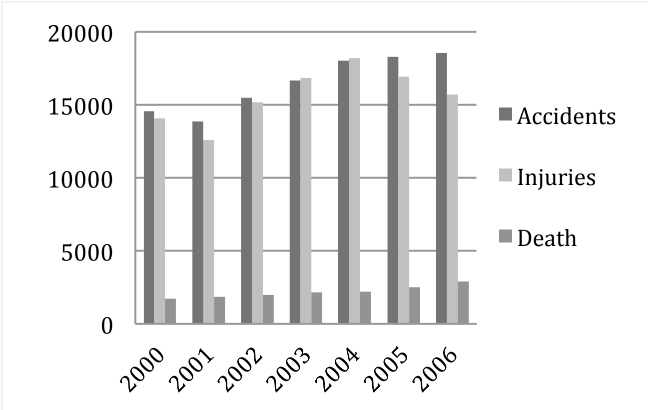
The next two figures clearly document the serious threat for public health in numbers:

The first figure shows the levels of SPM (Suspended Particulate Matter) in Dar es Salaam during a normal working day. Levels are far beyond the WHO level (black bar) in all but one location.The same situation applies for other transport related air pollutants like particulate lead or nitrogen dioxide.This results in an elevated risk of cardiovascular diseases, lung diseases and cancer.

The second statistic shows the development of road accidents in Dar Es Salaam, with annual casualties clearly above 2000 in 2006. The situation has not improved since then.

It also shows a growth of the percentage of deadly accidents. As always, most of the victims are not drivers, but pedestrians or cyclists.





(Fig. 30: Traffic- and Accident Data, Ministry of Infrastructure Development (2006), Chilingola (2005))

Today Dar es Salaam is on a good way to tackle its transport problems, by building a mass transit BRT Infrastructure. Once solved the initial problems, the start of the service will mark a turning point in the character of the transport system of the city by generating a wind of change.

This change offers a big opportunity for transport planning and urban planning in general as well. It should be used for the implementation of other measures in order to push the urban development of Dar es Salaam towards more quality and functionality.

Another big opportunity for urban development of Dar es Salaam is the new Development Area in Kigamboni on the southern side of the Harbour, though at present a big risk exists in this area. If the travel time between the new Development Area and Downtown Dar es Salaam is too long, Kigamboni may well become a "Stand-alone Project" without much influence on the rest of the city, even if the new bridge over the bay is built some time.

In this regard a cable-car could be the tool of choice for a public transport connection between Downtown and the new Development Area. A Bay crossing has the potential to be a spectacular pilot project solving various problems at a time:

- It could reduce the travel time between Kigamboni and Down Town to less than ten minutes.
- It introduces a new and very necessary public transport connection to the new urban development site, which links directly to BRT Phase I
- A potential ropeway station in the direct neighbourhood, or even included in the downtown Terminus of BRT Phase I would make the station a central mobility hub.

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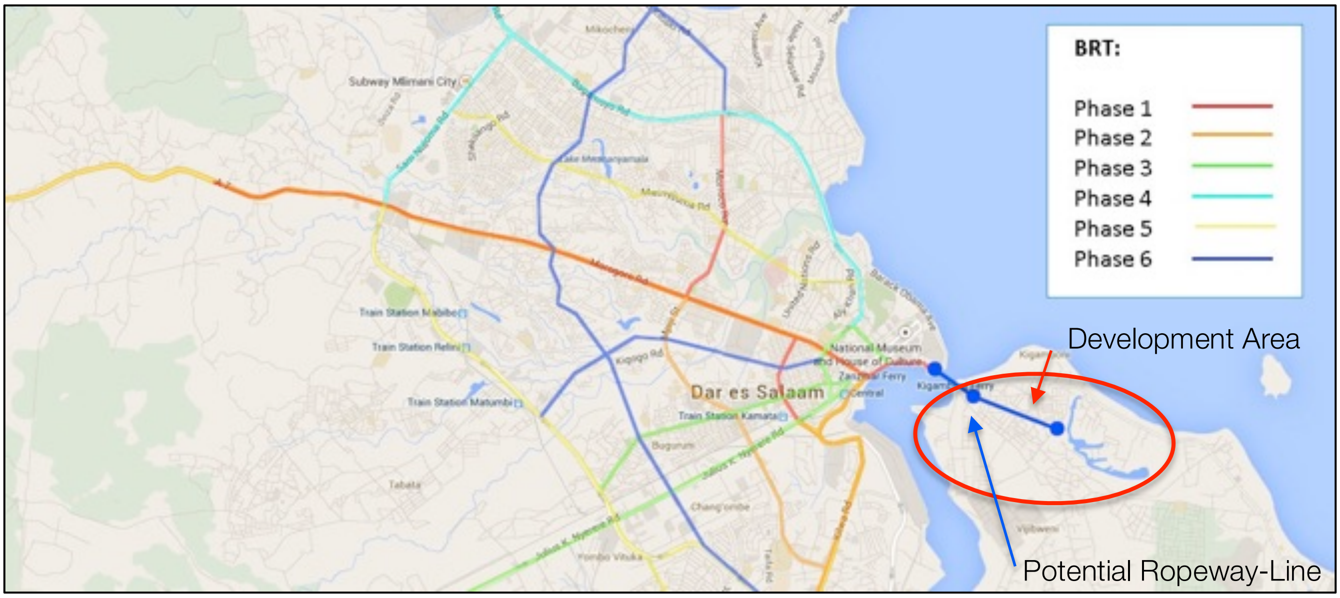

(Fig. 31: Recommended Ropeway Dar es Salaam – Kigamboni, Matthias Nuessgen)

This hub could be a perfect starting position for other future ropeway lines like for example an inner city ring connecting future BRT terminal stations within the city centre. As such it could Initiate a transformation of public space in Downtown Dar es Salaam, introducing a new way of treating urban space around public transport stations, including quality infrastructures for active modes of transport in the project. It could finally draw attention from the outside and constitute a high profile tourist attraction for Dar es Salaam.

7.3.6 Uganda

Kampala is experiencing significant traffic congestion with many junctions operating beyond capacity. The situation arises primarily because of the tremendous increase in traffic demand in the recent years which have not been matched with appropriate capacity improvements at the vital junctions and road segments leading in and out of the City Centre.

Fig. 32: Bus Parking in Kampala, Photo: Juergen Perschon

Kampala Capital City Authority plans to undertake certain city-wide improvements and interventions aimed at improving traffic operations management, including a Bus Rapid Transit corridor, measures to "de-marginalise" NMT and a Ropeway-line.

Thinking out of the box

One typical bottleneck is the so-called Kawempe Corridor. During Kampala rush hours, it takes more than an hour to transit the 6km-segment, foreseen for the first ropeway project of the city. Possibilities to expand the road space along the corridor are limited by the high costs of land acquisition, amongst other constraints.

Fig. 33: Kawempe Corridor, Juergen Perschon

After local transport experts learned about Latin American cable-car practice, a delegation of Kampala Capital City Authority (KCCA) went on a study trip to Algeria early 2014 to visit operating systems in Algiers and Constantine, including the Executive Director of the city council.

Fig. 34: Study Tour of Ugandan delegation to Algerian ropeway systems, J. Perschon

KCCA then decided to make the next step and intended to acquire consulting services in mid 2014, specifically towards the feasibility and possible implementation of a cable-car pilot project in the mentioned corridor. The overall objective of this assignment is to prepare a first phase that will test the viability of cable-propelled transit - also to identify further long-term options to extend such services, once proven successful.

In accordance with international best practice, the project is expected to increase the attractiveness and improving the accessibility and convenience of public transport and non-motorized vehicle use, in order to offer a real alternative to private car use.

The feasibility study will evaluate the project in an economic perspective but also include a demand analysis that looks at the transport needs of the low-income population. An environmental impact as well as a safety assessment will be carried out. The study will also look at questions of energy provision and security. Assumed funding for the construction phase can be assured quickly, Kampala could become one of sub-Saharan Africa's first urban ropeway systems.

7.3.7 Zambia

The status of public and mass transit in Zambia's capital city has deteriorated largely due to low level regulation of and poor coordination in the context of extreme liberalisation. Lusaka has seen a rapid increase in the level of motorization mainly due to a rise in the importation of used motor vehicles which is associated with a number of negative externalities:

- Pollution from defective vehicles on many urban roads is obvious
- Around 20,000 road crashes happen every year, almost half of it in the cities
- More than half of the fatalities are vulnerable road users.
- Efficient and low cost urban transport is non-existent in Lusaka

In recent time the country has seen massive investment in road infrastructure but this would not improve transport needs for the majority of the population, as it does not focus on an integrated approach.

Land use and urban road transport planning have not been properly aligned, making corrections to the state of road infrastructure more costly.

New plans on MRT

The situation of the city requires innovative approaches to ensure the provision of a safe, efficient, integrated and environmentally friendly transport system which meets the needs of the users

The 2002 Transport Sector Policy is now under review and it is intended to promote land use and urban road transport management through various strategies including introduction of mass transit transport systems in the major urban areas.

Fig. 35: Lusaka traffic: http://www.schnuefdis.org/afriBlog

The master plan of the Lusaka City Council identifies Bus Rapid Transit (BRT), Light Rail Transit and Non Motorised Transport (NMT). But in addition to the modes identified for the master plan, the cable-car system comes in as an innovative new option for a green, safe and cost effective mass transit system.

Cable-car technology was introduced in several workshops in 2013 and 2014 and derived from the Transport, Environment, Science and Technology (TEST) Programme. The TEST focuses on air pollution from mobile sources, traffic flow management and road safety. The University of Zambia TEST Chapter maintained close collaborations with the Lusaka City Council in an effort to offer practical solutions to some of the transportation challenges facing the city. On the basis of these thematic areas, the cable transit initiative was proposed as an alternative mass transit mode for growing cities with pronounced traffic flow challenges such as Lusaka.

The workshop resolved that a cable car system was a recommendable solution to urban congestion problems of the major cities in Zambia. However, cable transit systems vary widely and likewise the cost of infrastructure varies widely depending on the type and local conditions. Nonetheless, the cost of associated infrastructure per km is relatively higher than that of roads.

Cable-car technology is now recognised as one viable option to improve Lusaka's public transport.

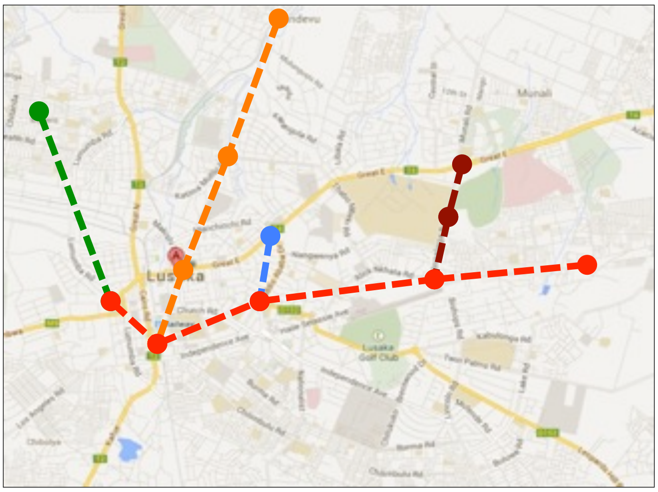

Fig. 36: Corridor Options for Lusaka Ropeway, Eurist:

7.3.8 Zimbabwe

Like in most African countries Zimbabwe is suffering a sustained rapid urban growth scenario generated by the growing migration to cities of people from rural zones who search for economic opportunities within the internal or structural urban growth. Both processes together make for a growth rate of over 4,5 % in Harare, which means the city will basically double in population in approx. 15 years.

Due to the incapacity of infrastructure development to keep pace with the urban growth, transport issues will increase drastically.

Already today, congestion is becoming intense during the rush hours. The total number of vehicles entering the CBD every day during working hours is about 160.000, and at the moment only 15% of Harare´s citizens own cars. The growing numbers of vehicle registrations will soon grind on towards a complete collapse in the inner city.

Public transport

The informal 16 – 18 seater combi-busses are no longer allowed to enter the CBD. This was prohibited in an intent to find a solution to growing congestion, but it has not improved the situation by much because illegal taxis, using private sedan-vehicles are the only transport option within the CBD at present. They seem to be experiencing a big increase in trips, which again leads to growing congestion. Customers travel either from one of the stations to the city centre, or from one station to another through the centre, connecting two bus trips. A regular public transport service connecting the main bus stations with the CBD and amongst each other is urgently needed in order to alleviate the traffic conditions. An urban ropeway system has been proposed to help address the problem, taking into account the following main criteria:

- The holding Bays are the main entrances into the CBD. From here trips are either made walking or using illegal Sedan-taxis causing even more congestion within the CBD.
- The final destination of many commuter trips is not the CBD. As the system is currently organized, many commuter trips are divided into two main parts. The first part leads from the origin to one of the central holding bays, and the second part departs at another central holding bay and leads to the trip destination. In order to complete this kind of commuter trip, travellers need to cross the CBD. A formal connection between the holding bays is non-existent and could be provided by the proposed system.

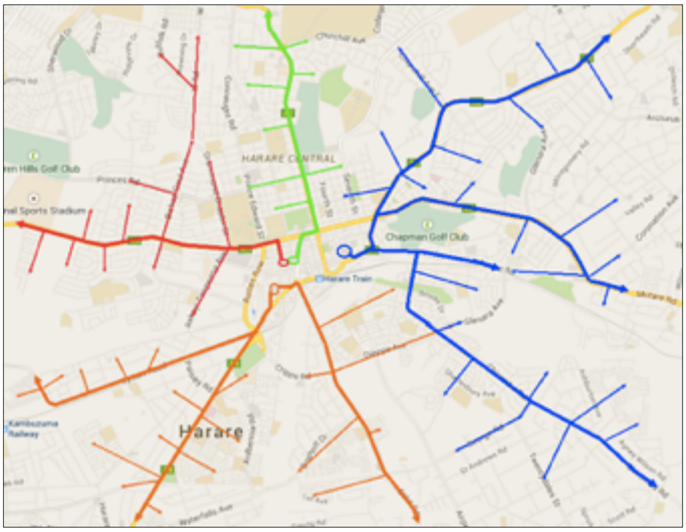

Fig. 37: Bus-System in Harare leaves CBD unserved. Matthias Nuessgen, 2014

- The holding bays have a clearly structured land use coding related to transport. This land use coding is not very likely to be changed. Their location within the centre of Harare however will make it clearly difficult for them to function well if the busses are changed from 18-seaters to bigger vehicles like the modern 18m articulated buses used for BRT.
- For this reason it is likely, that the holding bays in the western centre (Coppacabana and Market Square) will eventually be given up and their functions will be concentrated in one big station west of the centre (very similar to the 4th street station in the east).
  In this case the Ropeway line could easily be extended into the new transport hub without many complications.

Fig. 38:Pilot Corridor Proposal. Marc Funda, Doppelmayr, 2014

8 An ideal planning process for African public transport projects

This chapter briefly introduces Eurist´s vision of an ideal Nine-Step-planning process for any new transport mode or infrastructure in Africa. Essential criteria in the process are a broad support amongst the transport stakeholders, their long-term integration in the process and possibly even the operation of the new system, and the well organized and steady movement forward, avoiding an interruption of the process.

- The initiator needs one or several local partners in order to put the process on a broad base from the beginning. From the society-side it is necessary to contact all the stakeholder groups, civil society-organisations and NGO´s related to transport. Further scientific backing by transport related research institutes and universities can help a lot and will certainly make it easier to convince the political administration on municipal and national level.
- In order to brief all these organisations and institutions it is useful to organize an initial workshop on the potential of the new transport system, inviting external experts in order to share experiences with the implementation of the transport mode in other settings and provide a short initial study on the suitability for the local setting. On this base, it is recommendable that the participants of the workshop start to engage in the planning exercise themselves by making proposals for corridors, doing a SWOT analysis on the applicability of the transport mode or commenting on the organisation in round table discussions.
- If the workshop reaches general agreement on a common objective, a task-force is formed out of the different stakeholder groups to keep the process moving by briefing their superiors about the workshop-results, identifying the key decision makers, or starting to identify funding possibilities

for a feasibility study. A concept paper is needed to inform the identified decision makers and investors on the content and the possibilities of the project.

- In order for the decision makers to entirely understand the functionality and the potential of a new transport mode, it can be very helpful to initiate a study tour, taking them to visit a very good international example. Seeing a new transport mode or infrastructure working in reality helps a lot in order to imagine the benefits it can generate in the local settings. Talks with the local managers of the visited system may be useful in order to exchange experiences and parallels in transport issues solved by the implementation or discuss potential hurdles during the implementation phase.
- If the key-decision makers are convinced, the next step would be the establishment of an official steering committee in order to develop the terms of the feasibility study, get high level commitment for the planning process and take the necessary steps to include the new mode into the different levels of transport planning. In PPP models it is sometimes possible to get the budget for the study from a potential investor who wants to have a certain security before doing the actual investment. In any case it is necessary to convince the administration to make a clear commitment towards further partners. An example for this commitment could be the negotiation of a concession in case of implementation.
- As soon as the funds for the feasibility study are secured it is extremely important to perform it quickly in order to keep the process moving. During the study it is essential to monitor the process and guide and accompany the consultants closely in order to be able to respond quickly to doubts and questions regarding the local administration.
- As soon as the study is finalised the time has come to include the public and the media in order to disseminate the results of the study.
- The next step would be to produce and publish a very thoroughly and well defined tender for the construction of the infrastructure, to carefully evaluate the offers, and to contract the implementation phase.
- The last step is the actual implementation phase, with the construction and the hand-over of the actual infrastructure.

At the moment, there is no country in sub-Saharan Africa which has gone through all of these nine steps in the process of implementing a ropeway system. The most mature process is certainly the one in Lagos, entering in the implementation phase soon. Kampala has contracted a feasibility study and will perform it within the next months. The examples in Tanzania, Zambia and Zimbabwe all find themselves in a crucial phase prior to the feasibility study. The examples in Mombasa and Nairobi are in a similar stage but have been developed along another methodology.

9 Different notions of success

9.1 Functional and political values

As judged from a political standpoint two different ways to evaluate many measures or actions have been adopted. There is a functional side evaluating the benefits of the actuations to society. These values often are not immediately recognized or even noticeable, but in the long term they are normally more important than little short term improvements.

On the other hand there is the political value of the actions. It measures the political benefit a decider or its political party can draw out of a decision in the polls. Both evaluations may differ substantially in their results and are thus addressed in two different approaches.

9.1.1 Functional approach

When a ropeway for an African city is discussed or considered it is most likely to find near catastrophic traffic conditions in the city. Solutions have to be very effective and fast. Hence it is impossible for African cities just to copy the development trail of post-industrialized countries in the U.S. or Europe.

These transport paradigms are obsolete, even in the cities and countries where they still work. They are subject to important changes towards more sustainable solutions based on effective public transport systems.

Moreover, the function of the actual transport systems in Europe and the U.S. depends to a great extent on road infrastructure, which for most of the African cities makes it impossible to copy them. Not only, because of the huge investment that would be necessary to achieve this, but as well because of the different conditions of development to be encountered in Africa.

The road network of European and U.S. cities took decades to develop. It slowly adapted to the cities' necessities. The city development in Africa is much faster than it ever was in any European or American city. African cities need a system that adapts to this speed of development but as well to a rapidly changing urban landscape.

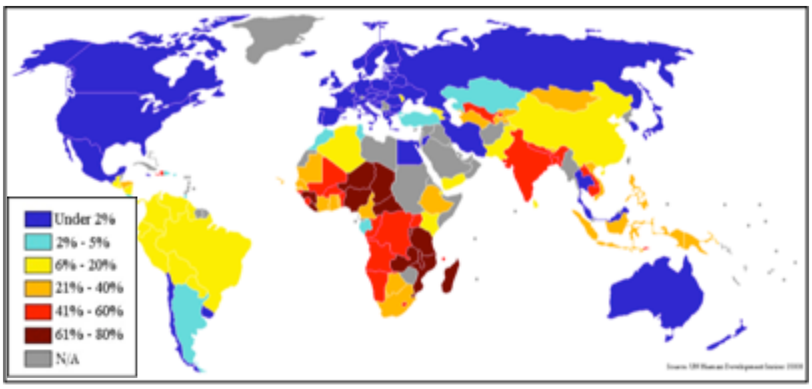

Fig. 39: The Distribution of poverty, Un Human Development Report

The social inequality is bigger in African cities with bigger social differences, bigger percentages of the poor, who can´t afford to move by car.

African cities need solutions for all parts of their society, not only for the 15% that can afford to own a car.

The systems in question must be able to solve the pressing transport problems like road accidents, , functional collapse, air pollution, quick implementation and the ability to adapt to the fast urban development. Solutions need to be flexible in use, location, and destination, and they have to be financially manageable for the African economies. After all, the change in the transport system should stimulate the economy and not charge it with even higher debts for a long time.

9.1.2 Political approach:

For politicians and decision-makers in Africa and anywhere else on the world, political will does not only depend on the above mentioned functional criteria. Decisions must help conserve the political power of the decision-makers. They are capable of doing so whenever there are short-term benefits to be made, which can easily be explained to the voters. Creation of permanent jobs during construction and operation of a transport system would be such a benefit, as well as the modernization of urban infrastructures and services at a relatively low cost.

Ropeway systems offer a number of other arguments, that may make them interesting from a political standpoint. Ropeway stations for instance are especially attractive to their neighbourhoods, if social, cultural and economic functions like, social services, health services, locations for cultural events, libraries or shopping malls are introduced in the buildings.

In case of a private or a PPP project, they increase tax income and will possibly even generate concession fees for the further operation when they are finally controlled by the government after an initial phase of operation by a private entity.

A fundamental barrier to overcome with every improvement in a transport system is that it normally makes some jobs obsolete or at least more insecure than they were before the implementation. In the case of urban ropeway systems these are the normally rather numerous operators and drivers of informal transport services. No politician wants to have them in his opposition so it is wise to include them into the planning process at an early stage, and ideally give them a certain level of property of the new system.

A very interesting feature is the possibility to implement the systems very quickly, possibly even during a single political term, which enables the governing politicians to make a promise and keep it within the same political term.

Moreover ropeways will often become urban landmark installations and may serve as a major tourist attraction. They have the potential to initiate an urban space-making process around them, thus changing the character of the city.

10 The need for reliable data

In order to solve a transport problem anywhere in the world, one of the first tasks is to look at best practice of other cities with similar problems and their approaches to solve these situations. This requires a reliable characterization of the city's own situation. Here is often where the problem starts.

Cities need to make their situations comparable to others by measuring data. In order to be comparable this should obviously be data that other cities measure as well.

The characteristic data cities measure is not always the same in every city. Rather, planners use indicators calculated from accessible data in order to make the city situations comparable.

Indicators can describe very different aspects, impacts, functions or characteristics of a transport system as shown in the next table issued by GIZ for the evaluation of the CSD process.

Dimension/Indicator	Underlying sustainability goal	Indicator type	Current availability of data
Environment			
Land consumption by transport infrastructure (as % of total surface)	Avoid sprawl and destruction of the environment by transport infrastructure	Effect/impact	Low
Pro-Kopf Treibhausgasemission des Transsportsektors	Verringerung der Auswirkungen des Transsportsektors auf den Klimawandel	Effect/impact	Medium
Percentage of population affected by local air pollutants (e.g. concentration of particulate matter smaller than about 10 micrometers [PM10], Non-Methane Hydrocarbons [NMHC] emissions, ...)	Reduce detrimental effects on human health and the environment	Effect/impact	Medium
Equity/Social			
Road fatalities	Reduce the number of people killed or injured in road traffic accidents	Effect/impact	High
Modal share of public transport/ non-motorised transport	Foster transport modes that are both accessible for a large part of the population and environmentally sound	Outcome	Medium
Share of transport cost from total household expenditure	Provide affordable transportation for all members of the society	Outcome	Medium
Economy			
Minimum taxation on fuel	Consider the external costs caused by transportation based on fossil fuels (especially road traffic)	Performance	High
Transport investments by mode	Prefer transport modes that are accessible and environmentally sound	Performance	High
Passenger kilometre/ tonne kilometre per unit GDP	Decouple economic growth from transport demand	Effect/impact	Medium
Governance			
Participatory transport planning	Involve the public in the decision process for transport policies and projects	Performance	Low

Fig. 40: Indicators, Giz

However, data about a city´s transport situation is not only important for measuring general differences in the transport systems. They also serve to monitor and evaluate very locally the effects of the city's own measures, once they are in place. This is why it is important to measure data not only once. It has to be kept up to date in order to build valuable data series indicating a change initiated by the chosen measures and policies. There are some benefits from transport measures that will be very clearly measurable after a short period of time, other effects are more difficult to prove.

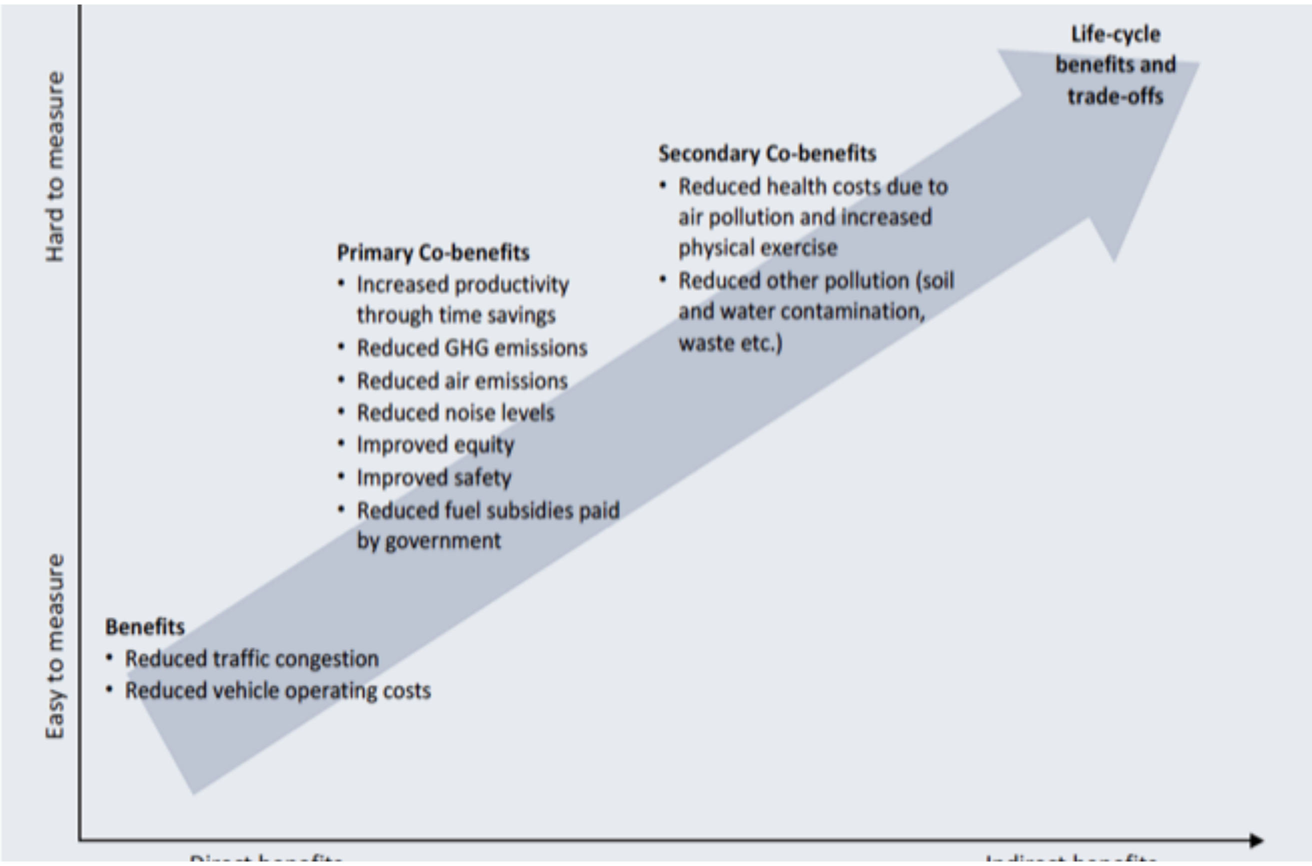

Fig. 41: Benefits of transport planning, Punte (2010, p. 15)

For the formulation of a planning process, currently the easily measurable data is the only data that is looked at. But sometimes good short-term effects can turn into severe long-term effects. This is exactly the mistake that has been made over decades in the western post-industrialized counties. However if better data is available, relations between transport and the long-term effects start to get visible as well and can be used to improve transport decisions.

11 Fields of planning and success factors

Eurist has been accompanying the start of cable car planning processes in Addis Ababa, Dar es Salaam, Harare, Kampala and Lusaka and working closely with the initiators of the implementation in Lagos, Mombasa and Nairobi. During the processes, members of Eurist have cooperated with transport-stakeholders from NGOs, civil society organisations, science, formal and informal public transport operators, private economy, municipal and national administration and politics.

The following criteria or success factors have been identified and confirmed during this work. They are categorized in four groups depending on the affected field of planning.

11.1 Implementation:

In the implementation phase the most important factor for all parties involved is planning security from a financial standpoint as well as in the timing of the implementation.

In order to achieve this, the numbers of the feasibility study and especially the contracting should not differ a great deal from reality. Considered as main criteria of this planning security are obviously the system cost and the very good relation between cost and achievement of the transport mode. This does especially apply if the project is run as a PPP or even completely private, making good use of self-financing business. Due to the normally very good cost–benefit ratio, this will most likely be a rather common business case for these systems. As it is mainly limited by the initial investment, the time frame of the concession and the ticket prizing, of small scale urban development is absolutely essential to plan ahead with a high amount of detail and security.

Besides the operators and investors, politicians are as well strongly affected by the implementation phase. The responsible politicians are counting on a fast and flawless construction phase and clearly visible short term benefits, including the affordability of the user fees for the entire population, suitable in order to justify potential public investments and to sell the measure as a political success.

Finally, ropeways are the most flexible ones amongst the urban transport infrastructures and should be conceived and planned in order enable adjustment to the quickly changing urban environment in rapidly growing African cities.

11.2 Operations and transport service, transport planning:

Once operating, a very good quality of the transport service is expected. In African cities this means a revolution in public transport quality. The definition of transport quality in developing countries includes an obvious service quality, working speed and capacity and a strong orientation towards safety in stations and vehicles. Creating an impression of safety is very highly valued and can be increased by measures like guards patrolling the stations or CCTV cameras in the cabins.

In order to get a good ridership from the beginning, good accessibility and integration with other transport modes (formal and informal) is extremely important. A very good system will take in account the integration into both existing transport modes and future infrastructure changes like BRT terminals to be built, and even anticipate future developments in the structure of the transport system.

A clearly unique selling point of the cable-car is its complete independence from ground based transport, the resulting independence of congestions and the extremely high reliability. A risk for transport planning is, the misinterpretation of ropeways as a mode bringing urgently needed relief for motorized transport, providing better conditions of circulation on the roads, and absorbing an important part of the traffic. In order to avoid this it is necessary to reduce the actual public space for motorized transport on the roads as a measure of demand management.

11.3 Society:

It is obvious, that only affordable transport modes can be socially sustainable. The fares should not be higher than the normal public transport fares in the city. It is important to be aware that even this level is too high for a considerable part of the society. The clearly expressed planning goal of a functional integration of public transport modes cannot work properly without a fare integration. Commuters should not need to pay twice when changing modes during one trip. It is important to use the momentum of change in the transport system to start negotiating a common tariff for all transport modes.

Every transport mode does create jobs, but it may well make others obsolete. The integration of informal transport associations should be considered in order to present an economic perspective for the drivers who might loose their jobs because of the existence of a better quality transport mode. Can shares of the system be offered to the public in order to achieve public ownership and support of the new mode? Which other measures are taken in order to get the public to support the measure? Social and cultural functions in the stations can be a way forward.

11.4 urban development:

The urban development aspect is probably a less direct and more long-term response to the introduction of a new urban transport mode. To some extent it will only work if the stations are considered a quality space, and attract an important part of the society in as many situations as possible, including people who are actually not users of the cable-car. Again, the location of social and cultural functions in and around the stations may be a good way to achieve this.

In order to make the stations easily and safely accessible for all parts of the society, they need to be social spaces. The introduction of quality infrastructure for active modes of transport is very important in this regard. If they use former road space it gives users an impression of dignity as they are reclaiming the urban space. This may initiate a process of space-making, improving the quality of public space around the stations, creating a showcase and an example for planners and investors, but as well for citizens to experience the positive effects of liveable urban space.

These process can be intensified and maintained by public events and champions guiding the development within the areas.

Generally speaking they are aimed at the generation of urban quality and liveability which again contributes to a paradigm change toward density, accessibility and proximity.

11.5 Success-factors

In African cities, public transport is extremely important. A big percentage of the population already depends on it. Improvements in the urban transport system are urgently needed and are likely to have very wide spread impacts, beyond the sole improvement of the way people move.

As a result, the success of a new transport mode can not only be measured in transport data, It is important to differentiate between different fields of impact.

The fields of implementation and operations are directly linked to the infrastructure and the service provided by the transport mode, whereas the other two fields measure impacts that are generated beyond pure transport needs from a social and an urban development point of view.

All these factors should be closely monitored, both in existing and new systems. Reliable data is urgently needed in order to evaluate the success of any transport infrastructure, and to make different systems comparable and able to learn from each other.

Implementation:	Operations:
• Affordability of infrastructure • Low construction cost and initial investment • Short implementation time • Potential for subsidy-free operation • Attractiveness for PPP or even private operations • Potential to adjust to a changing urban environment.	• Service quality • Safety • Security • Accessibility • Integration with other urban transport systems • Independence from ground-based transport • Reliability
Social sector:	**Urban development:**
• Social integration / affordability of fares • Creation of Jobs • Integration of informal transport • Public identification • Public appropriation (investment options)	• TOD-Strategy • Usability for the whole society • Integration of other functions beyond transport • Integration of active transport infrastructure • Reclaiming of public space • High quality public space • Showcase for the positive effects of liveability

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