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Implementation and Development of GLI:X Green Logistics Indicators in South Africa

by:
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Preface by Mr. Jacob Mamabolo, MEC for Public Transport and Roads Infrastructure, Gauteng Province, South Africa

When GLI:X was founded in 2016 as a research project, in close cooperation with the Gauteng Department of Roads and Transport, we had no idea how wide-ranging this process of setting topics, building a stakeholder community, and developing indicators would help us in identifying and methodically supporting important strategic fields in the development of a strategy for green, sustainable, and efficient freight logistics for the province.

From the very beginning, the project has gained such a high momentum through the dialogue-oriented dedicated cooperation that culminated into the signing of the A Joint Declaration of Intent in February 2017. This declaration was signed between the Department of Roads and Transport and the German Federal Ministry for Environment, Nature Conservation, Building and Nuclear Safety.

In addition to the continuous development process of GLI:X on specific field tests and topics, the scientific results were reviewed and continuously developed on various occasions. In this context, several digitization workshops were also conducted with the goal of creating an integrated GLI:X application in the Green Logistics area.

We have gained an understanding of how digitization can be used as a game changer for the GLI:X project and we will transfer this knowledge from a research project into a realization project, the Smart Freight Corridor (GLI:X GLC), upon completion of this stage of the GLI:X project. There, we will work together with selected stakeholders on concrete IT applications along the GLIX indicators find solutions to increase the efficiency of the supply chain and reduce emissions at the same time.

Abstract: Implementation and Development of GLI:X Green Logistics Indicators in South Africa

The aim of the project "Implementation and further development of the GLI:X - Green Logistics Indicators in South Africa" was to build on the results and successes achieved in the previous GLI:X projects I-II and to further develop and apply the GLI:X indicator system developed within the framework of these projects for other logistics-relevant cities and regions in South Africa in a participatory manner.

In the project, an indicator system of more than 50 indicators for more efficient, sustainable, safer and socially equitable logistics was developed through a participatory process and stakeholder building with the province of Gauteng, German companies and business partners, NGOs and others.

The project received a very high level of political support from the outset, as improving logistics was a key issue for future stability and sustainable growth in South Africa. As a result, after only half a year since the project began, a far-reaching cooperation agreement was signed between BMU and Gauteng Province. Parallel to this, concrete projects have already been implemented in GLI:X II, such as the initiation and monitoring of the procurement and use of e-bikes for an NGO, developed by a Berlin start-up.

In the course of the current GLI:X III project, the stakeholders involved increasingly wished to broaden the scope of the project and to arrive at a concrete application process. For this reason, a roadmap framework for implementing the GLI:X Smart Freight Corridor from Gauteng-Durban was developed, with the aim of finding a cost-effective, easy-to-implement solution through the collection and processing of data, leading to an improved overall management of logistics traffic along a Smart Freight Corridor.

The Green Logistics Indicators (GLI:X) project will end after 4 years in summer 2021 and will be continued in the new sub-project Green Logistic Corridor (GLC).

Kurzbeschreibung: Implementation and Development of GLI:X Green Logistics Indicators in South Africa

Ziel des Projekts „Implementierung und Weiterentwicklung des GLI:X – Green Logistics Indicators in Südafrika“ war es, auf die erzielten Ergebnisse und Erfolge der vorangegangenen GLI:X- Projekte I-II aufzubauen und das in deren Rahmen entwickelte GLI:X-Indikatorensystem für weitere logistikrelevante Städte bzw. Regionen Südafrikas partizipativ weiterzuentwickeln und anzuwenden.

Das GLI:X Projekt bezog sich auf den Projektpartner Gauteng/Johannesburg in Südafrika. In dem Projekt wurden über einen Partizipationsprozess und Stakeholderaufbau mit der Provinz Gauteng, deutschen Unternehmen und Wirtschaftspartnern, NGO´s und Weiteren ein Indikatorensystem von über 50 Indikatoren für eine effizientere, nachhaltigere, sicherere und sozial bessere Logistik entwickelt.

Das Projekt erhielt von Beginn an eine sehr hohe politische Unterstützung, da mit der Verbesserung der Logistik ein zentraler Punkt für die zukĀnftige Stabilität und das nachhaltige Wachstum in Südafrika angesprochen werden konnte. In der Folge wurde bereits nach nur einem halben Jahr Projektzeit eine weitreichende Kooperationsbereitschaft zwischen dem BMU und der Provinz Gauteng unterschrieben. Parallel dazu wurden bereits in GLI:X II auch schon konkrete Projekte umgesetzt wie z.B. die Initiierung und Begleitung der Beschaffung und den Einsatz von E-Lastenbikes für eine NGO, entwickelt von einem Berliner Startup.

Im Laufe des aktuellen Projektes GLI:X III ergab sich immer mehr der Wunsch der beteiligten Stakeholder, sowohl den Projektraum weiter zu fassen als auch zu einem konkreten Anwendungsprozess zu kommen. Aus diesem Grunde wurden Rahmenbedingungen für eine Roadmap für den Aufbau des GLI:X Smart Freight Corridors Gauteng-Durban entwickelt, mit dem Ziel, durch die Erfassung und Verarbeitung von Daten eine kostengünstige, einfach zu implementierende Lösung zu finden, die zu einer besseren Gesamtsteuerung der Logistikverkehre entlang eines Smart Freight Corridors führt.

Das Projekt Green Logistic Indicator (GLI:X) endet nach 4 Jahren Laufzeit im Sommer 2021 und wird im neuen Teilprojekt Green Logistic Corridor (GLC) weitergeführt.

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BBB_EE	Broad-Based Black Economic Empowerment (BBB-EE)
CBRTA	Cross Border Road Transport Agency
CO_2	Carbon dioxide
CEN	European Committee for Standardization
CSIR	Coucil for Scientific and Industrial Research
DIN	German Institute for Standardization
DIN-EN	DIN English
DIN-TS	DIN Technical Specification
DoT	National Department of Transport
FTIP	Federal Transport Infrastructure Plan
GDP	Gross Domestic Product
GHG	Greenhouse gas
GLC	Green Logistic Corridor
GLI:X	Green Logistics Indicators
GP	Gauteng Province
GPDRT	Gauteng Province Department Road and Transport
GTS	Green Transport Strategy
HGV	Heavy goods vehicle
ISO	International Organization for Standardization
KZN	KwaZulu-Natal

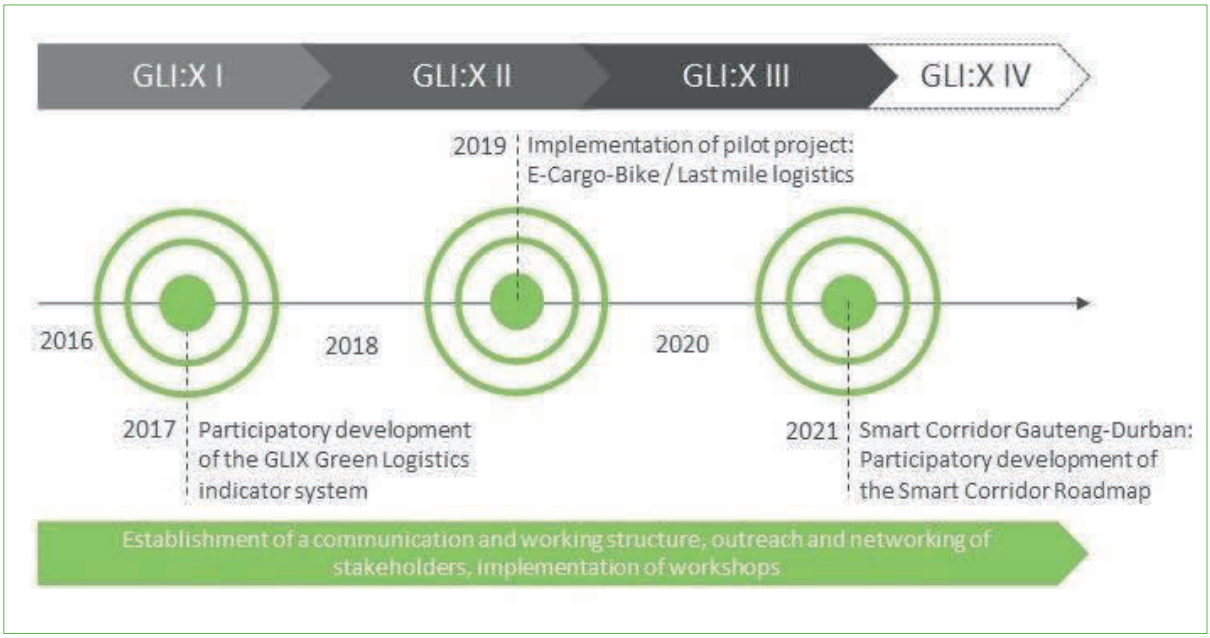
List of abbreviations

MEC	Member of the Executive Council
MoU	Memorandum of Understanding
NATMAP	National Transport Master Plan
NPD	National Development Plan
OECD	Organization for Economic Cooperation and Development
PPP	Public Private Partnerships
TEU	Twenty-Foot Equivalent Unit
RFA	Road Freight Association
SADC	South African Development Community
SABS	South African Bureau of Standards
SANRAL	South African National Roads Agency SOC Limited
SANS	South African National Standards
TFR	Transnet Freight Rail
UBA	German Federal Environmental Agency
UNFCCC	United Nations Framework Convention on Climate Change
WS	Workshop
ZAR	South African Rand

Summary

The GLI:X Green Logistics Indicators project has been established over several stages since 2016. Together with the province of Gauteng in South Africa, the project has succeeded in developing an indicator system for the measurability of green, socially responsible, and efficient freight logistics in the province in a cooperative dialog-oriented process.

Figure 1: GLI:X Process & important milestones (schematic)



Source: own illustration, GESI/nexus

Background: Increasing environmental problems in urban logistics

Smooth mobility and freight operations are not only essential for the economy, but also for people's daily lives, social participation, and a prosperous economic exchange. Freight logistics is an integral part of the transportation system and is the basis for production, supply, and disposal, and for maintaining quality of life. Urbanization, which has been ongoing for years, is not only increasing the need for everyday traffic in cities and metropolitan regions, but also traffic caused by the transport of goods and freight. This is contributing to increasing environmental challenges and congestion, as well as increased safety risks for other road users. For example, the transport and logistics sector accounts for approximately 10.8% of South Africa's national greenhouse gas emissions (see Department of Transport (2017): Green Transport Strategy 2017-2050). As large agglomerations of individuals, industries and associated service providers, cities and metropolitan regions have a particularly high demand for freight logistics - on the one hand, to supply themselves with goods and, on the other hand, to forward the goods and commodities produced locally in the production chain or to transport them to the end user. As a result, many urban regions are facing the particular challenge of remaining market competitive and making freight logistics faster, more efficient and more reliable - while at the same time not disregarding social and environmentally sustainable goals.

Project understanding: GLI:X as an opportunity for sustainable freight transport logistics

With this challenge in mind, the previous projects GLI-X Green Logistics Indicators (GLI:X I) and GLI:X - Green Logistics Indicators - Implementation Phase (GLI:X II) developed an exemplary indicator system for sustainable logistics for the Gauteng region in South Africa in a collaborative process together with stakeholders from politics, administration, science, and

business in the Gauteng province. The Gauteng metropolitan region in South Africa was selected because it is one of the most important economic regions on the continent.

The GLI:X indicator system thus represents an instrument for policy makers and industry to

- balance the immediate goals of freight logistics - cost efficiency, speed, reliability, and competitiveness - with broader but urgent sustainable development goals such as environmental protection, socio-economic development and a safe urban environment,
- set freight transport development trends as policy targets in a data-based manner (present2future benchmarking),
- measure and quantify the state of freight transport logistics in Gauteng in a structured and manageable way at regular intervals (monitoring),
- to facilitate the monitoring of policy success in the area of freight transport logistics without prescribing specific strategies and solutions, and
- thus support the development of new and innovative solutions.

In its methodological approach, the structured participatory dialogue process has also generated great added value from the point of view of the actors on the ground in that it has networked previously unnetworked actors. This makes it not only an excellent monitoring tool, but additionally a very essential instrument for communication between different governmental and non-governmental institutions and organizations. This is especially true for merging data from governmental and private sector companies.

Objectives of this project: Further development and scaling of the GLI:X indicator system

The aim of the project "Implementation and further development of the GLI:X - Green Logistics Indicators in South Africa" was to build on the results and successes of the previous GLI:X projects and to further develop the GLI:X indicator system for other logistics-relevant cities and regions in South Africa in a participatory manner and to evaluate the possible applications on site. This should be done following the process of developing the GLI:X indicator system for the Gauteng region. Furthermore, the transferability of the indicator system to the national level should be examined, including the national logistics corridors between Johannesburg/Gauteng and Durban. The dissemination of the GLI:X indicator system pursues the long-term goal of consolidating the export of green and sustainable environmental technologies in logistics throughout South Africa by analyzing framework conditions, existing technology and know-how, and presenting possible solutions.

The project specifically pursued the following objectives:

- Further development and adaptation of the indicator system in two additional South African cities/regions relevant to logistics.
    - Identification of the relevant stakeholders for the process
    - Participatory adaptation of the indicator system to the regional goals and challenges Determination of the data situation, identification of data sources and gaps and of the existing data
- Transfer of the indicator system to the national level with a focus on the (trans-) national transport corridors between Cape Town, Durban, Port Elisabeth and the Gauteng region, taking into account the central freight transfer centers:

- Coverage of corridors relevant for freight transport regardless of administrative boundaries.
- Comparison of the objectives of the indicator system with existing strategies at the national level
- Elaboration of the necessary methodological adjustments as well as a concept paper for the further development of the indicator on a national level

Challenges and Strategy: City regions as independent players - Corridors as a unifying theme

In addition to Gauteng as one of the most important economic regions in southern Africa with an economic output of approximately 10% of the gross domestic product of the entire African continent, the South African port cities of Durban, Port Elizabeth and Cape Town in particular play a key role in South Africa's trade and thus in the competitiveness of the South African economy. It is not only the performance of the ports themselves that plays an important role. The consistent further development of the corridors between the port cities and the economic centers and mining regions inland is crucial for the growth in freight volumes expected in the coming years as a result of the further expansion of production as well as demand.

Cities - in Africa rather urban regions - are increasingly becoming actors in their own right - not only in national but also in international (climate) policy. Particularly in the area of economic and transport policy, they sometimes represent more important stakeholders than national governments in southern Africa.

At the same time, the African city regions are all integrated into international supply chains and transport networks. In southern Africa in particular, the few corridors here are the central links and lifelines. These thus represent not only an issue of national (and international) transport policies, but also a direct interest of the city-regions.

Considering and using the interplay of national, regional, city and international levels

We wanted to take advantage of this in the GLI:X III project in order to promote the further development and broadening of the GLI:X indicator system. Since regions in South Africa are quite independent and strong, we hoped that activities at the city and regional levels would open the way to the national level - and vice versa: that this national attention would then lead back to interest in the regions. This led to an iterative process of dialogue and development, as was also desired by the city-regions (e.g. Gauteng). The workshop processes, which were clearly structured in terms of time and separated, had to be thought of as much more dynamically intertwined and had to be adapted adaptively.

In the course of the GLI:X I and GLI:X II projects, effective communication with various stakeholders was established, especially with the Gauteng Department of Roads and Transport, which also took over local leadership of the project. There has been a strong willingness to implement the tool in other cities and regions and at the national level.
GLI:X has also been so successful so far because the project has been able to align itself with existing or emerging local challenges and policy discourses and catalyze and accelerate them. This has been maintained and leveraged through GLI:X III as well.

Chapter 1 introduces the reader to the essentials of logistics as a driver of sustainable development as well as the concept definition of green logistics. Furthermore, the chapter provides a brief outline of some important trends in the logistics sector in recent years.

Chapter 2 outlines the GLI:X indicators system and highlights its unique selling proposition. indicators in logistics provide, by condensing complex phenomena into one or few easily digestible figures, a helpful tool for communicating complex topics in a structured and simplified way.

In recent years many indices (composite indicators) have been developed for cities that analyse, measure, and compare cities or regions with each other. They compare different cities using the same indicators and are often used to create rankings of these cities. Contrary to this approach, a present-to-future indicator system, such as the GLI:X indicators system, compares the present with the future – or the past with the present respectively – to show a development over time in a certain area using indicators that are representative for this area. For policymakers, these indices facilitate measuring the success of policies or strategies, while leaving open for discussion which strategies to use to foster development.

Furthermore, the chapter provides a brief outline of some important trends in the logistics sector in recent years.
To enable a better understanding of the challenges, a comparative description of standardization instruments as a tool to ensure sustainability in the field of logistics in South Africa was also compiled in comparison with international, European and German logistics standards.

Chapter 3 starts with a literature review of the existing challenges in freight logistics regarding green and sustainable logistical activities in several countries in the Southern African region, which is widely understood as the area of Africa south of the Cuene and Zambesi rivers. From those countries, Namibia, Zimbabwe and Botswana were selected as

As part of the literature review, strategic papers such as logistic policy s and master plans were consulted to present development paths set targets in terms of criteria for sustainable logistics. In particular, we examined whether the objectives of different stakeholders might be contradictory, whether the objectives are backed by target values, and whether there is a corresponding monitoring system (comparable to the Sustainable Development Goals). This aims to provide a deeper understanding of how the transport infrastructure networks in these countries are performing. Specifically, how well connected are they, and are there efforts in each country to increase the sustainability of the region's transportation infrastructure networks? The answers to these questions helped to assess the potentials and challenges of transport logistics in Southern Africa.

It then introduces provides insight in the problem background of the logistical situation in South Africa and its recent challenges. Followed by an overview of South Africa's extensive national policies and strategies to support a green economy, outlining the current policy and regulatory framework that provides the foundation supporting the greening of the freight logistics sector.

Subsequently, a comparison of national South African strategies with the goals of the GLI:X indicator was carried out and potential synergies were identified (Appendix B).

In a conclusion it is outlined in this chapter out that against a background of increasing worldwide public concerns for the environment, the impact of logistics on climate change has attracted increasing attention in South Africa through the transition towards an environmentally sustainable and climate-resilient economy. At the same time, it is noted, that they intend to embrace the green economy as a means of attaining inclusive and equitable growth that leads to sustainable development and promotes poverty eradication and the creation of green jobs.

The vision of transitioning South Africa towards a green economy has been declared at the highest political level and the green economy agenda is articulated in the macro-economic policy framework and national development vision. Green economy is seen as an important means to respond to a wide range of the critical and intertwined development challenges that range from unemployment, poverty and inequality to climate change. Nevertheless, there is a lack of integration of polices across different government departments and spheres. Equally important, implementation is often lagging behind policy development (Swilling et al. 2016).

Both the political framework and literature define an urgent need for the establishment of measurement systems to monitor the success of the various activities. Systems existing up to now are often described as insufficient or simply absent (Swilling et al. 2016). The Draft Revised White Paper on National Transport Policy points out "Government needs data to monitor and measure its progress against the targets it sets for itself. The Government must leverage its unique position to collect, collate and interpret data that no other organization in society can legitimately be expected to undertake" (Draft Revised White Paper on National Transport Policy 2017, p. 74).

This is the gateway to the GLI:X Green Logistics Indicator, which provides a tool for policymakers and the industry to enable the measurement and quantification of the state of freight logistics in a structured and manageable form, facilitating the monitoring of the success of policies pertaining to freight logistics without prescribing any solutions. This, ensures openness to new and innovative approaches as it enables cities and regions to benchmark their own future, comparing the present state with a future (or past) state and thereby illustrating the state of the development process.

Chapter 4 provides an overview of key public and private stakeholders that have been identified as part of the work of GLI:X III as relevant for the development and implementation.

Chapter 5 describes the method and workshops for reviewing a possible adaptation and further development of the GLI:X indicator system in two cities/regions in South Africa.

In participatory workshops with relevant local stakeholders, the specific challenges and goals of the respective city/region in the field of freight logistics were elaborated in an iterative process, and the GLI:X indicators system was introduced, discussed and, if necessary, adapted or further developed to the specific local conditions and goals.

The chapter also outlines the challenges and complexities that were encountered in this process.

The Chapter then describes the workshop series "Smart Corridor Development", a possible adaptation and further development of the GLI:X indicator system on a national level.

During the project it became obvious that the participating stakeholders regard the GLI:X indicators system as a foundation for the development of a database for the optimization of freight transport on the transport corridors between Johannesburg and Durban and Johannesburg and Cape Town.

Furthermore, it was pointed out that the interaction with the private sector, municipalities, academia, and civil society organizations such as trade unions on a provincial as well as on a national level needed to be significantly strengthened. There was also a need for action to create the technical basis for the development of the database, for the already initiated development of tools for the collection of partly regionally relevant transport data (app), and for capacity building for their application.

For South Africa's city regions, the major freight corridors are the country's central linkages and lifelines. These are thus not only an issue of transregional (national) transport policies but are also in the direct spotlight of the city-regions. In order to consider and utilize the interaction of national, provincial, city and international levels, an iterative process of dialogue and development with stakeholders was necessary.

The workshop activities for implementing the GLI:X indicators system at regional and national levels, which were actually structured and separated in their time frames, therefore had to be intertwined and adapted in a much more dynamic way.

A key role for South Africa's trade and thus the competitiveness of the South African economy is played by the South African port cities of Durban, Cape Town and Port Elisabeth, which play a decisive role in the further development of the corridors between the port cities and the economic centers and mining regions inland. Consequently, the focus was set on the elaboration of a potential indicator strategy for the transnational corridors between Johannesburg-Durban, Port Elisabeth and Cape Town.

We faced the problem of not having enough basis to prioritize one of the three possible corridor spaces to be studied, as data and policy scopes and support from the administration were difficult to identify. Therefore, preliminary discussions were held with representatives of the three main corridor endpoints (Durban, Cape Town, Port Elisabeth) to find a focus and determine prioritization. This process approach initially crystallized into two virtual workshops with the Ministers of Transport of the Gauteng/KwaZulu Natal and Gauteng/Eastern Cape regions.

Responding to local, regional and national needs, it was decided to examine the N3 corridor between Durban and Gauteng as the most important economic hub in Southern Africa, with the support of selected GLI:X indicators, for parameters for environmentally sustainable and at the same time efficient smart green logistics. This is most likely to be achieved using smart IT applications and data platforms that involve and interconnect the different actors on the supply chain and better manage transport volumes and logistics flows along the corridor.

To take initial steps, a series of online workshops was initiated together with the most important stakeholders from the public sector along the corridor.
General aims of the workshop series were the following:

- Define an overall vision and key objectives
- Identify the relevant Indicators for the Smart Corridor
- Identify the key stakeholders and requirements
- Form a core team and build a network of stakeholders / experts.

The workshops were developed in collaboration with the participants. Specialist experts from South Africa and Europe provided insight into existing practical examples, challenges and key factors that play an important role in implementing a smart logistics corridor.

Chapter 6 describes the activities performed to achieve Data gathering and management during the research period. Data gathering and management has been repeatedly identified at several stages in the entire GLI:X project as a crucial component for the successful implementation of the GLI:X Smart Freight Corridor, which depends heavily on whether or not said data is available and up to date. Furthermore, the evaluation of the application of the GLI:X indicator system will similarly depend on the availability of and access to data. As such, the requirements and objectives of these work packages are intrinsically related and can be developed in tandem.

Diverse goals of this work package can be summarized as follows:

- Provision of support for the Gauteng Department of Roads and Transport in its efforts to establish a collaborative method of data collection along the corridor, as well as the sharing of methodological experiences and assistance in questions dealing with data collection, data analysis and application.

- Provision of support for the Gauteng Department of Roads and Transport in advancing the GLI:X indicator system. Particular emphasis should be put on the digitization of logistics information, data collection in a smart corridor, and the political process in South Africa.

Activities performed to achieve these goals were manifold. Additionally, planned activities were continually adjusted to represent developing framework conditions at various stages throughout the lifetime of the project, including the effects from the pandemic crisis, political changes in the leadership of the participating provinces, and changes of staff members of the operating teams.

This chapter also addresses the challenges that Covid-19 has caused to the project.

The implementation of GLI:X workshops in South Africa could not be carried out as planned). Due to the South African government's approach of seeing the crisis as an opportunity for change and now developing economic structures for the transformation of an economy with sustainable, environmentally friendly tendencies, the GLI:X process thereby benefited directly through the associated high profile of innovative greener logistics. This was expressed, in part, by the great interest shown in the topic by policymakers in the Gauteng and KwaZulu-Natal provinces.

The challenges that Covid-19 has caused also resulted in the development and continuation of the document "Covid-19 experiences made in Germany" (Appendix C), which was developed by the project partners GESI and Nexus at the request of the partners in Gauteng to share experiences of the transport and freight logistics sector in handling the Corona pandemic in Germany with the partners in South Africa. Short reports were compiled by the GLI:X team in Berlin on the impact of Covid -19 on the logistics sector in Germany and how it was responded to. The objectives were to identify or possibly gain access to GLI:X indicator data in South Africa as a result of the changed conditions.

Chapter 7 outlines how, based on the findings of the workshops described in chapter 5 and 6, the vision of a Smart Freight Corridor between a port in South Africa and Gauteng as the most important economic hub in southern Africa was identified for implementation during the stakeholder participation process, and its development. This roadmap framework is planned as an implementation guideline that can also be used independently and is based on broad expertise. This was intended to provide the participating administrations in South Africa with a tool that can also be used independently in the future. Details on the roadmap framework are provided in the document "Strategy and Implementation Roadmap Framework for the Further Development of the GLI:X Indicator System at the National Level: GLI:X Intelligent Freight Corridor". (Appendix A).

The chapter also outlines the stakeholder perceptions of the vision to develop the GLI:X Smart Freight Corridor.

Chapter 8 presents the process and outcome evaluation of the project. The processes to implement the GLI:X indicators or, as it turned out during the project to develop and implement the GLI:X Smart Freight Corridor, have varied considerably throughout the project lifetime. Several events occurred that could not be foreseen and that either had a positive or negative impact on the current project processes. To assess these impacts, the GLI:X team performed interviews with two key persons that accompanied the project from the beginning to its current state.

Zusammenfassung

Das Projekt GLI:X Green Logistic Indicators wird seit 2016 in mehreren Phasen bearbeitet. Mit dem Projekt ist es gelungen, zusammen mit der Provinz Gauteng in Südafrika in einem kooperativen dialogorientierten Prozess ein Indikatorensystem für eine grüne, sozialverträgliche und effiziente Frachtlogistik der Provinz zu entwickeln. Dieses wurde auf die nächste Ebene, der Konzipierung eines einen Smart Freight Corridors, über die Grenzen der Provinz hinaus, ausgeweitet.

Hintergrund: Zunehmend Umweltprobleme in der Urbanen Logistik

Reibungslos funktionierende Mobilität und Gütertransport sind nicht nur für die Abläufe wirtschaftlicher Prozesse eine Grundvoraussetzung, sondern auch für das alltägliche Leben von Menschen, für soziale Teilhabe und florierenden wirtschaftlichen Austausch. Frachtlogistik ist ein integraler Bestandteil des Transportwesens und ist Grundlage für Produktion, Ver- und Entsorgung und für den Erhalt von Lebensqualität. Durch die seit Jahren anhaltende Urbanisierung steigt nicht nur der Alltagsverkehr von Personen in den Städten und Metropolregionen, sondern auch der Verkehr durch Waren- und Gütertransport. Dies trägt zu sich verschärfenden Problemen in Bezug auf negative Auswirkungen auf die Umwelt und Staus sowie erhöhten Sicherheitsrisiken für alle Verkehrsteilnehmer bei.

So entfallen auf den Transport- und Logistiksektor etwa 10,8% der nationalen Treibhausgasemissionen Südafrikas (vgl. Department of Transport (2017): Green Transport Strategy 2017-2050). Städte und Metropolregionen haben als große Agglomeration von Menschen, Industrien und Serviceanbietern ein besonders hohes Aufkommen im Bereich der Frachtlogistik – zum einen um sich selbst mit Gütern zu versorgen und zum anderen, um die vor Ort produzierten Waren und Güter in der Produktionskette weiterzuleiten oder zum Endnutzer zu transportieren. Deshalb sehen sich viele urbane Regionen mit der besonderen Herausforderung konfrontiert, marktfähig zu bleiben und Frachtlogistik schneller, effizienter und zuverlässiger zu gestalten. Gleichzeitig wollen sie aber auch soziale und ökologisch nachhaltige Ziele nicht außer Acht lassen.

Aufgabenverständnis: GLI:X als Chance für eine nachhaltige Güterverkehrslogistik

Vor dem Hintergrund dieser Problemstellung wurde in den vorherigen Projekten GLI-X Green Logistics Indicators und GLI:X – Green Logistics Indicators – Implementierungsphase (GLI:X Imp) ein Indikatorensystem für nachhaltige Logistik für die Region Gauteng in Südafrika in einem kollaborativen Prozess zusammen mit Akteuren aus Politik, Verwaltung, Wissenschaft und Wirtschaft der Provinz Gauteng exemplarisch – als Vorbild für andere Provinzen und Regionen im südlichen Afrika – entwickelt. Die Metropolregion Gauteng in Südafrika wurde ausgewählt, weil sie eine der wichtigsten Wirtschaftsregionen des Kontinents ist.

Das GLI:X-Indikatorensystem stellt somit ein Instrument für Politik und Industrie dar, um

- die unmittelbaren Ziele der Güterverkehrslogistik – Kosteneffizienz, Schnelligkeit, Verlässlichkeit und Wettbewerbsfähigkeit – mit breiteren, aber dringenden nachhaltigen Entwicklungszielen wie Umweltschutz, sozioökonomische Entwicklung und eine sichere städtische Umwelt in Einklang zu bringen,
- die Entwicklungstendenzen des Frachtverkehrs als politische Ziele datenbasiert festzusetzen (present2future benchmarking),
- den Zustand der Güterverkehrslogistik in Gauteng in strukturierter und überschaubarer Form in regelmäßigen Abständen zu messen und zu quantifizieren (Monitoring),

- die Erfolgskontrolle der Politik im Bereich der Güterverkehrslogistik zu erleichtern, ohne starre Lösungen vorzuschreiben und
- so die Entwicklung neuer und innovativer Ansätze zu unterstützen.

In seiner methodischen Herangehensweise hat der strukturierte partizipative Dialogprozess aus Sicht der Akteure vor Ort auch dadurch einen großen Mehrwert erzeugt, dass er bisher unvernetzte Akteure miteinander vernetzt hat. Dadurch ist er nicht nur ein hervorragendes Monitoring-Instrument, sondern zusätzlich ein sehr wesentliches Instrument für die Kommunikation zwischen verschiedenen staatlichen und nicht-staatlichen Institutionen und Organisationen. Dies gilt insbesondere für die Zusammenführung von Daten von staatlichen und privatwirtschaftlichen Unternehmen.

Ziele dieses Projektes: Weiterentwicklung und Skalierung des GLI:X-Indikatorensystems

Neben dem initialen Ziel der Entwicklung eines Indikatorensystem für nachhaltige Logistik für die Region Gauteng in Südafrika, war es ein weiteres zentrales Ziel des Projekts „Implementierung und Weiterentwicklung des GLI:X – Green Logistics Indicators in Südafrika“, auf die zu Anfang des GLI:X- Projekts erzielten Ergebnisse und Erfolge aufzubauen und das GLI:X-Indikatorensystem für weitere Städte bzw. Regionen Südafrikas partizipativ weiterzuentwickeln und die Anwendungsmöglichkeiten vor Ort zu erörtern. Dies sollte in Anlehnung an den Prozess zur Entwicklung des GLI:X- Indikatorensystems für die Region Gauteng geschehen. Des Weiteren sollte die Skalierung des Indikatorensystems auf die nationale Ebene unter Einbeziehung der nationalen Logistikkorridore zwischen Johannesburg/Gauteng und Durban geprüft werden. Die Dissemination des GLI:X-Indikatorsystems verfolgt langfristig das Ziel, über die Analyse von Rahmenbedingungen, vorhandener Technik und Knowhow sowie der Darstellung möglicher Losungen den Export von grünen und nachhaltigen Umwelttechnologien der Logistik in den gesamten südafrikanischen Raum zu verstetigen.

Konkret verfolgte das Projekt folgende Ziele:

- Weiterentwicklung und Anpassung des Indikatorensystems in zwei weiteren für die Logistik relevanten südafrikanischen Städten/Regionen
  - Identifizierung der für den Prozess relevanten Akteure
  - Partizipative Anpassung des Indikatorensystems an die regionalen Ziele und Herausforderungen Ermittlung der Datenlage, Identifizierung von Datenquellen und -lücken und der vorhandenen Daten
- Übertragung des Indikatorensystems auf die nationale Ebene mit Fokus auf die (trans-) nationalen Verkehrskorridore zwischen Kapstadt, Durban, Port Elisabeth und der Region Gauteng unter Einbeziehung der zentralen Güterumschlagszentren:
  - Erfassung der für den Güterverkehr relevanten Korridore unabhängig von administrativen Grenzen
  - Abgleich der Zielsetzungen des Indikatorensystems mit bestehenden Strategien auf nationaler Ebene
  - Erarbeitung der erforderlichen methodischen Anpassung sowie eines Konzeptpapiers zur Weiterentwicklung des Indikators auf nationaler Ebene

Herausforderungen und Strategie: City-Regions als eigenständige Akteure – Korridore als verbindendes Thema

Neben Gauteng als einer der bedeutendsten Wirtschaftsregionen des südlichen Afrikas mit einer Wirtschaftsleistung von ca. 10 % des Bruttoinlandsprodukts des gesamten afrikanischen Kontinents, spielen insbesondere die südafrikanischen Hafenstädte Durban, Port Elizabeth und Kapstadt eine Schlüsselrolle für den Handel Südafrikas und damit für die Wettbewerbsfähigkeit der südafrikanischen Wirtschaft. Dabei nimmt nicht nur die Leistungsfähigkeit der Häfen selbst eine wichtige Rolle ein. Für das in den nächsten Jahren erwartete Wachstum des Frachtvolumens durch den weiteren Produktionsaufbau als auch der Nachfrage sind die konsequente Weiterentwicklung der Korridore zwischen den Hafenstädten und den wirtschaftlichen Zentren und Bergbauregionen im Binnenland entscheidend.

Städte – in Afrika oft eher Städteregionen – werden immer mehr zu eigenständigen Akteuren – nicht nur in der nationalen, sondern auch in der internationalen (Klima-) Politik. Gerade im Bereich der Wirtschafts- und Verkehrspolitik stellen sie im südlichen Afrika bisweilen wichtigere Stakeholder als die nationalen Regierungen dar.

Zugleich sind die afrikanischen Stadtregionen alle in internationale Lieferketten und Transportnetzwerke eingebunden. Insbesondere im südlichen Afrika sind hier die wenigen Korridore die zentralen Verbindungen und Lebensadern. Folglich sind diese damit nicht nur Gegenstand nationaler (und internationaler) Verkehrspolitiken, sondern auch im Fokus der Stadtregionen. Dieses große Interesse bildete die Grundlage für das Vorhaben GLI:X III in welchem die Weiterentwicklung und Verbreiterung des GLI:X-Indikatorensystems vorangetrieben werden sollte. Da in Südafrika die Regionen durchaus eigenständig und stark sind, sollten die GLI:X Aktivitäten auf städtischer und regionaler Ebene den Weg auf die nationale Ebene eröffnen – und umgekehrt dann wieder zu einem verstärkten Interesse in den Regionen führen. Dieser Entwicklungsprozess erfolgte – auch auf Wunsch der Regionen (z.B. Gauteng) - in einem iterativen Dialogverfahren. Die zunächst zeitlich klar gegliederten und getrennten Prozesse wurden im Projektverlauf adaptiv an die Dynamiken des Projekts angepasst.

Im Zuge der Vorhaben GLI:X I und GLI:X II wurden schon gute Kontakte zu diversen Stakeholdern aufgebaut, insbesondere dem Gauteng Department of Roads and Transport, das auch die lokale Projektleitung übernommen hat. Hier bestand zudem die klare Bereitschaft, das GLI:X-Instrument gemeinsam mit anderen Städte bzw. Regionen und auf die nationale Ebene zu übertragen.

Dieser Erfolgsfaktor wurde durch eine Flexibilität und Anpassungsfähigkeit in allen drei Phasen des GLI:X Projekts ergänzt. Das Projekt hat sich kontinuierlich an bestehende oder sich abzeichnende lokale Herausforderungen und politische Diskurse angedockt und diese katalytisch zusammenbringen und beschleunigen können.

Kapitel 1 führt in die Grundlagen der Logistik als Motor der nachhaltigen Entwicklung sowie in die Definition des Konzepts der grünen Logistik ein. Darüber hinaus gibt das Kapitel einen kurzen Überblick über einige wichtige Trends im Logistiksektor in den letzten Jahren.

Kapitel 2 skizziert das GLI:X-Indikatorensystem und arbeitet sein Alleinstellungsmerkmal heraus. Indikatoren in der Logistik stellen ein hilfreiches Instrument dar, um komplexe Themen strukturiert und vereinfacht zu kommunizieren.

In den letzten Jahren sind viele Indizes (zusammengesetzte Indikatoren) für Städte entwickelt worden, die Städte oder Regionen analysieren, skalieren und miteinander vergleichen. Sie vergleichen verschiedene Städte anhand der gleichen Indikatoren und werden häufig zur

Erstellung von Ranglisten dieser Städte verwendet. Im Gegensatz dazu vergleicht ein Gegenwarts-Zukunfts-Indikatorensystem, wie das GLI:X-Indikatorensystem, die Gegenwart mit der Zukunft - bzw. die Vergangenheit mit der Gegenwart -, um die Entwicklung in einem bestimmten Gebiet im Laufe der Zeit anhand von Indikatoren aufzuzeigen, die für dieses Gebiet repräsentativ sind. Für politische Entscheidungsträger erleichtern diese Indizes die Messung des Erfolgs politischer Maßnahmen oder Strategien und lassen gleichzeitig die Diskussion darüber offen, welche Strategien zur Förderung der Entwicklung eingesetzt werden sollten.

Darüber hinaus gibt das Kapitel einen kurzen Überblick über einige wichtige Trends im Logistiksektor in den letzten Jahren.

Zur besseren Bewertung der Herausforderungen wurde außerdem eine vergleichende Darstellung von Normungsinstrumenten als Werkzeug zur Sicherung der Nachhaltigkeit im Bereich der Logistik in Südafrika im Vergleich mit internationalen, europäischen und deutschen Logistikstandards erarbeitet.

Kapitel 3 beginnt mit einem Literaturüberblick über die bestehenden Probleme in der Güterverkehrslogistik im Hinblick auf umweltfreundliche und nachhaltige Logistikaktivitäten in mehreren Ländern des südlichen Afrikas, das im Allgemeinen als das Gebiet Afrikas südlich der Flüsse Cuene und Zambesi verstanden wird. Aus diesen Ländern wurden Namibia, Simbabwe und Botswana als Beispiele ausgewählt.

Im Rahmen der Literaturanalyse wurden strategische Papiere wie Logistikpläne und Masterpläne herangezogen, um Entwicklungspfade und gesetzte Ziele hinsichtlich der Kriterien für nachhaltige Logistik darzustellen.

Hierbei wurde untersucht geprüft, wie die Zielsetzungen verschiedener Akteure in Beziehung stehen, ob die Ziele mit Zielwerten hinterlegt sind und ob es ein entsprechendes Monitoring-System (vergleichbar mit den Sustainable Development Goals) gibt.

Das Kapitel hat zum Ziel ein tieferes Verständnis der Frage zu vermitteln, wie Verkehrsinfrastrukturnetze in diesen Ländern miteinander verbunden sind, und on es in den einzelnen Ländern Bemühungen, die Nachhaltigkeit der Verkehrsnetze in der Region zu erhöhen gibt. So können Potenziale und Herausforderungen der Transportlogistik im südlichen Afrika beurteilt werden.

Anschließend wird ein Überblick über den aktuellen Problemhintergrund der logistischen Situation in Südafrika und ihre aktuellen Herausforderungen sowie über Südafrikas umfassende nationale Politik und Strategien zur Unterstützung einer grünen Wirtschaft gegeben. Dabei wird der aktuelle politische und regulatorische Rahmen skizziert, der die Grundlage für die grüne Ausrichtung des Frachtlogistiksektors bildet.

Im Anschluss wird ein Abgleich von nationalen südafrikanischen Strategien mit den Zielen des Indikators vorgenommen und mögliche Synergien herausgearbeitet (vgl. hierzu auch Appendix B).

Abschließend wird in diesem Kapitel dargelegt, dass vor dem Hintergrund der weltweit zunehmenden Sorge der Öffentlichkeit um die Umwelt die Auswirkungen der Logistik auf den Klimawandel in Südafrika durch den Übergang zu einer umweltverträglichen und klimaresistenten Wirtschaft immer mehr Aufmerksamkeit erregt haben. Gleichzeitig wird dargelegt, dass eine grüne Wirtschaft und eine nachhaltige Entwicklung auch soziale Effekte wie die Beseitigung der Armut und die Schaffung von grünen Arbeitsplätzen bewirken kann.

Die Vision des Übergangs Südafrikas zu einer grünen Wirtschaft wurde auf höchster politischer Ebene formuliert, und die Agenda für eine grüne Wirtschaft ist im makroökonomischen

politischen Rahmen und in der nationalen Entwicklungsvision verankert. Die grüne Wirtschaft wird als wichtiges Mittel zur Bewältigung einer Vielzahl von kritischen und miteinander verflochtenen Entwicklungsherausforderungen angesehen, die von Arbeitslosigkeit, Armut und Ungleichheit bis hin zum Klimawandel reichen. Dennoch ist festzustellen, dass es an der Integration der politischen Maßnahmen zwischen den verschiedenen Regierungsabteilungen und -bereichen mangelt. So bleibt auch die Umsetzung häufig hinter der Politikentwicklung zurück (Swilling et al. 2016).

Sowohl der politische Rahmen als auch die Literatur definieren einen dringenden Bedarf an der Einrichtung von Messsystemen zur Überwachung des Erfolgs der verschiedenen Aktivitäten. Die bisher existierenden Systeme werden oft als unzureichend oder schlichtweg nicht vorhanden beschrieben (Swilling et al. 2016). Im Entwurf des überarbeiteten Weißbuchs zur nationalen Verkehrspolitik wird darauf hingewiesen, dass "die Regierung Daten benötigt, um ihre Fortschritte im Hinblick auf die von ihr selbst gesetzten Ziele zu überwachen und zu messen. Die Regierung muss ihre einzigartige Position nutzen, um Daten zu sammeln, zusammenzustellen und zu interpretieren, was von keiner anderen Organisation in der Gesellschaft legitimerweise erwartet werden kann" (Draft Revised White Paper on National Transport Policy 2017, S. 74).

Dies stellt die Schnittstelle zum GLI:X Logistics Indicator dar. Er gibt politischen Entscheidungsträgern und der Industrie ein Instrument an die Hand, das die Messung und Quantifizierung des Zustands der Güterverkehrslogistik in strukturierter und handhabbarer Form ermöglicht und die Erfolgskontrolle von Maßnahmen im Bereich der Güterverkehrslogistik erleichtert. Dies gewährleistet die Offenheit für neue und innovative Ansätze, da es den Städten und Regionen ermöglicht, ihre eigene Zukunft zu bewerten, indem sie den gegenwärtigen Zustand mit einem zukünftigen (oder vergangenen) Zustand vergleichen und so den Stand des Entwicklungsprozesses veranschaulichen.

Kapitel 4 gibt einen Überblick über die wichtigsten öffentlichen und privaten Akteure, die im Rahmen des GLI:X III Projekts als relevant für die Entwicklung und Umsetzung identifiziert wurden.

Kapitel 5 stellt die Methode und Workshops zur Überprüfung einer möglichen Anpassung und Weiterentwicklung des GLI:X- Indikatorensystems in zwei Städten/Regionen Südafrikas dar.

In partizipativen Workshops mit den relevanten Stakeholdern vor Ort wurden in einem iterativen Prozess die spezifischen Herausforderungen und Ziele der jeweiligen Stadt/Region im Bereich der Fracht-Logistik herausgearbeitet sowie das GLI:X-Indikatorensystem vorgestellt, diskutiert und ggf. an die spezifischen lokalen Gegebenheiten und Ziele angepasst bzw. weiter entwickelt. Das Kapitel stellt auch die Herausforderungen und Schwierigkeiten dar, die sich hier ergaben.

Das Kapitel beschreibt dann die Workshopreihe "Smart Corridor Development", und erläutert wie eine mögliche Anpassung und Weiterentwicklung des GLI:X-Indikatorensystems auf nationaler Ebene erfolgen kann.

Schon während der ersten Workshops zeichnete sich ab, dass die beteiligten Akteure das GLI:X-Indikatorensystem als hilfreiche Grundlage für die Entwicklung einer Datenbank zur Optimierung des Güterverkehrs auf den Verkehrskorridoren zwischen Johannesburg und Durban sowie Johannesburg und Kapstadt betrachten. Dabei wurde betont, dass die Interaktion mit dem Privatsektor, den Kommunen, der Wissenschaft und zivilgesellschaftlichen Organisationen wie den Gewerkschaften sowohl auf provinzieller als auch auf nationaler Ebene deutlich verstärkt werden muss.

Handlungsbedarf bestehe auch bei der Schaffung der technischen Grundlagen für den Aufbau der Datenbank, bei der bereits begonnenen Entwicklung von Tools zur Erhebung von teilweise regional relevanten Verkehrsdaten (App) und beim Capacity Building für deren Anwendung.

Für die Stadtregionen Südafrikas sind die großen Güterverkehrskorridore die zentralen Verbindungswege und Lebensadern des Landes. Sie sind daher nicht nur ein Thema der überregionalen (nationalen) Verkehrspolitik, sondern liegen auch im direkten Blickfeld der Stadtregionen. Um das Zusammenspiel von nationaler, provinzieller, städtischer und internationaler Ebene zu berücksichtigen und zu nutzen, war ein iterativer Prozess des Dialogs und der Entwicklung mit den Beteiligten notwendig. Die Workshop-Aktivitäten zur Umsetzung des GLI:X Indikators auf regionaler und nationaler Ebenen mussten dynamischer ineinandergreifen und angepasst werden.

Eine Schlüsselrolle für den südafrikanischen Handel und damit die Wettbewerbsfähigkeit der südafrikanischen Wirtschaft spielen die südafrikanischen Hafenstädte Durban, Kapstadt und Port Elisabeth, die für die weitere Entwicklung der Korridore zwischen den Hafenstädten und den Wirtschaftszentren und Bergbauregionen im Landesinneren eine entscheidende Rolle spielen. Daher wurde der Schwerpunkt auf die Ausarbeitung einer möglichen Indikatorstrategie für die transnationalen Korridore zwischen Johannesburg-Durban, Port Elisabeth und Kapstadt gelegt

Um einen der drei möglichen zu untersuchenden Korridorräume zu priorisieren, fehlten zu Beginn Datengrundlagen. Ebenso waren politische Spielräume und Unterstützung der jeweiligen Verwaltung schwer zu ermitteln. Daher wurden Vorgespräche mit den Vertretern der drei wichtigste Korridor Endpunkte (Durban, Kapstadt, Port Elisabeth) geführt, um eine Fokussierung zu finden und Priorisierung festlegen zu können. Aus diesem Prozessansatz kristallisierten sich zunächst zwei virtuelle Workshops mit den Ministern für Transport der Regionen Gauteng/KwaZulu Natal und Gauteng/Eastern Cape heraus.

In der Folge wurde sich für den Verkehrskorridor zwischen Durban/KZN und Johannesburg/Gauteng als wichtigster wirtschaftlicher Knotenpunkt des südlichen Afrikas entschieden um dort die GLI:X Indikatoren anzuwenden und den Korridor auf die Potenziale für einen umweltverträglichen und zugleich leistungsfähigen smarten grünen Logistik hin zu untersuchen. Dies geht am ehesten durch die Hinzuziehung intelligenter IT-Anwendungen und Datenplattformen, welche die unterschiedlichen Akteure auf der Supply Chain mit einbeziehen und untereinander vernetzen und das Transportaufkommen und die Logistikströme besser entlang des Korridors steuern lässt.

Dieser "GLI:X Smart Freight Korridor" soll als Pilotprojekt dienen, das auf andere wichtige Güterverkehrskorridore, die aus der Provinz Gauteng herausführen, übertragen werden soll.

Daran anknüpfend wurde in einem ersten Schritt Online- Workshops mit den wichtigsten Interessengruppen aus dem öffentlichen Sektor entlang des Korridors initiiert.

Allgemeine Ziele der Workshopreihe waren die folgenden:

- Definition einer allgemeinen Vision und von Schlüsselzielen
- Identifizierung der relevanten Indikatoren für den Smart Corridor
- Identifizierung der wichtigsten Interessengruppen und Anforderungen
- Bildung eines Kernteams und Aufbau eines Netzwerks von Interessengruppen/Experten.

Die Workshops wurden interaktiv mit den Teilnehmenden entwickelt. Fachexpertinnen und -experten aus Südafrika und Europa gaben Einblick in bestehende Praxisbeispiele, Herausforderungen und Schlüsselfaktoren, die bei der Umsetzung eines intelligenten Logistikkorridors eine wichtige Rolle spielen.

Kapitel 6 beschreibt die Aktivitäten zur Datenerfassung und -verwaltung während des Forschungszeitraums. Das Sammeln und Verwalten von Daten wurde als entscheidende Komponente für die erfolgreiche Umsetzung des GLI:X Smart Freight Corridor identifiziert und in mehreren Phasen des gesamten GLI:X-Projekts durchgeführt. Dies war eine zentrale Aufgabe im Projekt, da die Bewertung der Anwendbarkeit des GLI:X-Indikatorensystems von der Verfügbarkeit von und dem Zugang zu Daten abhängt. Daher sind die Anforderungen und Ziele dieser Arbeitspakete eng miteinander verbunden und können gemeinsam entwickelt werden.

Die verschiedenen Ziele dieser Arbeitsphase lassen sich wie folgt zusammenfassen:

- Unterstützung des Gauteng Department of Roads and Transport bei seinen Bemühungen, eine kooperative Methode der Datenerhebung entlang des Korridors zu etablieren, sowie Austausch von methodischen Erfahrungen und Hilfestellung in Fragen der Datenerhebung, Datenanalyse und -anwendung.
- Unterstützung des Gauteng Department of Roads and Transport bei der Weiterentwicklung des GLI:X-Indikatorensystems mit besonderem Fokus auf der Digitalisierung von Logistikinformationen, Datenerhebung in einem intelligenten Korridor und den politischen Prozess in Südafrika.

Darüber hinaus wurden die geplanten Aktivitäten in verschiedenen Phasen der Projektlaufzeit kontinuierlich an die sich verändernden Rahmenbedingungen wie die Auswirkungen der Pandemiekrise, politische Veränderungen in der Führung der beteiligten Provinzen und personelle Veränderungen in den Operationsteams, angepasst.

In diesem Kapitel wird insbesondere auf die Herausforderungen eingegangen, die Covid-19 Pandemie für das Projekt mit sich gebracht hat. Die Durchführung von GLI:X Workshops in Südafrika konnten nicht in der geplanten Form durchgeführt werden. Durch den Ansatz der südafrikanischen Regierung, die Krise als Chance zur Veränderung zu begreifen und jetzt wirtschaftliche Strukturen für den Umbau einer Wirtschaft mit nachhaltigen, umweltfreundlichen Tendenzen zu entwickeln profitierte der GLI:X-Prozess in den letzten Monaten der GLI:X III Phase, unmittelbar durch den damit verbundenen hohen Stellenwert einer innovativen grüneren Logistik. Dies äußerte sich u.a. in dem großen Interesse von Seiten der Politik in den Provinzen Gauteng und KwaZulu-Natal am Thema.

Das Dokument „Covid-19 experiences made in Germany“, (vgl. Appendix C). welches auf Wunsch der Partner in Gauteng von den Projektpartnern GESI und Nexus entwickelt wurde, um Erfahrungen des Transport- und Frachtlogistiksektor im Umgang mit der Corona-Pandemie in Deutschland mit den Partnern in Südafrika zu teilen, ist in diesem Zusammenhang entstanden. Es wurden hier durch das GLI:X Team in Berlin kurze Berichte zusammengestellt, die darauf eingingen, welche Auswirkungen auf den Logistiksektor Deutschland festzustellen waren und wie darauf reagiert wurde. Ziele war es, durch die veränderten Bedingungen möglicherweise Zugang zu Daten der GLI:X Indikatoren in Südafrika zu identifizieren bzw. zu erhalten.

Kapitel 7 führt aus, wie auf der Grundlage der Ergebnisse der in Kapitel 5 und 6 beschriebenen Workshops die Vision eines intelligenten Güterverkehrskorridors zwischen einem Hafen in Südafrika und Gauteng als wichtigstem Wirtschaftsknotenpunkt im südlichen Afrika für die Umsetzung im Rahmen der Stakeholder-Beteiligung identifiziert und weiterentwickelt wurde.

Dieser Roadmap-Framework ist als Umsetzungsleitfaden geplant, der auch eigenständig genutzt werden kann und auf einer breiten Expertise beruht. Damit sollte den teilnehmenden Verwaltungen in Südafrika ein Instrument an die Hand gegeben werden, das in Zukunft auch eigenständig genutzt werden kann. (Detaillierte Ausführungen zum Roadmap-Framework finden sich in Appendix A.)

Das Kapitel schließt mit der Skizzierung der Vorstellungen und Erwartungen der Stakeholder an die Konzeption zur Entwicklung des GLI:X Smart Freight Corridors.

Kapitel 8 beschreibt abschließend die Prozess- und Ergebnisbewertung des Projekts. Die Prozesse zur Umsetzung der GLI:X-Indikatoren zur Umsetzung auf regionaler und nationaler Ebenen und der sich im Projektzeitraum zur ergebenden Entwicklung und Umsetzung der GLI:X Indikator Systems auf die Ebenen eines GLI:X Smart Freight Corridor haben sich während der Projektlaufzeit erheblich verändert. Um die Auswirkungen einer Reihe von nicht vorhersehbaren Entwicklungen auf die laufenden Projektprozesse zu bewerten, führte das GLI:X-Team Interviews mit zwei Schlüsselpersonen, die das Vorhaben von Anfang an bis zu seinem heutigen Stand begleitet haben.

1 Logistics as a Driver of Sustainable Development

Mobility and transportation are crucial for the organization of the everyday lives of people, for social participation, and for economic exchange processes. While science, politics, and public discussion most often focus on the movement of people when thinking about mobility, the movement of goods is often rather neglected. However, it is just as essential for ensuring sustainable socio-economic development, as it affects diverse sectors of life and society.

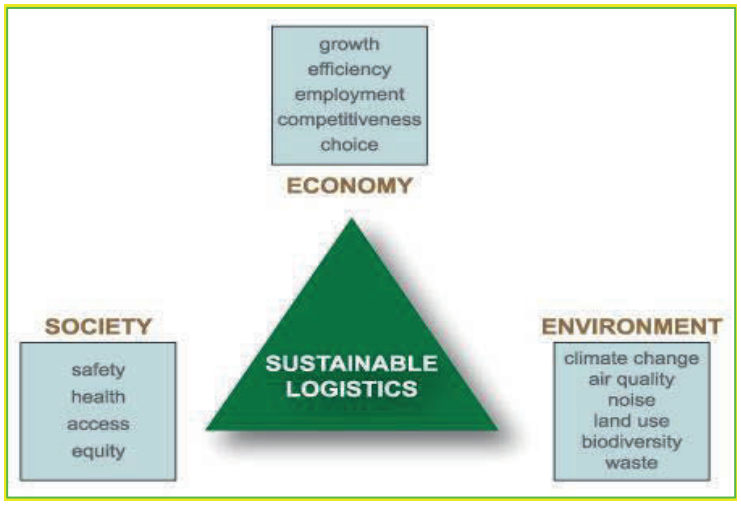
Freight logistics concerns the delivery of goods and products to their destination in a fast and reliable way. However, freight logistics can be seen as a social and environmental issue in addition to its inherent economic function. Freight logistics is an integral part of the production and consumption chain, and thus plays an important role in maintaining and raising living standards. The organization and efficiency of freight logistics ensures and enables everyday consumption, influences consumer prices of products, and creates job opportunities, thus adding to and ensuring quality of life. However, freight logistics can be responsible for side effects such as congestion of roads, emissions, accidents and other dangers to the environment and people.

The efficient and safe daily movement of goods is a critical factor in the economic growth and competitiveness of a country's economy. Infrastructure is only one component of a well-functioning transport of goods, which relies even further on the functioning operational context resulting from the interaction between private and public operators, national policies and regulations, and core infrastructure operators. A well-functioning and sustainable transport and logistics sector can support both effective regional integration as well as the development of effective corridors and improved systems to support import/export business in the region.

Cities and agglomerations as main consumers and producers of goods are especially burdened with the negative side effects of freight movement. They are responsible both for providing a large number of people with goods as well as functioning as nodes of transportation, which enable the transportation of goods that do not originate from or serve these cities themselves. As a result, traffic caused by freight movement burdens cities and diminishes the quality of life of their inhabitants. Negative agglomeration effects can seriously hamper efficient supply and distribution of goods, particularly in rapidly growing cities with a high population influx, inadequate infrastructures, diminishing resources, and environmental degradation. As a result, growing cities risk losing the advantages of being economic centres and hubs for local, regional, and global logistics.

It is therefore essential to develop a freight logistics system that takes into account not only economic factors, but also the social and environmental dimensions of logistics. As such, a holistic approach to freight logistics is needed for the sustainable development of the freight logistics sector. Otherwise, national, regional, and urban economies and societies will be burdened with high transportation costs and unreliable logistics operations as well as outsized negative externalities (see also Henseler et al. 2017).

Figure 2: The dimensions of sustainable logistics



Source: https://pgallegold.wordpress.com/2011/04/30/logistica-verde/

Green Logistics is commonly understood as primarily emphasising economic payback with some secondary positive environmental effects (e.g. load optimisation, efficient transportation, or route enhancement). By moving beyond the economic dimension and encompassing all three perspectives of sustainability into the concept of a functioning logistics sector, economic reasoning can be complemented by social and environmental aspects.

The GLI:X Green Logistics Indicators System, which has been developed in the framework of a research project funded by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, in a collaborative process with stakeholders from different sectors, takes this holistic perspective on freight transport and brings the immediate economic goals of freight logistics – cost-effectiveness, speed and competitiveness – in line with broader, but nonetheless urgent development goals, such as environmental protection, socio-economic development, and the safety and security of individuals and the urban environment (see also Henseler et al. 2017).

1.1 Recent Trends in Logistics

Like most other industries, transport and logistics are currently confronting immense changes: new technologies, new players, increasing customer expectations and new business models entering the market (Wehner 2018). Both individuals and businesses expect to receive goods faster, with more flexibility, and – in the case of consumers – at low or no delivery cost. Manufacturing is becoming more and more customized, which can be challenging for the logistics industry as they must deliver a better service at an ever-lower cost (Halldórsson et al. 2019). The following is a brief outline of some important trends in the logistics sector in recent years.

1.1.1 Sustainable Logistics

The climate objectives constituted in the Paris Climate Protection Agreement are forcing all logistics providers and users to rethink their strategies and mind-set. Many countries are enforcing new policies to reduce their CO2-emission levels. Stricter emission regulations and access restrictions for diesel vehicles, especially in the central districts of large cities, require logistics companies to invest in alternative drive systems and the electrification of logistics fleets, as well as the introduction of new low-energy modes for deliveries on the last mile (e.g. cargo-bikes). This development creates new opportunities for e-mobility and other new energy sources (Hoffmann 2010). The development and use of more efficient engines, which are made

of energy-efficient sustainable materials i.e. lightweight construction to improve energy efficiency of vehicles, will also gain increasing relevance in the future (Centobelli & Cerchione 2018). Another trend is smart containerization, i.e. the development of a variety of intelligent, modularized and variably-sized containers which enable a more efficient load utilization.

1.1.2 Urban/Rural Logistics Concepts

Urban logistics concepts

Increasing urbanization is fundamentally changing the supply concepts of metropolitan areas. By 2050, urban populations will account for more than 70 percent of the global population (UN DESA). A further challenge is the fact that urban space is susceptible to potential conflicts between different stakeholders, as a high population density is accompanied by limited tolerance for infringements and disturbances.

Under these demographic conditions, new strategies have to be developed to ensure efficient inner-city freight movements and innovative responses to increasing urban customer and business demands for on-demand and on-time deliveries.

More and more cities face the limits of their transport capacities, while logistics service providers are simultaneously facing increasingly competitive environments with lower margins and higher costs. However, logistics service providers can harness new business potential through e-commerce, e-food and multichannel trade, innovations in vehicles and logistics technologies and innovative pilot projects. Urban logistics - and in particular delivery on the last mile - is a disproportionately growing segment with a large number of stakeholders. The challenge is to find a balance of interests between growth, sustainability, urban infrastructure, and citizen acceptance in order to establish efficient and environmentally friendly urban freight transport systems (Frost & Sullivan; Gonzalez-Feliu et al. 2014).

Rural Logistics Concepts

While increasing urbanization is fundamentally changing the supply concepts of conurbations, at the same time the supply and better connection of the rural population to the main transport routes must be ensured. The challenge of supplying rural populations with everyday goods continues to grow. The interdependence between urban and rural areas is becoming increasingly important for the supply of rural products due to social and ecological factors. Therefore, the development of the rural economy is a key factor, and one which is attracting more and more recognition within the newly emerging logistics trends. This development is increasingly being driven by politics, alongside the development of the digital infrastructure. If areas outside conurbations are not to be left behind, alternative concepts must be developed which, in terms of logistics, are less geared towards the classic metric of speed, but rather to punctuality. Note: currently about 50 % of the production in the rural areas of Africa is still wasted in the farmlands, as the logistics are poorly or not at all available. (Transport times, cold chains, border crossings).

1.1.3 Smart Sharing Logistics Services

New market players, for example start-ups, IT companies, and established groups with a new market focus/new target group, are expanding and changing the range of logistics offerings and finding ways to cut out unnecessary costs in the value chain by exploiting digital technologies or new ‘sharing’ business models. As an additional advantage, they don’t have asset-heavy balance sheets or ponderous existing systems weighing them down. From Uber-style approaches for last-mile delivery, to more formal Joint Ventures and partnerships at corporate level, the whole sector is redefining collaboration (Gesing 2017).

This offers new possibilities for sharing economy approaches in logistics, such as real split storage, sharing of transport capacities, shared fleets and sharing logistics data. Logistics service providers in particular operate comprehensive transport and delivery networks and are able to provide high-quality data on current delivery processes. At the same time, sharing platforms collect a large amount of data on many different logistics processes. This data should be collected and evaluated (data mining) in order to identify new trends or to supply cities more efficiently with goods, and thus enable a more environmentally friendly supply chain (ibid).

1.1.4 Smart Data for Logistics

Industry 4.0 is currently becoming a central topic for South Africa. This gives logistics the opportunity to use the associated development of new ICT infrastructures for its own urgently needed optimization.

Smart Logistics, or Logistics 4.0, can be understood as the networking and integration of logistics processes – inside and outside of production facilities or trading companies – under the decentralized real-time control of logistics networks.

A component of a Logistics 4.0 solution is the Cyber Physical System (CPS), consisting of embedded systems that are networked via communication networks. The "endpoints" are man and material. However, it also includes assistance systems and devices with local intelligence and decision-making capabilities (e.g. detectors, cameras, telematics systems, self-propelled cars) (Panetto et al. 2019).

The networking of logistics processes enables better supply chain visibility with greater transparency in the supply and dispatch chain. In the longer term, however, the cargo itself could also become intelligent and organize its own transport autonomously.

The goals of Logistics 4.0 are cross-company automation and optimization, both in material flows and in the use of resources in inbound and outbound logistics. This results in a flexibilization of processes, business models and partner networks, all of which are developed jointly.

1.1.5 Intermodality

Intermodality and co-modality are important issues that have come to the forefront of considerations of efficiency and environmental compatibility. These concepts emphasize the benefits of different modes of transport (e.g., between rail and road), which are coordinated and therefore keep handover times and costs (for passenger and freight transport) between modes to a minimum. In general, intermodality is becoming more and more important, especially in logistics and freight handling (FLAVIA/Allianz pro Schiene (2011); PWC, Transport und Logistik Trends 2019. Havenga 2012).

2 Why Logistics Indicators?

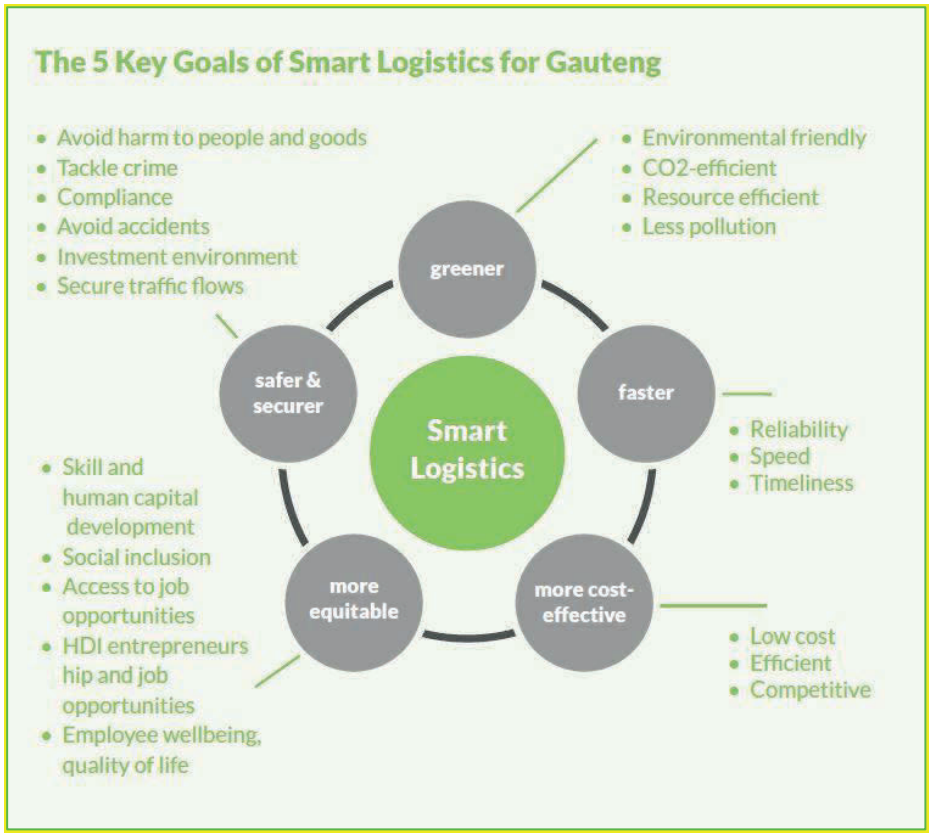
Indicators are measurable values that describe a certain phenomenon and indicate the change of this phenomenon over the course of time. Composite indicators, i.e. the aggregation of individual or sub-indicators, are designed to enable the measurement and quantification of complex phenomena, such as freight logistics, in a simplified manner. Composite indicators, when well designed, offer a condensed view on a certain phenomenon or topic. By condensing complex phenomena into one or few easily digestible figures, composite indicators provide a tool for communicating complex topics in a structured and simplified way. Although their design involves some subjective judgments, e.g. concerning the selection of the indicators, the weighting of indicators, the choice of the aggregation model etc., they are very useful for visualising developments and the dependencies between developments (see also Henseler et al. 2017). In recent years many indices (composite indicators) have been developed for cities that analyse, measure, and compare cities or regions with each other. They compare different cities using the same indicators and are often used to create rankings of these cities.

Contrary to this approach, a present-to-future indicator system, such as the GLI:X indicators system, compares the present with the future – or the past with the present respectively – to show a development over time in a certain area using indicators that are representative for this area. For policymakers, these indices facilitate measuring the success of policies or strategies, while leaving open for discussion which strategies to use to foster development.

2.1 The GLI:X Green Logistics Indicators System

To face the challenges in urban logistics, evidence-based tools are needed to inform, guide, and evaluate policies, and thereby improve decision-making. The "GLI:X Green Logistics Indicators" indicator system was developed in close cooperation with local stakeholders in the metropolitan region of Gauteng, South Africa. Specifically, it was developed in conjunction with the Gauteng Province Department of Roads and Transport within a project funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. The GLI:X Indicator System represents a broader trans-sectoral perspective on freight logistics and is thus structured with five main goals, following the three dimensions of sustainability: *cost-effectiveness* and *time and speed* (economic sustainability), *environmental prot*ection (ecological sustainability) and *safety and security* and *equitability* (social sustainability). Each of these goals is addressed by sub-indicators, which can best describe and measure the extent to which the goals are achieved. The goals and set of indicators were determined in a participatory process, bringing local stakeholders from various sectors and institutions together, thereby fostering cooperation and communication. The indicator system provides a tool for policy decisions pertaining to the design of efficient logistics transportation systems to meet societal objectives.

Figure 2: The Five Key Goals of the GLI:X Indicators System



Source: own illustration, GESI/nexus

2.2 Standards and Sustainability: Outline some of the key standards and standardization institutions in the field of logistics

The GLI:X Indicator is based on a set of individual indicators and thus also represents a "system of systems", with the goal of bringing the immediate goals of freight logistics – cost-effectiveness, speed, and competitiveness – in line with broader, but urgent development goals, such as environmental protection, socio-economic development, and ensuring a safe and secure urban environment.

By taking this trans-sectoral approach, the GLI:X Indicator unites logistics standards and “De facto” standards and norms with the norms and standards of various areas e.g. environmental protection and socio-economic development. Logistics itself is already a very complex system that is held together, structured and re-optimized by thousands of standards and norms that enable smooth interaction.

According to the German Institute for Standardization (DIN e.V.) in Germany, for example, there are approximately 34.000 DIN standards available; worldwide, there are about 22.000 ISO standards in use (Din, no date). The economic benefit of the current body of standards amounts to 16.77 billion euros a year (Din 2011). This is achieved by the manifold effects corresponding to the use of standards. Specifically, standards protect the safety of the community, facilitate international trade, enhance the interoperability of technologies and processes, and facilitate technological change and economic development by reducing information asymmetry (Hesser et al. 2006). The positive economic impacts of standards extend well beyond financial benefits. In addition to the economic growth generated through the function of standards as diffusers of knowledge, there are further benefits gained through other functions of standardization.

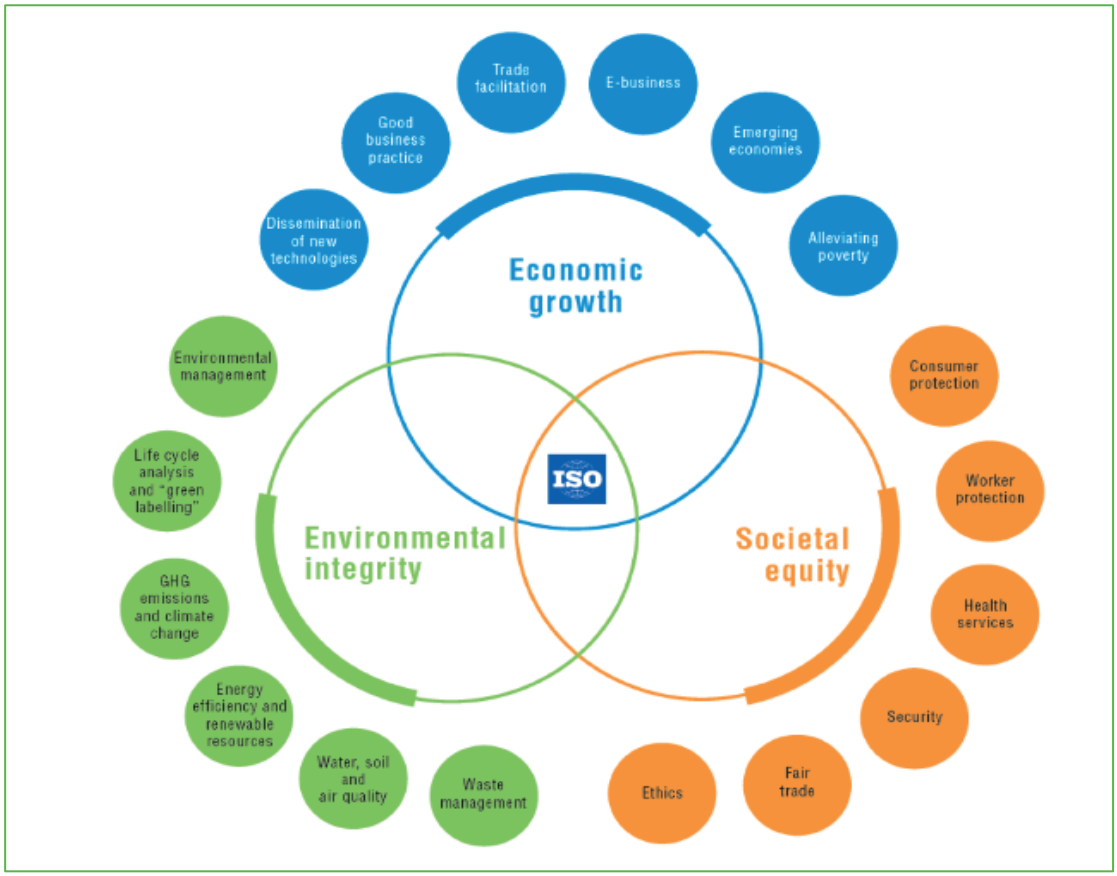
Trade and freight logistics as a facilitator also play a critical role in achieving the sustainable development goals; the movement of goods and services across borders, as well as flows of technology, ideas and people, enables progress towards ending poverty, improving economic growth and job opportunities, and reducing global inequality.

In 2015, the United Nations launched its 2030 Agenda for Sustainable Development and its corresponding 17 Sustainable Development Goals (SDGs) (United Nations 2016). This action plan to enhance peace and prosperity, eradicate poverty and protect the planet is recognized globally as essential for the future sustainability of our world. In order for the SDGs to be successful, the process requires consensus, collaboration and innovation and calls on the contribution of all elements of society, including local and national governments, business, industry and individuals.

According to Fruman (Fruman 2016), standards, such as the ones developed by International Organization for Standardization (ISO), can help ensure that trade makes the greatest possible contribution towards achieving the SDGs. Standards build confidence in the quality and safety of traded products (especially those from developing countries) by proving that they adhere to certain requirements, level the playing field on environmental issues, help protect consumers from harmful practices, and help small and medium enterprises compete internationally by spreading technology and best practices.

ISO's portfolio of more than 22.000 standards contributes to sustainability as the standards cover all three dimensions of sustainable development: economic, environmental, and societal (Fig.3). They contribute to economic sustainability by facilitating international trade, improving a country's national quality infrastructure, and supporting sustainable business practices. Social sustainability is ensured by helping countries and communities to improve the health and well-being of their citizens. ISO Standards cover all aspects of social welfare, from healthcare systems and related products to social inclusion and accessibility. Lastly, ISO International Standards promote environmental sustainability by helping businesses and countries manage their environmental impact and by providing recommendations for how to implement an environmental management system, measure and reduce greenhouse gas emissions and energy consumption, and encourage responsible consumption (ISO 2018).

Figure 3: ISO Standards: The three pillars of sustainable development



Source: ISO, 2015

The following provides a brief outline of the most important national and international institutions and existing key strategic standards and illustrates their immediate or possible impacts for the logistics sector.

To facilitate the reading, first a brief clarification of the terms used in this chapter:

A "standard"[1] is a document that specifies requirements for products, services and/or processes, laying down their required characteristics. This helps ensure the free movement of goods and encourages exports. Standardization promotes efficiency and quality assurance in industry, technology, science and the public sector. It serves to safeguard people and goods and to improve quality in all areas of life. Standards are developed in a consensus-based process organized by a recognized standards body. (DIN EN 45020:2007-03, Standardization and related activities; Din e.V.n.d) Standards are considered voluntary because they serve as guidelines, but do not of themselves have the force of law. Standards become mandatory when they have been incorporated into a business contract or incorporated into regulations.

A "De facto standard", in contrast, is quite simply a custom or convention norm that has achieved a dominant position by public acceptance or market force. In comparison to the development of

[1] Unterschied zwischen Norm und Standard: Unterschied im deutschen und englischen Sprachgebrauch: Im deutschen Sprachgebrauch ist in den letzten Jahren eine Begriffsverwirrung eingetreten, indem "Standard" analog dem englischen Begriff "Standard" auch für Normen verwendet wird. Im englischen Sprachraum fungiert der Begriff „Standard" als Oberbegriff und durch Hinzufügung der Adjektive „public" und „De facto" kann, falls notwendig, die Unterscheidung erfolgen. Das bedeutet: die Internationalen, Europäischen und Nationalen Normen sind im deutschen Sprachgebrauch "Normen" (und keine "Standards"), denn sie werden im Konsens und mit dem Normungsverfahren einer anerkannten Normenorganisation erstellt und veröffentlicht. Wenn im englischen Sprachraum der Terminus z.B. „DIN Standard" verwendet ist, so ist damit die deutsche „DIN Norm" gemeint. Der deutsche Begriff „Standard" dagegen kann von einem geschlossenen Kreis von Unternehmen oder auch nur einem Unternehmen unter Ausschluss der Offentlichkeit entwickelt werden. Im englischen Sprachgebrauch lautet die genaue Übersetzung dafür „De Facto Standard" oder auch „Industry Standard" (MbĀius, H; Möbius, M.2008).

standards, the development of De facto standards is not necessarily linked to a procedure, set of rules or the consensus of all interested stakeholders. Thus, especially in areas with a high degree of innovation, the rapid standardization process can promote and accelerate knowledge and technology transfer, therefore De facto standards can be developed much faster than standards. Many De facto standards are later adopted by international standardization organizations and converted into an official standard. For example, the term “industry standard”-refers to technical solutions that have proven useful. They are therefore supported by a large number of manufacturers and used by numerous users.

A norm is an accepted pattern or a way of behaving or doing things that most people do (Cambridge Dictionary n.d.).

2.2.1 German Logistics Standards

2.2.1.1 German Institute for Standardization (DIN e.V.)

Every European country has, in addition to the international standards, its own national standards. In Germany, the German Institute for Standardization (DIN e.V.) is the independent platform for standardization. “As a partner for industry, research, and society as a whole, DIN e.V. plays a major role in supporting the marketability of innovative solutions through standardization - be it in topics around the digitization of business and society or in the context of research projects” (DIN n.d.). DIN e.V. develops standards for virtually every field of product manufacture and development.

In 2015, DIN e.V. published a "Standardization Roadmap Logistics” (DIN 2015) to provide a detailed overview of existing comprehensive standards and regulations in every aspect of logistics. This roadmap also outlines special ongoing projects and provides an outlook on the general and sub-area-related need for standardization and regulation, with a focus on green transport and smart cities solutions (DIN 2015). To elaborate on these in detail would be beyond the scope of this paper. The following is a selection of some of the most significant standards applied for green sustainable logistics to provide an idea of the different aspects. Since the majority of them have already been recognized as European standards, they are outlined in the respective section.

DIN EN 16258 (Methodology for calculation and declaration of energy consumption and GHG emissions of transport services (freight and passengers):

The first approaches to green logistics were made in standardization with DIN EN 16258. This standard, which applies throughout Europe, describes a method for calculating and declaring energy consumption and greenhouse gas emissions for transport services (freight and passenger transport).

DIN EN 13427 to DIN EN 13432 (Packaging - Requirements for the use of European Standards in the field of packaging and packaging waste):

As green logistics is a comprehensive approach, all elements of the logistics chain are relevant. Thus, packaging standardization is also a link between environmental policy objectives and economic necessity. Packaging standards protect the environment and reduce costs. An example of such packaging standards is the DIN EN 13427 to DIN EN 13432 series of standards for prevention, re-use and recycling options.

2.2.2 European Logistics Standards

In the EU, the harmonization of national standards is now a priority. Standards adopted at European level are labelled with the abbreviation EN. National standards are given the appropriate suffix. Today, new standards are enacted on a Europe-wide basis.

These standards must be incorporated by the member countries into their national body of standards and other national standards must be withdrawn.

2.2.2.1 European Committee for Standardization (CEN)

The European Committee for Standardization, CEN, is an association that brings together the national standardization bodies of 34 European countries. It is one of three European Standardization Organizations (together with CENELEC and ETSI) that have been officially recognized by the European Union and by the European Free Trade Association (EFTA) as being responsible for developing and defining voluntary standards at the European level. CEN provides a platform for the development of European Standards and other technical documents in relation to various kinds of products, materials, services and processes.

DIN CEN/TS 16157 (Intelligent transport systems - data exchange specifications for traffic management and information):

In 2016, the European Commission adopted a draft mandate for the creation of new European standards in the field of "intelligent transport systems" (European Commission, M 546).

Parts of this subject have already been dealt with in existing European and international committees, such as:

DIN CEN/TS 16157-1 Intelligent Transport Systems - DATEX II Data Exchange Specifications for Traffic Management and Information - Part 1: Context and Framework structure.

This draft mandate also includes a number of standardization activities in the field of multimodal information services and urban logistics, for which technical specifications (CEN/TS) and/or European standards (EN) do not yet exist. The European Commission has recently adopted new rules to speed up the introduction of co-operative Intelligent Transport Systems (C-ITS) on Europe's roads (European Commission).

Intelligent Transportation System (ITS) are applications that apply advanced technologies of electronics, communications, computers, control, sensing and detecting in all kinds of transportation system in order to improve safety, efficiency and service, and traffic. C-ITS is an addition to ITS, with a particular focus on digital technologies placed roadside or in vehicles. C-ITS focuses on the communication between those systems – be it a vehicle communicating with another vehicle, with infrastructure, or with other C-ITS systems.

2.2.3 International Logistics Standards

The importance of international trade and cross-border logistics requires international regulations and standards in the areas of transport law, liability and insurance. Most rules are enforced through the multilateral cooperation of states or by supranational organizations like the United Nations and its transport related agencies, the FIATA (International Federation of Freight Forwarders Associations) or the IRU (International Road Transport Union).

In the field of environmental protection and management, many regulations are based on international agreements. These agreements require signatory states to abide by and enforce certain environmental standards.

2.2.3.1 International Organization for Standardization (ISO)

The International Organization for Standardization (ISO) is an independent, non-governmental international organization with a membership of 164 national standards bodies. It was founded in order to "facilitate the international coordination and unification of industrial standards" that support innovation and provide solutions to global challenges (ISO n.d.). More than 22.000 international standards belong under its auspices (for a detailed list refer to ISO Standards Catalogue: ISO Standards Catalogue, no date). ISO standards can be incorporated into national standards. However, there is no obligation to do so.

ISO 14000 ff (Principles of environmental management):

The ISO 14000 ff series of environmental standards concern environmental management issues related to production processes and services and can be directly applied to logistics companies. Mostly quoted as:

- ISO 14000 Principles of environmental management
- ISO 14001 certification standard and operating guidelines

This means the identification and control of the effects on the environment, the improvement of the environmental compatibility as well as the systematics of the environmental objectives. The aim is not to set a level system, but to create a holistic and strategic framework: an environmental management system.

ISO 14000 is the one of the most popular and widely used international standards. This is due to the increasing awareness of negative impacts on the environment and the subsequent need to meet the goals of sustainability.

ISO 14064 (Greenhouse Gases):

This international standard enables organizations to quantify and report greenhouse gas (GHG) emissions and removals in the global pursuit of combating anthropogenic climate change. (Ansi Blog 2019)

ISO 14067 (Greenhouse gases - Carbon footprint of products):

Requirements and guidance for quantification (ISO 14067:2018): This document specifies principles, requirements and guidelines for the quantification and reporting of the carbon footprint of a product (CFP), in a manner consistent with international standards on life cycle assessment (LCA) (ISO 14040, ISO 14044).

ISO 18601 to ISO 18606 (Packaging standards and the environment)**:**

One issue facing households, local authorities, and landfills is packaging from purchased items. ISO has published several Standards on packaging and the environment.

This is an example that there are sometimes European standards (DIN EN 13427 to DIN EN 13432) and international standards (ISO 18601 to ISO 18606) with almost the same content. For this reason, reference can be made to the international series of standards ISO 18601 to ISO 18606 in the international, i.e., non-European, movement of goods. The European standards DIN EN 13427 to DIN EN 13432 are still to be applicable to intra-European goods traffic.

ISO 26000 (Guidance on social responsibility):

The goal of ISO 260000 is to contribute to global sustainable development by encouraging business and other organizations to practice social responsibility to improve their impacts on

their workers, their natural environments, and their communities. It provides guidance rather than requirements, unlike other well-known ISO standards (ISO n.d.).

It was developed in a participative way by a wide variety of different interests. The working group of about 500 experts were drawn from about 80 countries and international organizations, such as Consumers International and the International Organization of Employers. To ensure consistency, ISO has also entered into special agreements with the International Labor Organization (ILO), the Global Compact, the Global Reporting Initiative and the Organization for Economic Cooperation and Development (OECD). As a result, ISO 26000 is probably the most inclusive sustainability standard in regard to the issues it covers ((ISO n.d.). These range from environmental issues and the use of the precautionary principle to organizational governance. Additionally, the standard directly addresses human and labor rights as well as corruption, fair competition and consumer concerns.

The environmental section not only addresses the precautionary approach and environmental risk management, but also is concerned with the promotion of substantive performance, directly applicable to companies, in the areas of sustainable procurement, adoption of environmentally sound technologies and control of climate change impacts. (ISO n.d.).

The standard also makes use of the concept of "sphere of influence" since it is both intuitive and productive in areas of responsibility that are not addressed in law.

As mentioned, is also intended for any sort of organization: large or small, for companies from any industry, for the public sector and for the third sector. While there is some disagreement about how successfully it has met the needs of smaller organizations (Schwarz & Tilling 2009), it is perhaps its applicability to the public sector that is most interesting.

2.2.4 South African Bureau of Standards (SABS)

The South African Bureau of Standards (SABS) is a South African statutory body that was established in terms of the Standards Act, 1945 (Act No. 24 of 1945) and continues to operate in accordance with the latest edition of the Standards Act, 2008 (Act No. 29 of 2008) as the national institution for the promotion and maintenance of standardization and quality in connection with commodities and the rendering of services. It develops, promotes, and maintains South African National Standards (SANS). (SABS, no date)

Internationally, SABS experts represent South Africa's interests in the development of international standards, through their engagement with bodies such as the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). South Africa was a founding member of ISO.

SANS 1395-1:2019 (RTMS national standard):

RTMS is an industry–led, government-supported, voluntary, self-regulation scheme that encourages consignees, consignors & road transport operators to implement a management system (a set of standards) that demonstrates compliance with the Road Traffic Regulations and contributes to preserving road infrastructure, improving road safety & increasing productivity.

Since the standard was launched, it has become increasingly apparent that contractors and consignees are increasingly choosing companies that can verify that they have successfully completed the SANS 1395 RTMS compliance assessment process. In doing so they show that each of their vehicle poses a minimal risk to the road infrastructure, the environment and other road users, and giving them a competitive edge.

The four key components of the RTMS standard are:

- loading control
- safety & compliance
- driver wellbeing
- training and development

These four pillars have been incorporated into ten elements of the standard as followed:

- Fleet inventory
- Load assessment and verification
- Road safety maintenance of roadworthy vehicles
- Vehicle and load safety
- Health and wellness
- Support (training and HR management
- Documents and records
- Performance evaluation
- Continual improvement -efficiency and road safety

SANS/ISO 14000 and SANS/ ISO 14001 (Principles of environmental management):

This previously mentioned series of environmental standards, related to environmental management issues, represents SABS' active support of environmental conservation (SABS n.d.)

Highlighting the relevance of standards aiming to green the transport and logistics sector, the South Africa Green Transport Strategy, which was released in 2018, mentions the necessity of developing climate change response norms and standards as one of five implementation themes[2] that have to be addressed to achieve the country's 2030 vision of ensuring a just transition to a sustainable low-carbon economy. According to the Green Transport Strategy implementation plan, South Africa aims "to develop norms and standards for climate change response at national, provincial and local level and to promote strategies and standards for delivering transport infrastructure, integrated transit planning and systems that build climate resilience, whilst minimizing the environmental impact of transport infrastructure" (Green Transport Strategy, p.25).

2.2.5 Conclusion

The implementation of standards increases access to international markets, as large multinational corporations base their contracts with first and second tier suppliers on product standards, as well as on their adherence to common process standards. International standards contribute to reducing technical and procedural barriers to trade and minimizing transaction costs by helping the transition from country-specific specifications to globally applicable ones. Thus, standards play a key role in the United Nations Sustainable Development Goal 17 to

[2] For details, please refer to Figure 10.

"promote a universal, rules-based, open, non- discriminatory and equitable multilateral trading system" (ISO 2016).

Developments in recent years have shown that the focus of the logistics sector on ecological aspects is becoming more and more important, be it due to legal requirements, marketing strategies or in order to stimulate economic optimization with ecological aspects. Standards are suitable in all cases where interfaces or processes are needed to develop optimization potentials. Specifications are ideal for introducing new, innovative approaches to the markets.

With the publication of a few relevant standards in the field of green logistics, standardization organizations have been able to make an important contribution to the design of corresponding business concepts. DIN EN 16258 - a method for calculating and declaring energy consumption and greenhouse gas emissions for transport services- for example, is an important tool for the ecological optimization of logistics chains. The same applies to ISO 14067, which provides guidelines for the quantification and reporting of the carbon footprint of a product.

ISO 14000, the standard for environmental management systems, is one of the most popular standards worldwide due to the increasing awareness of negative impacts of businesses on the environment and thus the subsequent need to meet the goals of sustainability. The same applies to ISO 26000 on social responsibility as an example of a standard contributing to sustainable development.

According to Fruman (2016), there are two powerful ways in which ISO standards contribute to achieving the SDGs. First, by helping to increase developing country participation in trade – failing to do this is one of the greatest barriers to investment and outsourcing. Second, as a vessel for practical solutions to implement the SDGs.

Fruman emphasized that promoting standardization is therefore an important goal for the World Bank Group: "As we intensify our work in the area of standards, together with ISO and many of you represented here today... closer cooperation and support, especially for developing countries, will be needed to maximize the opportunities that exist."

From the World Bank Group perspective, there are three pillars key to meeting the SDGs. Standards can contribute to all of them.

- The first is data: A more rigorous and systematic approach to collecting and utilizing data to make fact-based decisions, diagnose problems and monitor progress is needed.
- The second is financing: Official development support is not enough; it needs to be complemented by a much greater focus on domestic resource mobilization. Standards can draw private investment.
- The third pillar is implementation backed by partnerships. There is a need to strengthen existing partnerships and form new ones" (Fruman 2016).

Although there are minor differences between national and international standards, they largely follow a similar goal of ensuring an efficient, secure and sustainable logistics process. Even so, by now, none of the existing international standards truly address the full range of issues that must be taken into account when considering the international and multi-modal nature of the logistics sector. So, there is still need for improvement.

At the same time, in addition to national, European and International standards, De facto standards are often being developed in the field of innovation in order to gain competitive advantages with their use. In subsequent stages, there is a possibility that public standards might be developed based on these industrial standards. However, nowadays, the development

through digitization is a very dynamic and fast process. Thus, industry standards - even ones already applied in practice - do not always turn (or cannot turn) into a general standardization process due to very long development procedures and voting processes in the standardization committees. Therefore, it is always important to keep recent logistics mega trends as described above and their De facto standards in mind.

The high political importance that South Africa attaches to the standardization processes of its transition to a green sustainable economy can be seen in the Green Transport Strategy. One of the five implementation themes[3] of South Africa's Green Transport Strategy is the creation of environmentally friendly and resource-efficient logistics standards during the next five to seven years through the ecological optimization of supply chains with the help of climate change response norms and standards.

[3] The five implementation themes of the Green Transport Strategy: 2018-2050 are: climate 1). Change responds norms and standards, 2). Green roads, 3). Green rail, 4). Green transport technologies and 5.) Green fuel economy standards.

3 Literature Review

3.1 Sustainable Logistics in Developing Countries – Main Challenges

As mentioned above, the freight logistics sector is crucial for the organization of the everyday lives of people, for social participation, and for economic exchange processes. However, it also causes negative side effects such as congestion of roads, emissions, and other dangers to the environment and people. Therefore, an efficient, reliable and sustainable freight logistics sector is essential to economic growth and competitiveness, as well as to the quality of life (see Henseler et al. 2017).

Logistics services and transportation infrastructure in most low and middle-income countries are often described to be poorly maintained and managed. Transportation times can be extraordinarily long, which can be contributed to several factors such as quality of infrastructure, red tape and bureaucratic delays as goods move across borders (Buyonge & Kireeva 2008). Despite ongoing efforts of the SADC to align customs procedures, there is still much work to be done. Additionally, transport and insurance costs as percentage of trade value are rather high in comparison to the average of all OECD countries, and especially high for landlocked developing countries (Havenga 2010). This has a negative impact on the economic development of logistics activities, which are often strongly export-oriented. Due to limited funds and expertise, improvements often can only be induced in a very basic way (Yildiz 2014).

This stands in direct contrast with the global agreements to the 2030 Agenda for Sustainable Development to achieve the 17 Sustainable Development Goals. The 2030 Agenda points out that sustainable transport plays a crucial role in fighting climate change, reducing air pollution or improving road safety. Moreover, it supports inclusive growth, job creation, poverty reduction, access to markets, the empowerment of women, and the well-being of persons with disabilities and other vulnerable groups (United Nations 2016).

Sustainable development of the transport and logistics sector faces several challenges in all countries. However, researchers and other observers of the logistics sector in low and middle-income countries conclude that those countries need support "… to ensure that their pathway to development follows a well-planned route that fulfils the social, economic and environmental needs and aspirations of current and future generations" (United Nations 2016).

The challenges faced by developing countries related to the demanded increase in the sustainability of the logistics sector can be demonstrated in the following four thematic fields of necessary action. They include ten recommendations that were compiled by the above-mentioned Advisory Group on Sustainable Transport of the United Nations in 2015. This group was appointed by the UN Secretary-General Ban Ki-moon to provide this set of recommendations on how the transport sector can advance sustainable development. The group describes a holistic, multi-dimensional concept of sustainability and supports an integrated planning approach - emphasizing security, safety and technological aspects - that is embedded in a monitoring and evaluation framework. Its members have built their recommendations based on the observations of the mobility sector on a global scale. They were looking at larger trends of urbanization, demographic shifts and globalization as well as at technological progress in digital connectivity in the transport sector as a whole. They also took a closer look at the logistics and freight sector that form part of the transport sector. Examples included in their analysis report are studies of the challenges linked to the 'Last Mile' deliveries in cities, trade logistics at ports, or of large-scale freight corridors in India. Also, the results of the research undertaken by the Global Logistics Emissions Council were taken into consideration for the formulation of their following ten recommendations:

10 recommendations of the United Nations High-Level Advisory Group to advance sustainable transport

POLICY DEVELOPMENT AND IMPLEMENTATION

1. Make transport planning, policy and investment decisions based on the three sustainable development dimensions—social development, environmental (including climate) impacts and economic growth—and a full life cycle analysis.
2. Integrate all sustainable transport planning efforts with an appropriately balanced development of transport modes: integration vertically among levels of government and horizontally across modes, territories and sectors.
3. Create supportive institutional, legal and regulatory government frameworks to promote effective sustainable transport.
4. Build technical capacity of transport planners and implementers, especially in developing countries, through partnerships with international organizations, multilateral development banks, and governments at all levels, to ensure equitable access to markets, jobs, education and other necessities
5. Reinforce efforts toward preventing road traffic deaths and injuries.
6. Foster an informed, engaged public as a crucial partner in advancing sustainable transport solutions.
7. Establish monitoring and evaluation frameworks for sustainable transport and build capacity for gathering and analyzing sound and reliable data and statistics.

FINANCING

8. Promote diversified funding sources and coherent fiscal frameworks to advance sustainable transport systems, initiatives and projects.
9. Increase international development funding and climate funding for sustainable transport.

TECHNOLOGICAL INNOVATION

10. Promote sustainable transport technologies through outcome-oriented government investment and policies that encourage private sector investment and action through various incentive structures.

Source: Advisory Group on Sustainable Transport of the United Nations in 2015

3.2 Logistics in Southern Africa

In comparison to most industrialized countries that have experienced continued economic growth and market integration on a global scale, African countries "continue to engage at the periphery of the global economy" (Hartzenberg 2011). This, in turn, affects the ability of logistics operations to compete internationally where, irrespective of distance, goods have to be moved as quickly, reliably and cost-effectively as possible (Tseng et al. 2005). The dire situation of logistics in Africa can be illustrated by the following two examples:

- Shipping a vehicle from Japan to Abidjan (Ivory Coast) costs approximately US$ 1500 whereas shipping that same car from Ethiopia's capital to Abidjan costs more than three times as much (Hartzenberg 2011).

- Moving a container from its place of production to the nearest port and subsequently finalising export procedures takes on average 36 days in the South African Development Community, 116 days in Central African Republic and only 6 days in Germany (Djankov et al. 2006).

In their assessment of logistics challenges in Africa, Hanif and Kaluwa (2016) attribute much of the current problems to a small, fragmented, regional market and the large number of sparsely populated landlocked countries. Landlocked countries have reduced access to global markets, especially as their transport infrastructure development lags behind and national governments have largely focused on improving roads but not rail. All the while, efforts are being made to increase market integration within Africa, and Hartzenberg (2011) points out that African regional integration arrangements such as SADC or SACU "are generally ambitious schemes with unrealistic time frames towards deeper integration". With a multitude of regional economic communities and integration schemes, a complex web of institutions and regulations has been spun that results in inefficiency (Ndulu et al. 2005). Hence, the lack of trade facilitation continues to be an obstacle to improving competitiveness of products from Southern Africa in the regional and global markets.

The high volumes of exports – especially of mineral resources and goods from agricultural production – makes the Southern African region strongly dependent not only on its freight transport routes and networks, but also on international commodity markets. This high dependence on commodities constrains growth, largely owing to commodity price volatility which cannot be controlled by domestic governments and policy making (Sindzingre 2011). Consequently, the rapid economic growth experienced in the region "appears […] to be intrinsically fragile and based on distorted factors rather than sound economic fundamentals" (ibid.). As a result, countries in Southern Africa have difficulties in financing infrastructure development alone and remain reliant on foreign aid. De Bod and Havenga (2010) suggest to focus future investments on improving railway networks as a sustainable and cost-effective means of transport for humans and goods.

This leads to the following questions: What is the status of transportation infrastructure networks in the countries of Southern Africa? How well are they connected, and are there efforts in the individual countries to increase the sustainability of the transportation networks in the region? Answers to these questions are important in assessing the potentials and challenges of transportation logistics in Southern Africa.

The following chapter seeks to give an overview of the conditions of the transport networks in the Southern African region, which is widely understood as the area of Africa south of the Cuene and Zambesi rivers. From those countries, Namibia, Zimbabwe and Botswana were selected as examples to demonstrate the diversity of the transportation conditions, as well as the different conceptions of sustainability. Out of these countries, Namibia stands out due to its strong efforts in developing infrastructure. Zimbabwe and Botswana were chosen because, as landlocked countries, they are strongly dependent on the transportation corridors of South Africa, which connect them to the economic centre in Johannesburg and the ports in Cape Town and Durban. In the Southern African context, South Africa takes on a unique role as a newly industrialized country among its low- and middle-income neighboring countries. Despite being considered wealthy on a per capita basis, severe income inequalities persist, with South Africa being "one of the most unequal countries in the world" (World Bank 2018b).

3.2.1 Zimbabwe

In 2018, 15.3 million people lived in 390,757 km^2, which equals a population density of 39 people per km^2 (GTAI 2018b). Thus, the Republic of Zimbabwe is, as most other countries in Southern Africa, very sparsely populated. Having gained independence in 1965, the country has suffered economic hardship during former President Mugabe's 37-year rule, which was ended by a coup d'état in 2017. In the 2000s, inflation skyrocketed, eventually leading to political instability and the local currency being replaced by the US Dollar in 2009. Varying unemployment rates have been discussed in international and regional media, with figures ranging from 95% to 5%, depending on whether employment in the informal sector is considered as employment or not (BBC 2017, World Bank 2019b, Africa Check 2017). On a positive note, education levels are still well above the African average, although they have fallen as a result of the general economic situation.

Zimbabwe's economy relies heavily on the export of raw materials -especially gold, platinum, coal- and agricultural cash crops such as cotton and tobacco (CIA 2017). Also, nature and landscapes offer interesting destinations for tourists. Until the mid-1990s, these sectors (agriculture, mining and tourism) flourished. During the economic crisis of 2009, the country's economic freedom ranking plummeted and has retained a "repressed" economic freedom status since. In 2019, the economic freedom index ranked Zimbabwe 175 out of 180 countries. Years of economic crises and mismanagement have brought about an overall opaque business environment and low entrepreneurial activity (Miller et al. 2019). With a mean score of 2.17 out of 5 on the Logistics Performance Index[4] (LPI), Zimbabwe has one of the lowest scores worldwide for the period 2012-2018 (World Bank 2018a). Other countries featured in this report also perform stronger on the LPI: Namibia (2.73), Botswana (2.96), South Africa (3.51) (ibid).

Both in terms of export and import, South Africa has become the main trading partner for Zimbabwe in recent years. In 2016, 80% of Zimbabwe's exports and 41% of its imports were transported to and from South Africa (WITS 2017). Among the main import commodities are machinery, chemicals and food products. Concerning exports, other important trading partners are Mozambique, United Arad Emirates and Zambia. The decline in outputs of the mining, agriculture and manufacturing sectors has resulted in a skewed trade balance with the country's imports exceeding its exports. This has had negative effects on the availability of return loads for transport operators. Other major challenges in exporting goods from Zimbabwe are high costs of transport and excessive red tape in customs (CBRTA 2016). In response, the government has increasingly been focusing on expanding the number of one stop border posts with its neighbors South Africa, Botswana and Mozambique (Newsday 2019).

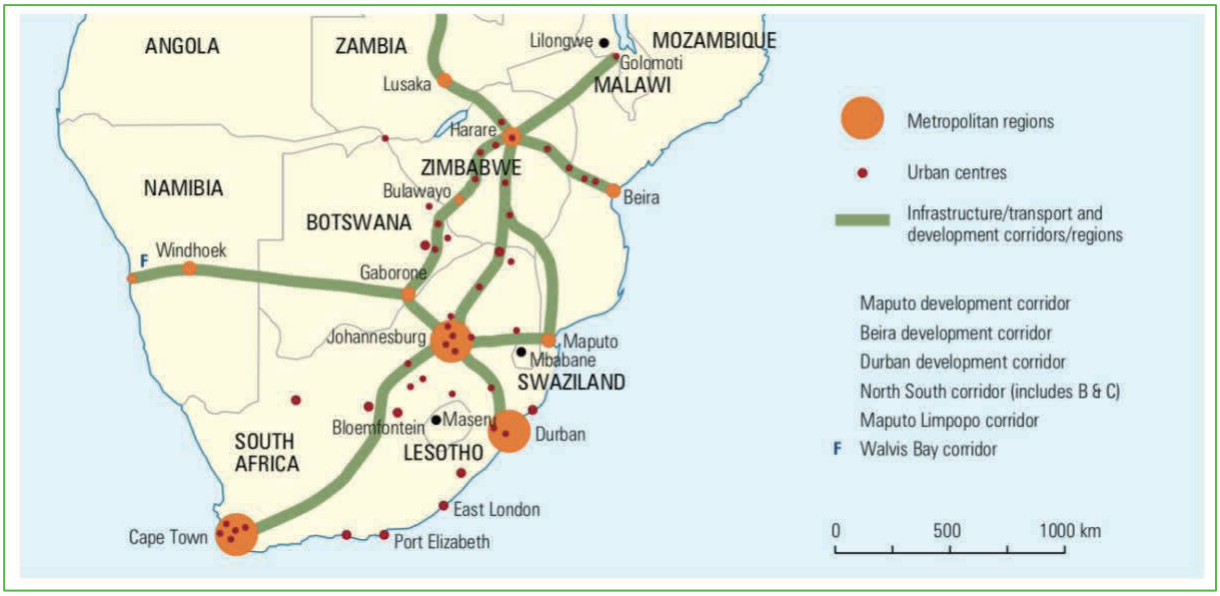
As a result of inadequate maintenance, Zimbabwe's road infrastructure has suffered significantly over the past 30 years, considering that the country was once deemed to have the best road network in Africa. Most trunk and primary roads were constructed in the 1960's and 70's and have outrun their design life. The unavailability of high-grade gravel and financial resources to repair the aging road network have made reconstruction efforts more difficult (Cochran 2018). Currently, there are 88.100 km of roads, of which nearly 20% are asphalted. There are 3.400 km

[4] The Logistics Performance Index is one of the most commonly used indices for logistics based on global data. The World Bank created the Logistics Performance Index (LPI) in 2007 and has been publishing biennial reports since 2010. The LPI comprises an assessment of international logistics along six main indicators on a five-point scale (with five being the top score): 1) efficiency of customs and border management clearance; 2) quality of trade- and transport-related infrastructure; 3) ease of arranging competitively priced international shipments; 4) competence and quality of logistics services; 5) ability to track and trace consignments; 6) frequency with which shipments reach consignees within the scheduled or expected delivery time. As far as logistics services within countries are concerned, the LPI does not provide comprehensive information, due to limited data availability (World Bank 2018a).

of railroad, 3 international airports and no waterways viable for freight transport (AFDB 2011, CBRTA 2016). Most of the traffic and 80% of the trade volume are transported by road (Cochran 2018).

Despite being landlocked, Zimbabwe is strategically located at the heart of Southern Africa with several major corridors converging in the capital Harare: Maputo Limpopo corridor, Beira development corridor, Durban development corridor, North-South corridor and Walvis Bay corridor as shown in Figure 3 (UN Habitat 2010). Thus, there is great potential for Zimbabwe to become a logistics hub within Southern Africa- a project the government is keen to promote. In early 2019, President Mnangagwa signed several agreements with Belarus to construct further roads and railway lines that will connect the Atlantic and Indian Ocean (Dzenga 2019). At present there are no dry ports within the country, but Zimbabwe built a dry port facility at the port of Walvis Bay in Namibia in 2019 (Maphosa 2019).

Figure 4: Main road freight corridors in Zimbabwe



Source: UN Habitat (2010)

Zimbabwe's railway lines run along similar lines as major roads and corridors. Coal and other mining products are the main commodities transported by rail as they account for roughly 40% of freight tons; agricultural products and supplies account for one- third of traffic. However, rail freight has seen a sharp decline from 18 million tons in 1998 to 2.7 million tons in 2009 (AFDB 2011). The railway system suffers from frequent vandalism, as well as an overall antiquated infrastructure that is in dire need of maintenance and recapitalization. As a result, some sections of the rail network are no longer in good condition, especially between Gweru and Harare. The state-owned National Railways of Zimbabwe has accumulated too many debts to pay for its maintenance backlog, let alone invest in new locomotives or signaling systems (Cochran 2018).

Since the 1990s, Zimbabwe's rulers have preferred to enter Public Private Partnerships (PPP) in building and providing infrastructure services. However, this model largely failed due to a lack of government resources (human and financial), currency instability and high political risks among other reasons (AFDB 2011). There has been a renewed push for PPPs in planning transport infrastructure projects, such as the Zimbabwe National Railways Recapitalization Program as well as aforementioned recent agreements with Belarus. It remains to be seen whether foreign investors' reluctance to invest in Zimbabwe will ease as the country's future remains uncertain.

3.2.2 Namibia

Namibia is one of the most sparsely populated countries in the world. In 2016, 2,514,000 people of different ethnicities and demographic groups lived distributed on 824,268 km^2. That corresponds to a population density of about three people per km^2 (UN Statistics Division 2019). In terms of size, Namibia is about one third smaller than South Africa (ca. 1,221,000 km2).

The Foreign Office of the German Federal Government describes Namibia as a semi-presidential democratic republic that is currently considered as politically stable (Federal Foreign Office Germany 2019). The World Bank classified the country as a country of upper middle income whose economy was expected to grow by 2.5% in the year 2018. Despite the fast-growing middle class, incomes are still very unevenly distributed. Also, at a rate of 34%, unemployment remains very high (World Bank 2019a).

The economy of the country is characterized by the presence of numerous mineral resources, such as diamonds, uranium, copper and zinc; by its agricultural production of mainly fish, meat and grape; as well as by growing tourism. Most mineral resources and agricultural goods are exported, resulting in a high export rate of around 43%. In comparison to this, the import rate is roughly 52%. In 2017, half of all goods were exported within the South African Development Community (SADC5), with South Africa being the main trading partner both for exports and imports. Europe represents a little more than a third of exports (CIA 2019a, Trading Economics). Accordingly, the transport, logistics and communications sector experienced the highest growth rate (6.1%) across all business sectors. In comparison: the agriculture, forestry and fishery sector grew by 3.6%, as well as the retail and hospitality sector; the mining and industries sector decreased by 0.3% and the construction sector by 26.5% (GTAI 2018a). The decline of the construction sector follows a building boom and is mainly caused by the government's inability to pay debts owed to contractors (Nakashole 2017). These fluctuations underline the relevance and importance of the transport sector for sustained economic development of Namibia. In addition, Namibia's road quality ranks 31st in the Global Competitive Index and is thus among the best in the world and the best in Africa (WEF 2018). According to the report on the country's status at the Third United Nations Conference on Housing and Sustainable Urban Development - Habitat III in July 2015, the total road network was estimated to comprise roads of a total length of 45.387km, of which 6.387km were paved (Republic of Namibia 2015). The network mainly follows directions aligned in a North-South and East-West grid to connect residential areas as well as road networks of neighboring countries and two container ports in Lüderitz and Walvis Bay. Both ports are administered by the Namibian Ports Authority (NamPort), a state-owned organization established in 1994. Lüderitz, traditionally a fishing port, has a new cargo and container quay that was completed in 2000. The port is strategically located to cater for southern Namibia and the Northern Cape. Walvis Bay, the only deep-sea harbor, is the main port for the country's export and import trade, especially to southern, west and central Africa and Europe (Embassy of the Republic of Namibia, 2019). The transport infrastructure also includes 2.628 km of rail network (GTAI 2018a).

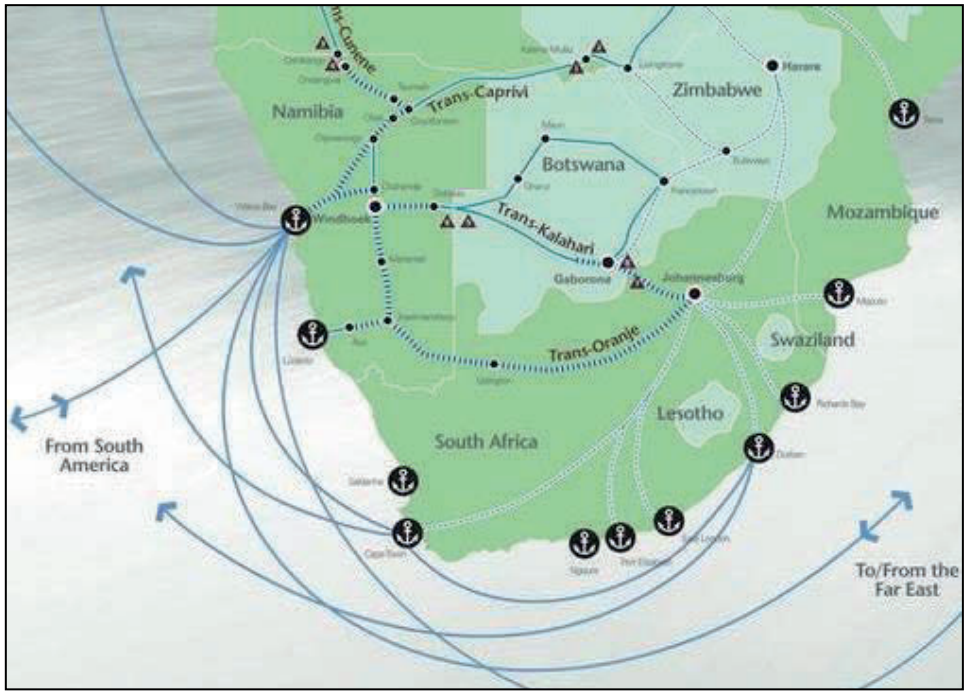
Despite these positive indications, the transport sector also faces a range of challenges. The KfW Group observed that "the traffic routes are not yet comprehensively deployed and the chances of people to participate in social and economic life are to be regarded as low in some regions" (KfW 2016). Also, the UN estimated a fatality rate as a result of motor vehicle accidents of 30.4 per 100k people in 2016, making Namibia one of the countries with the highest per capita death

[5] The South African Development Community consists of the following 15 member states: Angola, Botswana, Comoros, Democratic Republic of Congo, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Tanzania, Zambia and Zimbabwe.

rates worldwide. In comparison, South Africa's rate of 25.9 is only somewhat lower, whereas Germany (4.1) has one of the lowest death rates (WHO 2018).

Emphasizing the relevance of the transports and logistics sector, the Namibian National Development Plan number 4, which was released in 2012, mentions the logistics sector as one of four strategic areas that have to be addressed to achieve the country's vision 2030, which envisages that "industrialization in Namibia, driven by innovation and respect for the sustainability of our environment, will ensure the expansion of the country's capacity to produce secondary goods and services" (NDP4 2012). Furthermore, the NDP4 envisions that, through developing the transport infrastructure, "… by 2017, Namibia shall have a well-functioning, high quality transport infrastructure connected to major local and regional markets as well as linked to the Port of Walvis Bay…." In this context, the Port of Walvis Bay will particularly be expanded. The NDP4 describes the Port of Walvis Bay as "…the preferred west coast port in Africa, as well as the preferred corridor for southern and central African logistics operations" (NDP4 2012). At present, the Walvis Bay Corridor is formed by the TransCaprivi and TransKalahari highways as well as the railway line to Grootfontein (Embassy of the Republic of Namibia, 2019). The figure below shows the relevance of the future development of the Walvis Bay port and corridor for international trade, as well as for the distribution of goods on roads (continued blue lines) and rail (dotted blue lines).

Figure 5: Main Ports in Namibia



Source: Walvis Bay Corridor Group (2018)

The NDP4 also acknowledges sustainability and environmental issues. For instance, it states that Namibia "… fully embraces the notion of sustainable development, i.e. the type of development that meets the needs of the present without limiting the ability of future generations to meet their own needs" and that the "environment is clean, and [Namibia] will continue to keep it so".

For the logistics sector, Namibia has set a number of indicators that were already the subject of setting development targets in the previous version of the plan. Goals foresee the improvement of conditions along these indicators. They mostly address improvements in roads (first three indicators) and improvements of the rail system (four indicators out of ten). For the

environmental perspective of the logistics sector, especially the indicator 'rail coverage' is important, as freight transportation on rail is often considered to be more environmentally sustainable and cause fewer emissions. However, after the NDP3 phase. the goal of expanding to 3,000km could not be achieved. Indicators addressing safer, securer and more equitable logistics are so far not included in the current NDP list of indicators. Also, indicators which directly address environmental friendliness, such as CO2 emissions, primary energy use and decrease of pollution, which are included in the GLI:X indicators system, are not yet included.

Figure 6: Logistics indicators and performances after NDP3 target

Indicators	NDP3 target	Out-turn
Km of rural roads improved to bitumen standard	1,875	1,715
Km of Trunk and Main Roads rehabilitated	1,242	584
% of paved roads in acceptable [very good, good, fair] condition	90	7% Very good 26% Good 59% Fair 7% Poor 1% Very poor (92% acceptable condition)
% of unsealed road in acceptable [very good, good, fair] condition	80	4% Very good 18% Good 49% Fair 18% Poor 11% Very Poor (71% acceptable condition)
Design of non-motorized transport (NMT) policy document	1	0
Freight transported by rail (tons per annum)	3 million	2.15 million (average)
No. of Passengers transported annually (rail)	300,000	6,800 (annual average)
Wagon turn-around time (number of days)	5	8.2 (average)
Rail coverage (km)	3,000 km	2,488
Locomotive Availability	95%	69.5% (average)

Source: National Development Plan 4

Project example for sustainable transportation and logistics

Being aware of the central relevance of the transport sector for the country of Namibia and the above-mentioned goals and challenges, in early 2004, the Namibian Ministry of Works and Transport together with the GIZ (German agency for international cooperation) initiated the project "Strengthening of Institutional and Management Capacity in the Road Transport Sector". The main goal was to support Namibian institutions in achieving Namibia's goals spelled out in its Vision 2030 and its current National Development Plan 4. In this context, GIZ helps to train the personnel of relevant government offices and to improve the state-owned enterprises' organisational development, assists in the implementation of their performance monitoring, to increase the safety on Namibia's roads and to improve Windhoek's public transport infrastructure. The results that could be achieved by June 2016 can be summarized as follows:

Planning frameworks were drafted: The National 'Transport Policy 2016' and the - in the meantime awarded - 'Sustainable Urban Transport Master Plan' was approved by the cabinet already in 2014 and its implementation hast started.

- 24 new public busses were procured jointly by Federal Republic of Germany and City of Windhoek.
- Process of Master Plan Development for Northern Regions has been initiated in 2016
- Capacity Building: The number of enrolled students in civil engineering could be increased to more than 500 in year 2016.
- This project mostly addresses Public Transportation in Windhoek. However, it includes Capacity Building measures that can be expected to have a positive long-term effect on the transport and logistics sector

Especially the statements documented in the Namibian National Development Plan 4, as well as ongoing projects on national level targeting at a sustainable development of the transportation and logistics sector show the direction the Namibian Government has taken towards a sustainable expansion of the transportation network – including infrastructural and capacity building measures (Semar 2016).

The Namibian government has recognized as one of the main challenges for the sustainability of the logistics sector the insufficient funding for transport infrastructure development and maintenance as well as the lack of skilled labour (NDP 5 2017). The sector will have to address its deficits in handling increased volumes of cargo and quality of service to be able to compete with international logistics companies. As Savage et al. (2013) discussed in their assessment of the Namibian logistics sector: "it is good, but not good enough".

3.2.3 Botswana

Botswana has come a long way since gaining independence from the United Kingdom in 1966. Once populated by only half a million people, its population more than quadrupled to 2,333,000 in 2018 (UN DESA 2017). With a surface of 581,730 km^2, it is still one of the most sparsely populated countries in the world. It used to be among the poorest in the world, with an income per capita of less than $100, 22 college graduates and 12 kilometers of tarred road in the late 1960s (Liojanga 2016, Dionne 2016). Since then, it has become "one of the world's development success stories" with an economic growth rate of over 4% in 2018, which it is predicted to maintain until 2021 (World Bank). Most indices, such as the Human Development Index, the Global Peace Index or the Corruption Perceptions Index, have ranked Botswana highest in Sub-Saharan Africa for years (UNDP 2018, IEP 2018, TI 2018). However, despite its high education

expenditure, Botswana still lacks a skilled workforce, resulting in persistently high unemployment rates of about 18% and income inequality (World Bank).

As "Africa's oldest continuous democracy" Botswana is considered to be one of the most stable and investor-friendly countries in continental Africa (Lekalake 2016, GOB 2015). The government pursues a policy of regional integration and maintaining an open economy. Next to good governance, one of the main factors contributing to Botswana's continued economic success is revenue generated from exporting raw diamonds, although this renders the economy vulnerable to fluctuations in the global (diamond) market (Barclay 2009). Sustained economic growth over the last 50 years has brought about higher living standards and increasing imports of consumer and capital goods, which mostly come from South Africa. This trade pattern is also reflected in different modes of freight transport: Whereas 88% of goods are exported via air transport, 68% of imported goods are transported on roads mainly from South Africa. Rail freight transport plays a negligible role both in imports (3%) and exports (1%) (CBRTA 2018).

The rail network totals a length of 886 km and consists of one main line and three branch lines connecting metropolitan areas in eastern Botswana with South Africa and Zimbabwe. By rail, soda ash is the main export item and raw materials for textile industry are main imports to and from South Africa (World Bank 2009). The state-owned Botswana Railways offers the transfer of containerized freight at dry ports in Gabarone, Palapye and Francistown, from which cargo can be shipped to the SADC region. Rail freight traffic has been very volatile in recent years, with a general negative trend. Between the first quarter in 2016 and 2017, imports by rail fell by 18%, exports by 22% and transit traffic by 86% (CBRTA 2018).

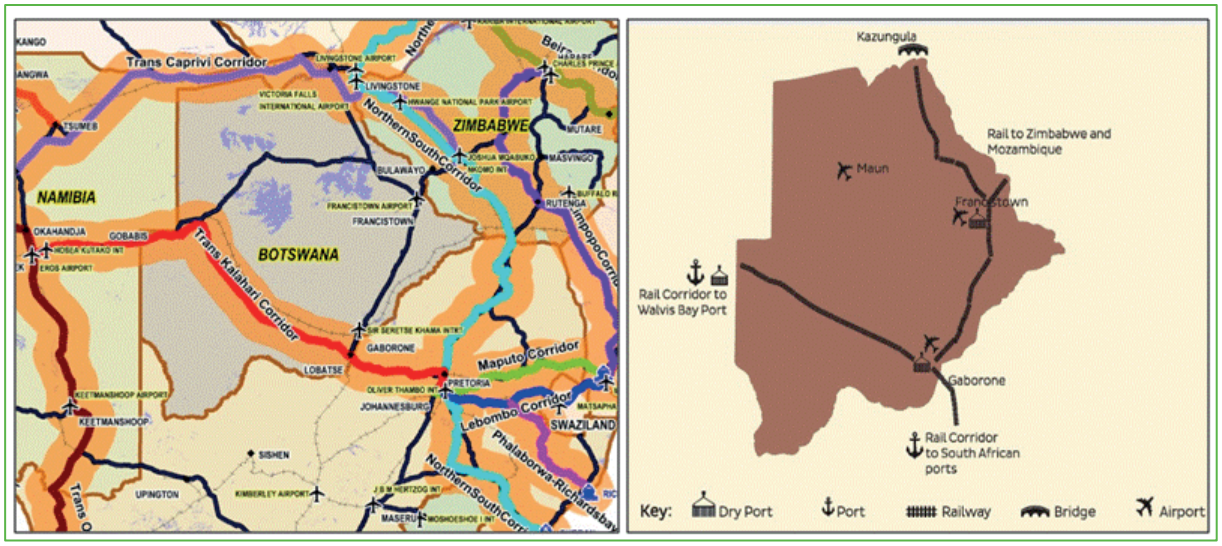
Botswana's geographic location, landlocked between South Africa, Namibia, Zambia and Zimbabwe, puts the country in the heart of the Southern African Development Community (SADC). Accordingly, the country's road infrastructure is under stress due to traffic passing through from neighboring countries. After independence, the government started to expand the road network to connect all cities, towns and villages that are mostly located in the eastern part of the country. In 2017, the road network measured 31,747 km, of which 31% were paved roads (CIA 2019b). The majority (61%) of roads are maintained by the Central Government, with the rest being taken care of by local authorities (CBRTA 2018). To reduce vehicle overloading, and hence wear and tear on roads, axle weight limits are regulated by national legislation. The weight limits are enforced through permanent weighbridges at all major border crossings and portable weighing equipment within the country (MTC 2011).

In 2009, the World Bank approved a loan of $186 Mio for the Integrated Transport Project. The project, which is ongoing until 2021, aims to develop a modern method of road asset management, reduce congestion in the capital and improve strategic planning of inter-regional transport. Main project activities are capacity building, institutional strengthening and road sector investments. However, the focus is not only on roads, as the project also includes a feasibility study for three railway lines to neighboring countries and the development of a national multi-modal transport master plan (World Bank 2009).

As of 2019, the Trans-Kalahari Corridor is Botswana's sole road freight corridor connecting the port in Walvis Bay (Namibia) with Pretoria (South Africa). Figure 4 shows the corridor (red line) running from the border with Namibia across the southern part of the country, through Gaborone and crossing eventually into South Africa. Since 2010, there have been plans to build a corresponding Trans-Kalahari Railway Line, however it is unclear whether the project will ever come to life due to financial constraints. At the moment, rail freight coming from Walvis Bay has to be offloaded from trains in Gobabis near the Namibia/ Botswana border, since the railway line ends there. From there on, freight needs to be transported to Gabarone or South Africa by

truck. As Parida (2014) points out, this intermodal system is currently barely used. In addition, Botswana has signed a construction deal with Zambia (its northern neighbor) to build the Kazungula bridge over the Zambezi river. Once the construction of the road and rail bridge is finished, it will be connected to Botswana's main railway line between Gabarone and Francistown, which will then become a rail corridor to serve South African ports (also figure 4).

Figure 8: Existing road and planned rail freight corridors in Botswana



Source: SADC 2012, GOB 2015

Botswana's social and economic development has largely been driven by a succession of National Development Plans (NDPs) that outline planned projects, programs and policies within a given period of six years. The last two NDPs touched on the subject of logistics primarily in connection with (regional) trade development and planned infrastructure investments. However, the government recognized that the "absence of strategic planning of infrastructural development has manifested in developments that negatively impact the environment and negate efforts towards sustainability" (GOB 2016). Besides planned programs to improve air quality and integrated planning, there is no indication of a government-led strategy on sustainable logistics. The head of Botswana Couriers, a parastatal logistics provider, complained that the lack of a sustainable transport strategy has had various negative effects on the logistics sector, such as congestion, higher costs and waiting times. In addition, there has been little private sector input in policy development, partially due to the absence of an interest group representing the logistics sector (Sunday Standard 2013).

While Botswana's report on sustainable development to the United Nations discusses a range of opportunities and limitations of the transport sector for a green economy, this does not include the logistics sector at all. In this context, the primary focus is the reduction of the use of private cars and the promotion of public transport, as well as non-motorized transport (UNDP 2012). Therefore, it appears that the topic of sustainable logistics is largely left to the private sector.

3.2.4 Conclusion

As discussed above, the logistics sectors of the four countries discussed face a range of challenges in varying degrees. This can be partly explained by their histories and development statuses: all four are considered middle income countries, albeit Zimbabwe is a lower middle-income country and Botswana, Namibia and South Africa are upper middle-income countries (World Bank n.d.). Among these four countries, South Africa's situation is unique partly due to

its Apartheid history, which brought about social and spatial fragmentation, but also due to its role as the economic engine for Southern Africa (Zondi 2012, IMF 2016). As a result, South Africa has become the main import partner for all of its neighbours. Despite there being an extensive rail network, representing approximately 80% of Africa's total rail, 89% of freight is transported on road in South Africa (PWC 2013). Similarly, cross border logistics in all of (Southern) Africa relies heavily on roads, e.g. along the North South Corridor (South Africa-Botswana-Zimbabwe-DRC) only 5% of freight is moved by rail (CBRTA 2017). Some of the main problems associated with road freight are its high costs, due to low-return loads, regulatory inefficiencies at border posts a. o., as well as its environmental impact (Vilakazi 2018).

While urbanisation rates in South Africa slowed down somewhat in the early 2000's, Botswana, Namibia and Zimbabwe continue to experience a large influx of people into urban areas (UN-Habitat 2014). At the same time, there is a significant increase in the number of motorised vehicles, coupled with slow infrastructure development, which has gradually led to congested inner cities in Southern Africa (Haq and Schwela 2012). In Botswana, the vehicle fleet in use grew by 139% from 2005 to 2015, the majority of which are private cars. The numbers of vehicles in South Africa and Zimbabwe increased by 40% and 38% over the same period (OICA n.d.). In times of modest economic growth, city dwellers increasingly purchase private vehicles to get them around the city, as public transport is either non-existent or dysfunctional. Neyhutanda (2007) found that, in some South African cities, the increasing use of private cars and motorbikes has reduced the number of public transport users and thereby diminished overall service efficiency. In addition, the ever-growing number of vehicles on Southern African roads causes problems in terms of air pollution, environmental degradation, congestion, road safety, infrastructure wear and tear, as well as economic losses incurred by people and goods being stuck in traffic. (AFDB 2013, Sylla et al. 2017). For this reason, solutions need to be found for improving the flow of goods and people, as well as integrated transport planning in urban areas.

Savage et al. (2013) found, in their analysis of challenges in the Namibian logistics sector, a number of issues that need to be addressed equally across Southern Africa such as the lack of skilled labour, red tape, an inadequate state and capacity of infrastructure (roads, rail, harbours), high transport costs and sustainability. To tackle the lack of skilled labour, the logistics industry has reverted to employing staff from abroad while capacity is being built domestically (ibid). Though it is important to intensify education and training opportunities, there also need to be incentives for skilled labour to remain in the country long-term.

The reduction of inefficient border and customs procedures is slowly underway as regional integration is continuously furthered by the SADC as well as the Southern African Customs Union (SACU). A gradual improvement of transport infrastructure has been ongoing for several decades, but is heavily reliant on international investment. It should not be forgotten that Botswana, Namibia and Zimbabwe are vast countries with very low-density populations for whom it is unfeasible to upgrade the entire road network. Moreover, intra as well as interregional cooperation is necessary to increase (intermodal) connectivity across countries and cut transport costs. Improved infrastructure, as well as aligned border procedures, can contribute to reducing high transport costs, but ultimately this also depends on the overall economic development of the region in order to profit from economies of scale.

Outside of South Africa, sustainable logistics appears to be still a relatively new topic for policy-makers and logistics providers. Initially, South African logisticians were also slow to react to environmental concerns. However, due to increasing public and political pressure, the industry stepped up its activities (Ittmann & King 2011). Several multinational logistics providers in South Africa have started to provide training on eco-friendly driving and utilised route

optimisation (Göransson & Gustafsson 2014). Besides reducing carbon emissions, an important factor that seems to motivate logistics companies is saving costs. Possible measures suggested for Namibia are an industry self-regulation system, support for small and medium logistics operators, waste facilities at ports, and incentivising recycling and the use of cleaner fuels (Schade 2016).

3.3 The Logistic Sector in South Africa

3.3.1 Overview and Challenges

Green Logistics is gaining momentum, as the former President of the Republic of South Africa Jacob Zuma pointed out at the 2010 Green Economy Summit that South Africa has no option but to respond to the notion that there is a tradeoff to be made between faster economic growth and the preservation of our environment. Additionally, he emphasized that South Africa has no choice but to become eco-friendly to manage its natural resources in a sustainable manner (Zuma 2010).

As part of South Africa's New Growth Path endorsed by the government in 2011 (National Development Plan 2030), the green economy was identified as one of the priorities with the potential to create a large number of jobs, promote industrialization and create a more sustainable future.

South Africa is one of the most efficient African countries when it comes to trade facilitation logistics and is among the best in terms of transport infrastructure. The air and rail networks are the largest on the continent, and the major roads are generally in good condition (National Freight Logistic Strategy, Executive Summary).

In the 2018 Logistics Performance Index (World Bank Group 2018), its global logistics performance ranks well with an overall ranking of 33rd out of 160 countries. However, on a national level, South Africa's freight logistics industry is regarded as inefficient.

The National Freight Transport Strategy describes the problem in a brief abstract as follows: "The freight system in South Africa is fraught with inefficiencies at system and firm levels. There are infrastructure shortfalls and mismatches; the institutional structure of the freight sector is inappropriate, and there is a lack of integrated planning. Information gaps and asymmetries about the skills base is deficient and the regulator frameworks are incapable of resolving problems in the industry. "(National Freight Logistic Strategy, p.4).

One explanation for these seemingly contradictory statements can be found in the fact that "the untapped potential in the Sub-Saharan African region came to the forefront when the multi-national companies started focusing more on Africa. Thus, a sudden surge in investments in infrastructure development (road, rail and transport connectivity) from China, clubbed with conducive regulatory and policy support and regaining momentum in economy have brought Africa on the global stage." (Ernst & Young 2017). However, despite their significance, national logistics costs are not directly included in any of the indicators developed for ranking countries on a global scale (Farahani et al. 2009). The Logistics Performance Index (LPI) measures the current logistics environment in six areas: customs, infrastructure, international shipments, logistics quality and competence, tracking & tracing and timeliness (Arvis et al. 2010). The global logistics ranking therefore does not give a detailed reflection of the challenges the South African national freight system has to cope with.

In order to understand the challenges of South Africa´s logistics sector and its barriers, one has to take a look at South Africa's challenging economic structure. South Africa´s main economic

activity is located in the center of the country: the metropolitan region of Gauteng with the major city Johannesburg. Due to the historical development of mining and the discovery of gold and other precious metals in the northern interior, Gauteng became the major logistics and manufacturing hub with a fast-growing freight transport sector, as well as a rapidly growing population. However, the city is 570 km far from the nearest Port of Durban, the largest container terminal in the country. The country´s other important large logistics hub and port, Cape Town, is situated 1,400 km from Gauteng. This has precipitated very long freight corridors with little industrial activity in between. Furthermore, South Africa has followed the global route of economic specialization; consequently, domestic distribution of agricultural and manufactured goods between dispersed economic centers is unduly transport intensive.

South Africa's logistics costs totaled up to R429 billion in 2014 and equated to 11.2% of GDP or 51.5% of transportable 20% GDP (figure 8) and were forecasted to grow by 6.3% in 2016, in line with inflation estimates (figure 9). Reasons are various: constraints in access, fuel pricing, reliability and network interfaces, particularly in the port and rail network.

Figure 7: South Africa´s Logistic Cost Trends

Source: Havenga, J.H. et al. Logistics Barometer South Africa 2016

Logistics costs can be broken down into three direct elements: transport, storage, and handling costs. In South Africa the majority of transportation costs come from road transport, which makes up 83% of the transportation costs due to the long distances between production and consumption centers and poor railway infrastructure (see Havenga et al. 2016). Most of the freight, about 89 % in the country, is transported by road (CSIR 2018), which is the least environmentally friendly option. The Emission Database for Global Atmospheric Research (EDGAR) states that South Africa was the 15th largest CO_2 emitter in the world during 2015, while being the 33rd largest economy (World Bank GDP Data 2019).

In fact, the low amount of investments and the contribution of poor roads - around 76% of South Africa´s road network are unpaved gravel or earth roads (Sanral) - leads to a high percentage of road transport cost to Gross Domestic Product (GDP) at 4.7% (CSIR 2012).

Furthermore, since the deregulation of the railway sector in the late 1980s -and low quality and maintenance of its infrastructure - rail freight has seen a sharp decline. In 2013, it made up only

10.4% (National Freight Logistic Strategy). The railway system suffers from frequent vandalisms, but also an overall antiquated infrastructure that is in dire need of maintenance and recapitalization.

Nowadays intermodal rail transportation is seen as the solution for the eco-friendly future. By combining the positive aspects of environmentally friendly rail transportation with the flexibility of road transportation to give customers access to the rail network, South Africa hopes to reduce the effects on congestion and the environment. Underlining the relevance of the government´s road-to-rail strategy, Transnet made already several investments to renew the rail infrastructure (Transnet Online integrated Report 2018/Our performance).

The key players operating South Africa's transport infrastructure are two parastatal transport companies; while Transnet is the main operator of ports, railway and pipelines, SANRAL (The South African National Roads Agency SOC Ltd) is responsible for the management, maintenance and development of South Africa's proclaimed National Road network, which includes many - but not all - National ("N") and some Provincial ("R") route segments.

Well-functioning transport and logistics infrastructure relies not just on hardware, but also critically on the operating environment that emerges from the interaction between sector operators: national policies and regulatory regimes, state-owned companies and operators of core infrastructure. Safety and security in logistics is a major issue, with frequent hijackings of trucks, unrest, thefts at warehouses as well as inadequate roads and infrastructure and improper roadworthiness of vehicles causing accidents.

There is also a challenge in implementing the policy for the expansion of the Broad-Based Black Economic Empowerments (BBB-EE) in freight business, as opportunities are limited for a number of reasons, often attributed to the current difficult local economic situation (for a more detailed description please refer to 3.3.2.2.3)

Figure 8: Main freight corridors South Africa

NETWORK SECTION	FREIGHT COMMODITIES	ROAD TONNE (mt)
Gauteng-Durban	containers, steel, cars, coal, manganese, fuels, perishables	44
Gauteng-Cape Town	cars, grains, containers, perishables, cement, steel	15
Gauteng-Musina	foods, fuels, vehicles, cement, perishables, beverages	12
Gauteng-Tlokweng	fuels, cement, containers, vehicles, food	6
Gauteng-Ressano Garcia	mineral ore, fruit, sugar, timber, cars, paper	8
Cape Town-Namibia	fish, containers, fertilisers, cement, machinery	4
Cape Town-Port Elizabeth	cars, fuels, fruit, perishables, steel, tyres	37
East London-Durban	beverages, foods, fuels, vehicles	6
Durban-Pongola	containers, fuel, chemicals, timber	7
Winburg-Harrismith	maize, livestock, perishables, steel, containers	5.8
Gauteng-Upington	foods, cement, steel, machinery, vehicles, perishables	2.1
East london-Bloemfontein	vehicles, steel, grains	1.2
George-Colesberg	fuels, grains, perishables	1.6
Britstown-Nakop	food, cement, steel, machinery, cars, perishables	0.2
Gauteng-Swaziland	beverages, cement, coal, vehicles, grains, sugar	38
Thaba Nchu-Maseru	containers, fuel, cement, grains, coal, foods	3
Ermelo-Richards Bay	coal, steel, timber, chrome	0
Sishen-Saldanha	iron ore, lead	0

Source: National Freight and Logistics Strategy Review 2015

Göransson & Gustafsson (2014) concluded that green logistics is implemented to a large extent among the major transportation companies in South Africa. Especially fuel efficiency and route optimization are seen as drivers for companies to go green. They believe that this is directly related with their abilities to reduce logistics costs effectively. Other incentives to implement green strategies are seen in a better corporate reputation and the positive image of an environmentally conscious company as well as differentiating from competitors (ibid).

As barriers that might be a hurdle to the implementation of green logistics, Göransson & Gustafsson (2014) identified the low quality and maintenance of the infrastructure and roads apart from the highways. This goes along with the finding of the 2010 CSIR State of Logistics report that bad roads are able to increase costs by almost 10% compared to good quality roads (CSIR 2010).

Jansen van Rensburg (2015) found, in her analysis of barriers to going green in the South African logistics sector, a number of issues that need to be addressed equally such as the lack of skilled labor, an inadequate state and capacity of infrastructure (roads, rail, harbors). Small and medium-sized enterprises especially struggle with the initial high investment costs of environmental programs and technology.

The topic of Green Logistics in South Africa has so far only been partially investigated in research, while much research has been conducted on supply chain management. According to GĀransson & Gustafsson (2014), the majority of logistics research in South Africa focused on the current state of logistics (compiled by the University of Stellenbosch, the Council for Scientific and Industrial Research (CSIR) and Imperial Logistics) and logistics costs within the country (Havenga, 2010). Smith and Perks (2010) conducted a study within the Nelson Mandela metropolis that looked at corporate perceptions of the impact of implementing green practice on corporate functions. GĀransson & Gustafsson (2014) conducted a study on the perception of green logistics management in the road transport industry in Johannesburg. Jansen van Rensburg (2015) conducted a study on the drivers, benefits and barriers of implementing green logistics practices in South African small and medium-sized enterprises (SME´s).

3.3.2 Policy Framework

Against a background of increasing worldwide public concerns for the environment, the impact of logistics on climate change has attracted increasing attention through the transition towards an environmentally sustainable and climate-resilient economy. At the same time, they intend to embrace the green economy as a means of attaining inclusive and equitable growth that leads to sustainable development and promotes poverty eradication and the creation of green jobs.

This section provides an overview of South Africa's extensive national policies and strategies to support a green economy, outlining the current policy and regulatory framework that provides the foundation supporting the greening of the freight logistics sector.

3.3.2.1 Integrated Plans

3.3.2.1.1 National Development Plan (NDP) Vision 2030

The National Development Plan (NDP) 2030 is one of South Africa's central planning documents. It aims to eliminate poverty and reduce inequality by 2030 and endorses a just transition to a low-carbon economy. In May 2010, the National Planning Commission drafted the National Development Plan based on a Diagnostic Report pointing out South Africa's achievements and shortcomings since 1994. The draft of the National Plan was published in November 2011.

Chapter 4 of the National Development Plan (NDP) calls for the development of economic infrastructure as the foundation of social and economic development. Further, it stresses the

need for a low-carbon development of the sector. In detail, the NDP (2011, p.183) aims to "*bridge geographic distances affordably, foster reliably and safely so that all South Africans can access previously inaccessible economic opportunities, social spaces and services ", "support economic development by allowing the transport of goods from points of production to where they are consumed. This will also facilitate regional and international trade.",* and to "*promote a low-carbon economy by offering transport alternatives that minimize environmental harm*".

The NDP emphasizes decreasing the high transport costs, improving the poor freight transport infrastructure and shifting freight from road to rail by strengthening and optimizing freight corridors. "*Planning should prioritize improving the capacity, efficiency and sustainability of these corridors while enhancing the performance of seaports and inland terminals*" (NDP 2011, p. 187). The NDP points out the following strategic infrastructure investments (NDP 2011, p. 187-189):

- As one of the main freight corridors and the key to achieve a shift of freight from road to rail the **Durban-Gauteng freight corridor** is supposed to be a priority and needs to be expanded. This includes the development of a new port on the site of the old Durban airport and the strategic investment in the intermodal flexibility and capacity of terminals on either end of the corridor.
- South Africa's mineral sector is limited by the existing transport capacity for coal, manganese and iron via rail. Therefore, **coal-transport corridors** should be expanded. Improvements to the coal transport corridors require strengthening lines tunnels, bridges, power supply and building new lines. In order to unlock coal deposits in the Waterberg, a new coal line is to be developed linking it both to domestic power generators and to export facilities in Richard's Bay.
- The capacity of the **iron ore and manganese line** should be expanded enabling larger mineral exports. This involves improving strategic freight corridors for Southern African and international trade.
- A **north-south corridor**, a Durban to Dar es Salaam transport network, is also described as a strategic infrastructure investment as it links the two major ports of the Southern African Development Community.
- **Ports as the end points of the freight corridors** need to improve their overall performance and reduce prices to be competitive. According to the Port Regulator, South African ports have very high operating costs that are significantly higher than the global average. The cause for the poor performance is mainly seen in the monopolistic market structure.

In various places in the report, the importance of implementing a monitoring system in order to be able to verify the progress with regards to the set goals in the NDP is pointed out (e.g. NDP 2011, p. 204). According to the report, this is critical for accountability and transparency.

3.3.2.1.2 White Paper on National Transport Policy

The First National White Paper on Transport Policy was launched in 1996. In 2017, a Draft Revised White Paper on National Transport Policy 2017 was published. The overall policy vision of the Paper is a *"transport system that provides equitable and reliable access for all in an economically and environmentally sustainable manner to advance inclusive growth and competitiveness of the country"(*Draft Revised White Paper on National Transport Policy 2017, p. 1).

One focus of the Paper is the goal of an **equitable transport sector**. To ensure this, several mechanisms are mentioned including training and education, fair labor practices, job creation and security and sound working conditions. For the training and skills development, the Transport Education and Training Authority (TETA) is responsible (Draft Revised White Paper on National Transport Policy 2017, p. 12). Further, the Department of Transport commits itself to promoting Broad-Based Black Economic Empowerment (B-BBEE). Finally, public participation in decision making is encouraged. (Draft Revised White Paper on National Transport Policy 2017, p. 3).

With respect to safety and security, it is made very clear that "*the safety, security, and quality of service of some modes of transport are currently below acceptable levels*" (Draft Revised White Paper on National Transport Policy 2017, p. 3). Further, the protection of the rail system from theft and vandalism is emphasized as it is critical for the shift from road to rail.

To achieve a better competitiveness of South Africa, improving infrastructure and operations through greater effectiveness and efficiency is mentioned as a goal of the paper (Draft Revised White Paper on National Transport Policy 2017, p. 4).

Last but not least, the goal of an ecological and sustainable transport sector is also an important element of the paper. Especially, the integration of environmental sustainability in investment decisions is stressed (Draft Revised White Paper on National Transport Policy 2017, p. 4).

The implementation of the goals is planned to be supported by a monitoring system, that helps the government to make evidence-based decisions based on high-quality and up-to-date data. The "*government needs data to monitor and measure its progress against the targets it sets for itself. The government must leverage its unique position to collect, collate and interpret data that no other organization in society can legitimately be expected to undertake*" (Draft Revised White Paper on National Transport Policy 2017, p. 74).

National Transport Master Plan (NATMAP) 2050

The National Transport Master Plan (NATMAP) 2050 is the central planning document for the long-term development of the transport sector. The entirety of Chapter 7 deals with the freight sector and points out the most relevant obstacles and strategies.

- Due to deregulation and low investments road freight accounts for 76% of freight transportation. Only in bulk mining, **rail freight** has the highest market share. As road freight contributes to overloading and the deterioration of the road network and traffic congestion, a road-to-rail strategy was developed. The rebalancing of the road freight–rail freight split is supposed to reduce the overall transport and logistics costs and externality costs (e.g. road damage, accidents, congestion, noise and emissions) (NATMAP 2050, p. 7-2). Causes for the reduced efficiency and attractiveness of rail freight relative to road freight are the reduced accessibility of rail freight due to the closing of several rail stations, the high costs for safety measures, the lacking reliability and timeliness of the rail transport, the comparably high travel times from collection to delivery point and the higher costs, rates and tariffs compared to road transport (NATMAP 2050, p. 7-5). As a response, Transnet is in the process of rolling out investments and focusing on operational efficiencies (NATMAP 2050, p. 7-8).
- Not only rail freight has its challenges, but also **road freight** has constraints that are mentioned in the NATMAP, i.e. costs of roads, availability of diesel, shortage of skilled personnel and increasing externalities. Especially the externalities concern the policy makers such as considerable congestion during peak hours, road accidents and air pollution in cities (NATMAP 2050, p. 7-9). Additionally, one major concern for provincial and national

authorities responsible for providing and maintaining roads is overloading. Therefore, an improvement of the overload control system is emphasized (NATMAP 2050, p. 7-4f. & 7-12). Furthermore, road carriers currently contribute do not adequately to compensate for externalities caused. Therefore, the NATMAP points out that the road infrastructure management and funding is a strategic thrust (NATMAP 2050, p. 7-9).

- Apart from the local challenges, the **regional development of the corridors** within the COMESA-EAC-SADC Tripartite Free Trade Area is also highlighted. This area consists of 22 countries, stretching from Cape Town to Cairo. The NATMAP lists several challenges in the tripartite transport and transit facilitation landscape including lacking political and regulatory harmonization as well as corruption. They result in bad working conditions for commercial drivers, high transport costs, lacking timeliness and speed as well as a low competitiveness. "*Reducing transport costs and cross-border challenges, improving corridor efficiencies and logistics are central to regional integration*" (NATMAP 2050, p. 7-6). To reach that goal the strategies focus on an improved modal integration, the corridor development and the improved national coordination and alignment of transport agencies, authorities and parastatals.

- There is an overall **lack of freight data**. Some information is provided e.g. by the South African National Roads Agency SOC Limited (SANRAL) and the provinces, but freight origin and destination (OD) data is unavailable in South Africa due to, inter alia, lacking legislation to enforce the disclosure of this data. "*The lack of information on road freight volumes, operators, commodities, and movements is a continuous concern for planning authorities*" (NATMAP 2050, p. 7-6). Therefore, the DoT has started to develop a national freight databank (NATMAP 2050, p. 7-12).

- In chapter 7.4.1 the implications of the analysis are summarized and in chapter 7.4.2 several freight interventions are proposed. In chapter 13.5 "Measure, Monitor, Evaluate (KPIs)" progress against objectives is measured using key performance indicators. "The tracking of indicators will be executed by data collection through the establishment of the national multimodal transport data bank proposed earlier in this report" (NATMAP 2050, p. 13-20). KPIs related to freight include (NATMAP 2050, p. 13-21 f.):

- **Time and Speed:** Journey time and travel journey time variability on strategic roads/trunk routes in metropolitan areas,

- **Safety and Security:** i) 50% reduction in the number of people killed or seriously injured in road and rail accidents by 2025 and 10% reduction in fatalities year on year, ii) Reduce average number of overloaded trucks on provincial and national roads by x%, iii) % increase in RTMS certification and compliance in order to improve heavy goods vehicle safety performance, roadworthiness, and self-regulation

- **Environment:** i) Reduce Greenhouse gas emissions from all road-based transport by 5% from current levels by 2025, by 34% by 2020 and by 42% CO2 by 2025, ii) Improve energy efficiency by 12% by 2015 and conduct 8 environmental awareness activities per annum

- **Infrastructure:** i) Improve by **X**% of thousands of 2-lane-kilometers from "fair" or "good" by 2020, ii) Reduce road surface with very poor condition by 5% in 2025

Green Transport Strategy (GTS)

In 2018, the National Department of Transport (DoT) launched a Green Transport Strategy: 2018-2050, that sets out a clear environmental policy for the transport sector.

The strategy is based on five implementation themes: 1). Change responds norms and standards, 2). Green roads, 3). Green rail, 4). Green transport technologies and 5). Green fuel economy standards.

Figure 9: The Implementation Themes and Strategic pillars of the Green Transport Strategy

IMPLEMENTATION THEMES	STRATEGIC PILLARS
Climate Change response norms and standards	1. Develop norms and standards for climate change response at National, Provincial and Local level to ensure that there is consistency in the way climate change responses are implemented across different jurisdictions
Green Roads	2. Shift car users from INDIVIDUAL private passenger cars to public transport, including rail
	3. Provide infrastructure to promote NMT and eco-mobility transport
	4. Provide transport infrastructure in a manner supportive of the eco-system, while not dearly compromising generations to come
Green Rail	5. Extend the rail network to provide reliable, safe and affordable high-speed transport while switching to renewable energy trains
Green transport technologies	6. Reduce the carbon footprint and over-reliance of petroleum based fuels, by decarbonising the transport sector
	7. Promote alternative fuels such as Compressed Natural Gas (CNG) or biogas, and liquid biofuels as transport fuels
	8. Promote electric and hybrid-electric vehicles
Green Fuel Economy Standards	9. Develop **"Green Procurement Guidelines"** to promote efficient, and low carbon vehicle technologies
	10. Provide norms, standards and regulations that promote green fuel economy in vehicles and improve emission standards of fuel in South Africa

Source: GTS

This ambitious strategy intends on enabling the transport sector to contribute to the national efforts to combat climate change. Thus, it wants to promote behavioural changes towards sustainable mobility alternatives through information, education and awareness. Additionally, it seeks to initiate the low-carbon transition of the sector and to contribute to the alignment and development of policies that promote energy efficiency and emission control measures in all modes of transport.

To achieve these objectives, the GST highlights:

- ensuring that South Africa has environmentally sustainable low carbon fuels by 2022 by converting 5% of the public and national sector fleet to cleaner alternative fuel and efficient technology vehicles;
- promoting fuel economy norms and standards and implementing regulations that promote improved efficiency in fossil-fuel powered vehicles;
- ensuring a modal shift from road to rail transport by encouraging a 30% shift for freight transport, from road to rail, and a 20% shift of passenger transport from private cars to public and eco-mobility transport;
- investing in green energy infrastructure, such as like biogas filling stations and electric car charging points;

- reviewing current levels of the environmental levy on new motor vehicle CO2 emissions and expanding it to commercial vehicles; and
- helping ensure that freight vehicles only enter urban hubs during off-peak hours, by possibly implementing road freight permits and road-use charges.

This acknowledges that emissions from the transport sector account for 10.8% of the country's total greenhouse gas (GHG) emissions, with road transport being responsible for 91.2% of these GHG emissions (GHG Inventory 2014).

The freight sector is not treated separately but is mentioned a couple of times in the report as the GTS identifies and proposes key measures to facilitate the modal shift from road to rail and promotes cleaner vehicle technologies. Identified as the most significant source of transport-related CO2 emissions, the road transport sector will be the focus of the Green Transport Strategy as it allows the greatest opportunities for reductions. The GTS recommends intermodal transport as a preferred logistic tool and supports the determination of the NATMAP 2050 vision to establish rail transport strategies. (GTS, p.31). As mentioned above, one of the short-term strategic targets it aims to achieve is a 30% shift of the freight transport from road to rail within the first phase of its 5-7 years implementation plan (GTS, p.25). However, it is pointed out that this strategy requires long term finance and investment, especially as the rail sector has to overcome tremendous challenges (overages rail infrastructure, inefficient management skill) to meet these goals (GTS, p.19).

3.3.2.2 Sector Plans

3.3.2.2.1 National Rail Policy

South Africa's extensive rail network – the 14th longest in the world– connects with other networks in the Sub-Saharan region and neighboring Namibia, Botswana, Mozambique, Zimbabwe and Swaziland and carries about 180 million tons of cargo annually both for the local and export market. However, the rail sector has suffered from severe underinvestment since the 1980s. The consequentially obsolete rail infrastructure and rolling stock, inefficient operations, and under-utilization of the network has contributed to the shift of freight transport towards roads. This was accompanied by a lack of policy direction regarding the role of the two modes (road and rail) in the surface freight transport industry (Development Bank of Southern Africa [DBSA] 2012), caused by the absence of sufficient market intelligence to inform policy (Havenga 2007) and ignoring the trend that intermodal rail will continue to be the fastest-growing freight mode in the next decade. (Havenga, Simpson & De Bod 2014).

The government's efforts in making a significant impact in reducing GHG emissions has put the country's 20,247km rail network on a top priority list, with projects aiming to address maintenance backlogs, increase freight rail volumes, grow the market share of container traffic, and procure new fleets for both the passenger and freight sectors, as rail is seen as a key sector of a successful decarbonization strategy (Green Transport Strategy 2018-2050, p.19).

The 2017 National Rail Policy Draft White Paper drives a long-term vision 2050 agenda and is aligned with the National Development Plan 2030 in supporting the government's broader objectives to an intermodal shift. To reposition rail to play its future role as preferred land transport freight mode and backbone with which all other transport modes integrate, the paper states that a comprehensive modernization approach is needed. *At the same time the imbalance between road and rail usage has to be leveled and competitive neutrality between road and rail pricing has to be set up.* (Executive Summery, Department of Transport, Pretoria 2017, National Rail Policy Draft White Paper 2017)

The Market Demand Strategy 2012-2019 (MDS) was Transnet's response to this challenge of infrastructure underinvestment. This strategy aimed to expand and modernize South Africa´s ports, rail and pipelines infrastructure in order to achieve a significant increase in freight volumes, particularly for commodities such as iron ore, coal and manganese over a period of seven years to solidify its 'road to rail' strategy.

The majority share of investment was allocated to General Freight and Freight Rail: Rand 108.6 bn (Green Transport Strategy 2018-2050, p.19) have been invested in rail infrastructure and the purchase of 1064 locomotives to modernize the fleet (Transnet Online integrated Report 2018/Our performance). Further investments were made in expanding the capacity of the export coal line and in expanding the transport capacity of the Waterberg coal fields (Transnet online integrated report 2018/our performance).

Transnet is now shifting towards the new Transnet 4.0 strategy, and the main growth thrusts of Transnet 4.0 include the expansion of the company business, with a focus on digitalization to improve processes. (Transnet Online integrated report 2018/strategy and resource allocation).

3.3.2.2.2 Comprehensive Maritime Transport Policy (CMTP) for South Africa

South Africa's seven commercial ports are generally considered to be the gateway to Southern Africa. While the ports of Durban, Cape Town and Port Elisabeth handle mostly container and higher value goods, the ports of Saldanha Bay and Richards Bay have a strong primary product orientation. Mossel Bay port handles bulk liquids, and the port of East London handles containers, bulk and cars. Additionally, a new port, Coega, in the Eastern Cape, is being developed to handle large vessels. (National Freight Logistic Strategy, p.23)

Approximately 80-90% of the country's exports are conveyed by sea, and its ports are the conduits for trade between South Africa and its Southern African neighbors as well as hubs for traffic to and from Europe, Asia, USA and the east and west coasts of Africa. (Comprehensive Maritime Transport Policy 2017 CMTP, Executive Summary)

The fundamental theme of the 2017 Comprehensive Maritime Transport Policy is the proper governance management and development of the Maritime Transport sector to serve the country, the industry and be of service to the world. The CMTP envisions the development of a maritime transport sector in South Africa that will build on its historic potential and contribute to the economic growth, new business generation, and entrepreneurship and employment creation opportunities in the country. It takes into account domestic, regional and global challenges and imperatives. (Comprehensive Maritime Transport Policy, Executive Summary)

The policy broadly defines "maritime transport" as "*an integrated system that involves the design, construction, operation, management, servicing and maintenance of merchant, leisure and other ships in the service of seaborne trade*" (Comprehensive Maritime Transport Policy, p.8) and also considers overland logistics corridors facilitating the movement of people and goods through port connected road and rail infrastructure.

The following actions are put forth by key statements regarding ports development as contained in the draft policy:

- the introduction of instruments for monitoring and evaluating private sector participation in commercial ports
- Monitoring the competitiveness of South African ports

The Green Transport Strategy identifies maritime transport as a very small contributor to transport sector emissions in South Africa - less than 2.2% (GHG Mitigation Potential Analysis,

2014) - but admits that this is only due to maritime transport operating mainly beyond South African boundaries (Green Transport Strategy 2018-2015, p.21).

3.3.2.2.3 Road Freight Strategy 2017

The South African road network comprises some 754.600 km of roads and streets. According to Sanral about 15.600 km are surfaced national toll and non-toll roads. The unpaved gravel provincial road network is approximately 348.000 km in length, while urban roads comprise another 16.800 km. Unproclaimed gravel and earth roads are about 221.000 km (SANRAL; DoT).

The Green Transport Strategy identified the road transport sector as the major contributor to the GHG emissions - approximately 91.2% of total transport GHG emission (GHGI, 2015). There is a vision that, through the implementation of the recommendations of the Road Freight Strategy 2017, a transition from the current situation to an effective regulatory and institutional framework will be possible. To achieve this ambitious goal, the strategy emphasizes the need to use international best practice systems, technologies and efficient management to not only achieve high-quality standards for a sustainable road freight sector, but also to reduce environmental impact. (Road Freight Strategy 2017, Executive Summary).

The report points out that, regarding the road freight operation in corridors, there is a need for a reliable indicator system as there is no readily available information about road freight origin and destination volumes. This is due to the fact that there are no systems in place to record such data. Most of the information that is published has been derived from calculations based on road traffic volumes, surveys and industry data. A complicating factor in any discussion of corridor tonnage is the fact that there are varying levels of traffic and tonnage at different points on the "corridor". This makes it difficult to define the extent of the "corridor" traffic as opposed to local and short distance traffic that uses a section of the route. Vehicle journeys may also include varying distances on several corridors. (Road Freight Strategy 2017, p.33).

3.3.2.2.4 Integrated Transport Sector Broad-Based Black Economic Empowerment (BBB-EE) Charter

Broad-Based Black Economic Empowerment (BBB-EE) is an affirmative action program to achieve equal economic opportunities for formerly disadvantaged citizens (Africans, Coloreds, Indians and Chinese) in South Africa. The law was enacted in 2003 under the shorter name Black Economic Empowerment (BEE) to address the large economic inequality between white and black people in South Africa that was caused by Apartheid Policies. (BBB-EE Legislation).

The BBB-EE is a complex construction that includes, in addition to the corresponding law, codes of good practice, transformation charters, sector codes and scorecards.

Codes of Good Practice (Section 9 + 10 BEE-Act) represent the core of the definition and implementation of the BEE strategy. As a kind of legal regulation, and administrative guideline at the same time, the details for the entire BEE complex are regulated here- from strategy to implementation and control.

Sector Charters (Section 12 BEE-Act) are the instruments for practical implementation in various branches of industry. Within the legal framework and the Codes of Good Practice, a sector-specific BBB-EE implementation can be agreed upon in a kind of interaction between government and business: a kind of self-regulation of commercial enterprises. The intention to not use the same approach for the entire process and not to govern all aspects of the process through legislation gives the businesses a little flexibility. It is, in a sense, a liberalized form of implementing state requirements in a partially self-regulatory way.

The Transport Sector Broad-Based Black Economic Empowerment (BBB-EE) Charter has been published as Integrated Sector Code in terms of Section 9(1) of the Broad-Based Black Economic Empowerment (BBB-EE) Act. It comprises eight sub-sectors, which seek to boost one of South Africa's largest infrastructure and Gross Domestic Product (GDP) contributors. In alignment with the government's National Transport Action Plan, the codes aim to fast-track the implementation of efficient transportation, freight and logistics sectors within the economy. One of the main highlights is the achievement of a 35% black-ownership target within a period of five years (BBB-EE Legislation).

The BBB-EE status of a company has become an essential criterion for economic decisions and entrepreneurial management. In addition to price, quality and service, BBB-EE is crucial in the South African economy for success or failure (BrÄll 2018). The big players of the economic sector have come to an arrangement: they support the process, partly out of insight into the inevitability, partly with deep conviction into the correctness. The message has been received by small and medium-sized enterprises, but not much has been done to implement it (Forbes & Rust 2019).

Critics of BBB-EE object that the classification according to ethnic affiliation indicates that, in Post-Apartheid South Africa, racial affiliation is just as important as in the past (Shava 2016). They state that South Africa is systematically burdening itself with a handicap, even though the BBB-EE in general has the capacity to become an economic imperative aimed at redressing past imbalances if it is used carefully (Lindsay 2015; Shava 2016). Instead of continuing with the elimination of competition-inhibiting mechanisms, new bureaucratic hurdles and cost-increasing measures would be introduced (Papenfus 2015).

3.3.3 Summary and Findings for the GLI:X Project

Findings

- the logistics costs as a percentage of GDP in South Africa are too high
- there is an overall lack of freight data
- the largest portion of South Africa's high and growing transport demand will remain on long-distance road corridors
- reposition rail to play its future role as preferred land transport freight and backbone with which all other transport modes integrate
- strengthening and optimizing freight corridors is an import issue
- the implementation of the Transport Sector Broad-Based Black Economic Empowerment (BBB-EE) Charter is a challenge

Summary

The vision of transitioning South Africa towards a green economy has been declared at the highest political level and the green economy agenda is articulated in the macro-economic policy framework and national development vision. Green economy is seen as an important means to respond to a wide range of the critical and intertwined development challenges that range from unemployment, poverty and inequality to climate change. Nevertheless, there is a lack of integration of polices across different government departments and spheres. Equally important, implementation is often lagging behind policy development (Swilling et al. 2016).

Both the political framework and literature define an urgent need for the establishment of measurement systems to monitor the success of the various activities. Systems existing up to now are often described as insufficient or simply absent (Swilling et al. 2016). The Draft Revised White Paper on National Transport Policy points out "*Government needs data to monitor and measure its progress against the targets it sets for itself. The Government must leverage its unique position to collect, collate and interpret data that no other organization in society can legitimately be expected to undertake*" (Draft Revised White Paper on National Transport Policy 2017, p. 74).

This is the gateway to the GLI:X Green Logistics Indicator, which provides a tool for policy-makers and the industry to enable the measurement and quantification of the state of freight logistics in a structured and manageable form, facilitating the monitoring of the success of policies pertaining to freight logistics without prescribing any solutions. This, ensures openness to new and innovative approaches as it enables cities and regions to benchmark their own future, comparing the present state with a future (or past) state and thereby illustrating the state of the development process.

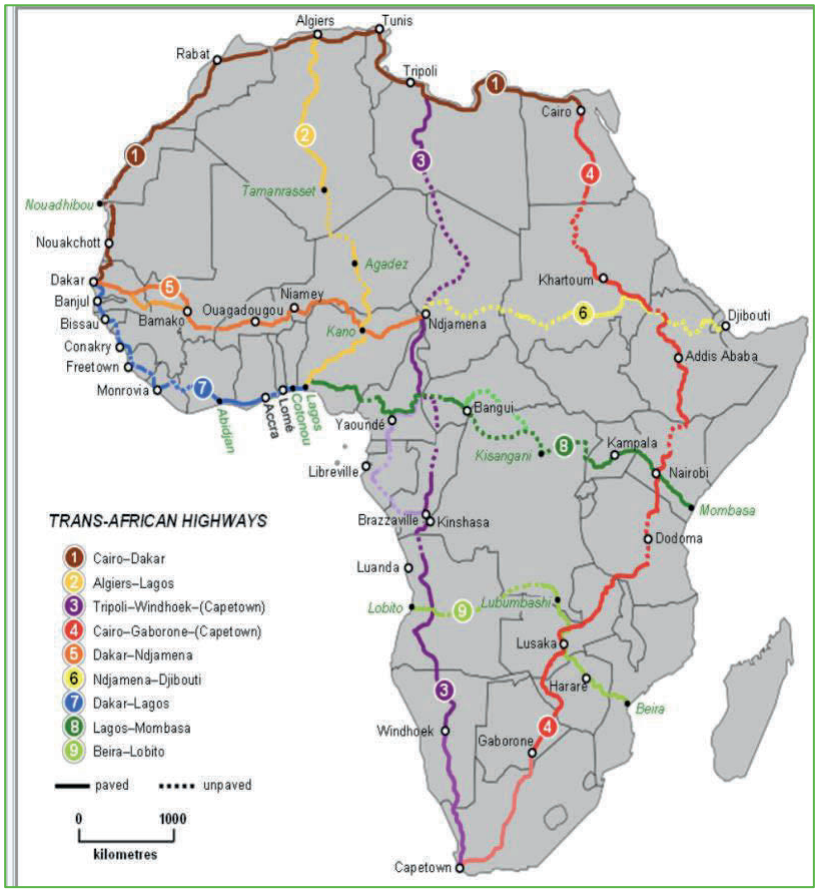
The GLI:X Green Logistics Indicators are illustrated in the table in Appendix B, which compares the objectives and target values of the South African government's strategic policy papers with the goals of the GLI:X Indicators System.

3.3.4 Concluding remarks

Hubs and Corridors – national level meets continental strategy needs

An efficient national logistics network depends on the smoothest possible interaction between logistics hubs and the logistics corridors connecting them. For South Africa, this network is also the starting point for cross-border continental traffic, which will play an increasingly important role in the future and must become particularly efficient from South Africa's point of view, as there are concerns that South Africa could otherwise be disadvantaged by the expected economic growth development in Central Africa due to its southernmost location on the continent. This also includes geostrategic initiatives, similar to China's "One Belt, One Road" initiative, to which South Africa must position itself.

Figure 10: Map of Trans-African Highways



The Trans-African Highway network comprises transcontinental road projects in Africa being developed by the United Nations Economic Commission for Africa (UNECA), the African Development Bank (ADB), and the African Union in conjunction with regional international communities. Source: https://de.wikipedia.org/wiki/Trans-African_Highways

Within Africa, South Africa's logistics infrastructure is considered to be the most efficient, followed by Egypt. This is interesting to the extent that the two nations that are most effective on the continent are also the two nations that form the northern and southern corners of the planned North-South corridor, which, in its first phase, will extend from South Africa to Central Africa with the countries Tanzania, Malawi, Botswana, Democratic Republic of Congo and Zimbabwe.

The Gauteng and Durban regions are the continent's most important end points within South Africa, from which the distribution within South Africa is achieved.

Figure 11: Comparison logistic quality and competence South Africa / Best international performer Singapore

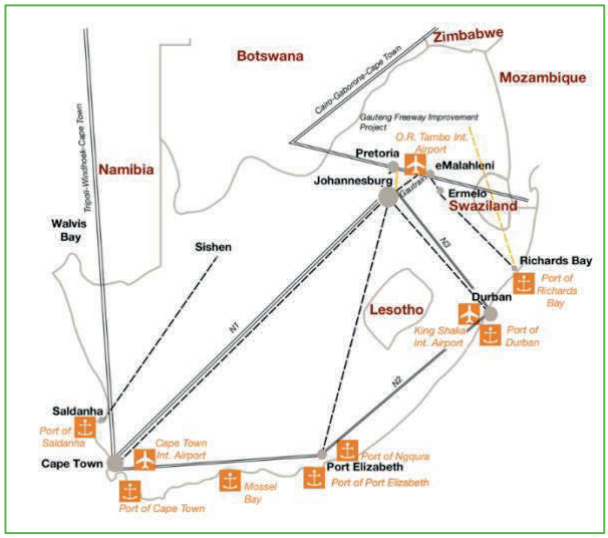
Source: World Bank/PWC

South Africa's logistics performance according to World Bank research exceeds that of its regional peers. In comparison with Singapore, one of the best international performers, it is generally significantly better than its neighbors and among the best in the region.

Regional Development - Territorial Cooperation

A multimodal approach is used in the planning to optimize transport in corridors. This will also include hubs and intermodal transshipment facilities (freight centers), which are significant for efficient traffic flow and crucial for hinterland connection of ports and distribution of freight flows.

Figure 12: Important freight corridors



Source: World Bank/PWC

For the GLI:X indicator, corridor development is a crucial link between the hubs. The infrastructural design of the further infrastructure planning and corridor development should therefore be able to orient itself closely to the indicators of GLI:X in order to achieve a high and sustainable performance of the corridors according to the criteria of GLI:X. In discussions, it became clear that there is a great demand for information regarding competition and possible investment priorities between rail and road. The interest was therefore repeatedly expressed in obtaining more information about the experiences and steering possibilities made in Germany and the EU (projects).

4 Stakeholder Analysis

4.1 Government key players for freight

According to Tibane (2018), the Department of Transport (DoT) is responsible for the legislation and policies for all sub-sectors regarding Transport, i.e. infrastructure and operations of rail, pipelines, roads, airports, harbors, and the intermodal operations of public transport and freight. The DoT is also responsible for the following public entities that play an important role for the freight sector:

- The Airports Company South Africa (ACSA) owns and operates the principal South African airports including OR Tambo International Airport in Johannesburg, Cape Town International Airport and King Shaka International Airport in Durban.
- The South African National Roads Agency Ltd (SANRAL) operates the South Africa's national toll and non-toll roads.
- The Ports Regulator of South Africa are responsible for the economic regulation for the South African ports, i.e. pricing, the promotion of equity of access to ports, the monitoring of the industry's compliance, and the hearing of any complaints.
- The Cross-Border Road Transport Agency (CBRTA) handles cross border road transport policies, issues cross-border permits, and undertakes law enforcement for road transport.
- The Railway Safety Regulator aims at promoting safe railway operations for all rail operators in South Africa and those of neighboring countries whose rail operations enter South Africa.
- The Road Traffic Infringement Agency (RTIA) is responsible for discouraging road traffic infringements and for supporting the prosecution of offences.
- The Road Traffic Management Corporation (RTMC) coordinates road-traffic management and is supposed to improve traffic-law compliance and reduce road fatalities.
- Transnet Limited is supposed to operate the port, rail and pipeline infrastructure in a cost-effective and efficient manner.
- Given the cross-sectoral importance of the freight sector, other institutions and departments also play an important role in achieving the central public goals. They are addressed specifically in the numerous strategic plans and frameworks that are described in the following section.

4.2 Key players in logistics: corridor development

During the ongoing process a next stakeholder analysis on relevant actors in the provinces of KwaZulu-Natal (Durban) and Western Cape (Cape Town) and the province of Eastern Cape (Port Elisabeth) was conducted in 2019. The focus was on researching stakeholders that could be relevant for the further development of the GLI:X indicator system for freight and logistics corridors in the context of GLI:X Smart Freight Corridor planning. Further development and specification of the aims of the GLI:X Smart Freight Corridor resulted in the decision to focus on the development of a Smart Corridor between the provinces of KwaZulu-Natal and Gauteng. As such, stakeholders from Western Cape and Eastern Cape have been generally omitted in this version.

The purpose of the stakeholder list that has been developed in the recent months is to outline the key stakeholders that have been identified as part of the work of GLI:X III as relevant for the development and implementation of a Smart Corridor between Gauteng and KwaZulu-Natal. The document follows a consistent structure, in which groups of stakeholders are categorized according to their activities and connection to the Smart Corridor initiative. This document has been continuously updated to include individuals who have provided expert inputs to the held Workshops, as well as individuals from key stakeholder institutions who have significantly contributed to the Workshops and meetings held with the purpose of outlining requirements, objectives, and key steps in the implementation of the GLI:X Smart Freight Corridor.

Group A refers to public and private stakeholders directly involved in the transportation and logistics industry in South Africa and are considered key stakeholders in the development and implementation of the Smart Corridor. Additional stakeholders in this category have been identified relating to sources for financial support, key networks and associations, and universities and research centres.

Group B refers to German logistics and automotive companies that have an active role in South Africa, and represent further opportunities for future cooperation, data collection, and funding.

Group C identifies key German private industry stakeholders involved in the research, development and implementation of Smart Corridor projects. While several individuals and organisations were identified during the course of the 2021 Workshops, it was agreed upon within the GLI:X consortium, together with the partners from Gauteng Department of Roads and Transport, that the initial focus of the 2021 Workshops entailed first bringing together public sector stakeholders before inviting private sector organizations to take part. As such, Group C represents an area for further cooperation in the next steps of implementation of the GLI:X Smart Corridor.

Group D outlines significant Smart Corridor projects that can be used as references for the development of the GLI:X Smart Freight Corridor, as well as individual organizations responsible for implementing Smart Corridor projects, and international logistics and freight forwarding companies.

Additionally, representatives from the National Road Freight Association were considered for participation as part of the 2020-2021 Workshop series, and, while the RFA represents a central partner in the implementation of the GLI:X Smart Freight Corridor, recommendations from our partners from the Gauteng Department of Roads and Transport have resulted in primary engagement with other important stakeholders before engaging with the RFA.

Two Stakeholders have been identified as being central for the involvement in the GLI:X activities to develop the smart freight corridor: Transnet and SANRAL.

Engagement with **Transnet** is ongoing, and representatives from Transnet have been present during each of the four Workshops conducted in 2020-2021. Currently, Transnet is conducting internal discussions to identify key individuals within the organizational structure who can participate and contribute more concretely to the implementation of the GLI:X Smart Corridor. As such, cooperation with Transnet is expected to continue and deepen in the next phase of implementation.

SANRAL is considered as a key partner in the work to be carried out in the implementation of the smart corridor and provided active representatives for three of the four Workshops carried out in 2020-2021. Additionally, analogous to the current internal discussions taking place within Transnet, SANRAL is also undergoing internal realignment to determine which individuals can best contribute to the development and implementation of the GLI:X Smart Freight Corridor. As

such, it is expected that future cooperation with SANRAL will similarly continue and deepen during the next phase of implementation.

The complete list of relevant stakeholders is available at the UBA and may be provided upon request.

5 Workshops for the adaptation and further development of the GLI:X indicator system in two cities / regions of South Africa

5.1 Methodology

One of the research questions of the was project was whether it is possible to transfer the GLI.X indicator system to two further cities or regions.

The port cities of Cape Town, Durban and Port Elisabeth were considered as starting/ending points of the most important transport corridors. Within the previous projects it became clear that the application of indicators for the logistics sector can not stop at the borders of a single province. Logistics and freight transport must encompass all freight transport from origin to final destination in the country, in this respect, the two most important and highest-volume transport corridors in South Africa, located between Johannesburg and Cape Town and between Johannesburg and Durban, should be considered in particular. The port in Durban is the largest port in southern Africa and the main port for Johannesburg. It handled 81 million tons of cargo and 2.7 million TEUs in 2015. Cape Town is home to South Africa's second-largest port, handling a total of 17 million tons in 2015 - nearly 5 million of which were bulk cargo - and nearly 900,000 TEUs. The two cities of Durban and Cape Town with their provinces Western Cape and Kwa-Zulu-Natal as starting/ending points of these corridors are therefore the focus of the project.

Based on expert interviews and extensive desktop research on stakeholders and sources in these two regions, the GLI:X team contacted stakeholders/possible data holders and hlod numerous stakeholder conference calls to assess the interest and potential feasibility of transferring the GLI.X indicator system to these South African cities. In doing so, the GLI:X team engaged hand-in-hand with local stakeholders in an iterative development approach.

5.2 Workshops in Durban and Cape Town, 2019

During June and November 2019, a total of 4 workshops (2 per region) were held in Durban (Kwa-Zulu-Natal) and Cape Town (Western Cape) to discuss the further development and the applicability of the GLI:X indicator system together with local stakeholders. The workshops in June and November focused on identifying which corridor could prove most suitable for the pilot implementation of the GLI:X Smart Freight Corridor. Based on existing contacts and references from the Gauteng Department of Roads and Transport, workshops were conducted to present the GLI:X indicator system and determine avenues for potential cooperation, in addition to thematic areas of further development.

5.2.1 Workshops in June 2019: Introducing the GLI:X indicator system / Define regional goals and challenges in logistics

The workshops in June 2019 generally aimed to introduce the concept of the GLI:X indicator system to the participants and to discuss local requirements, to find application possibilities with relevant local stakeholders in the regions along the main freight corridors in South Africa, and to analyze possible goals for the following phase and the availability of data.

The discussion focused on four central questions:

- What are the main challenges, goals and strategies for freight logistics in the region?

- How would the indicator system be modified to be adaptable to the situation, challenges and goals of the region?
- Who are relevant public and private role players in the region which have to be involved in the process?
- How can collaboration be organized in the future?

In preparation for the workshops, several coordinating meetings were held with members of the Gauteng GLI:X team, who played a key role as communicator and networker with their respective regional counterparts.

5.2.1.1 1st Workshop in Durban

Figure 13: Participants of 1st workshop in Durban

Source: own picture, nexus

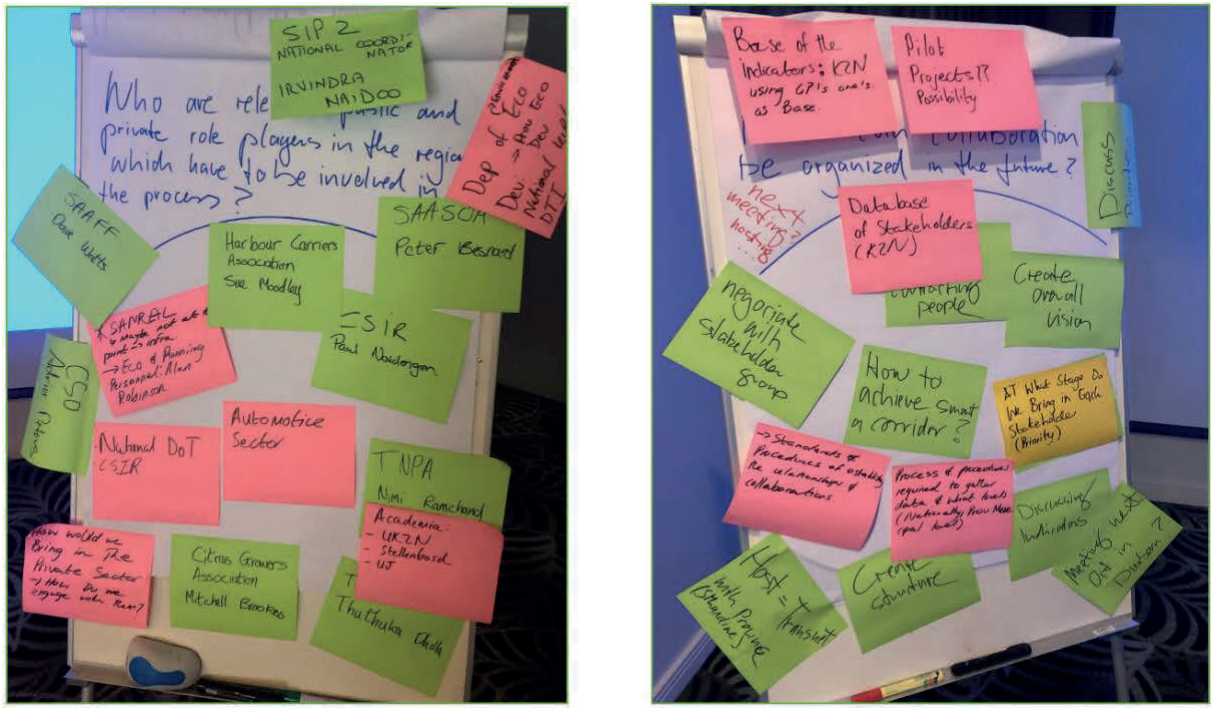
Selected key representatives from the public and private sectors were invited to the first workshop on June 21, to discuss the above-mentioned questions in a small group (7 participants). Present were officials from KZN, GDRT, eThekwini Municipality and Transnet LTD.

As a result of this workshop, the following key needs were identified:

- Need for a mission statement and functional target for the corridor that goes further than "just" investment management in rail and road infrastructures,
- Need for an MoU: to ensure data sharing while maintaining data sovereignty of cooperating partners (win-win strategy) and to enable synergies,
- Need to improve logistics processes along the entire supply chain,
- Need for legislation to support all data collection,

- Need for a vision as well as an action plan for implementation.
- Need for a long-term strategy (definition of framework, selection of example indicators, stakeholder dialogue etc.)
- Need for definition of functions of a "smart corridor" and selection of appropriate indicators for an environmentally sustainable yet efficient corridor.

Figure 14: Replies to the question "Who are relevant public and private role players in the region which have to be involved in the process?" and "How can collaboration be organized in the future?"



Source: own pictures, nexus

5.2.1.2 1st Workshop in Cape Town

A broader invitation was extended for participants to the first workshop in Cape Town on June 24, 2019, which was attended by approximately 30 stakeholders from Western Cape Government, City of Cape Town Metropolitan Municipality, GDRT, GAIN Group und WCDTPW. The discussion focused on the review of the city's freight policy.

As a result of the discussion, Transnet's monopoly position was seen as a key challenge, due to which freight transport does not yet play a major role in Cape Town's strategic planning. However, the problems currently encountered in South African logistics have a significant impact on the efficient functioning of the city: congestion and parking problems affect the competitiveness of South African business, jeopardize the livelihood of small transport companies, and lead to environmental and health problems.

Although interest in the specific indicators was rather low, needs were seen mainly with regard to further bilateral discussions, work in smaller groups with selected participants and the identification of the proper contact persons and those responsible for the process.

Figure 15: Workshop in Cape Town, June 2019

Source: own picture, nexus

5.2.1.3 Comparative analysis of the results of the first workshops in Durban and Cape Town

Table 1: Comparative analysis of the results of the first workshops in Durban and Cape Town

	Durban	Cape Town
Participants	7 Stakeholders	30 Stakeholders
Working-Atmosphere	Very intensive and productive cooperation. Participants showed great interest in a quick implementation and application of the GLI:X indicator system.	Very reserved reactions and low interest in the indicators. Overall, the participants were poorly prepared, despite the provision of detailed information material for each participant as part of the invitation.
Results	Identification of concrete needs for the organizational and content-related cooperation.	Discussion at a general level with little specific information.

Source: own illustration, nexus

5.2.1.4 Lessons Learned from the initial workshops in Durban and Cape Town, combined with the current discussions with the MEC of Gauteng, Mr. J. Mamabolo

As a follow-up to the workshop, in-depth discussions were held with key stakeholders to evaluate the different experiences in the workshops. Among others, discussions were held with MEC Jacob Mamabolo and the German Embassy in Pretoria. According to the interviews, a particular success factor of the GLI:X project – apart from the technical progress – was seen in the fact that the different stakeholders came together at the same table on a common ground to work together. Through its neutral position, the GLI:X team was able to initiate further conversation between stakeholders in a new way, including the re-evaluation of resources. This process should take place not only within the administration, but also between the stakeholders themselves and with relevant partners in countries surrounding South Africa.

The applied approach for the workshop held in Durban resulted in more engagement and participation, due to the small group size, which allowed participants to first lay foundations for their cooperation that could be expanded upon and slowly grow in line with demand. In the workshop in Cape Town, on the other hand, the number of participants was too large and there were noticeable hesitations on the part of individuals to become actively involved in the discussion. Possible reasons for these barriers were seen in the historical rivalry between Johannesburg-Cape Town, in the different political alignments of the ruling parties Johannesburg ANC / Cape Town DA (Democratic Alliance), in the lack of a culture of data sharing between institutions in South Africa (including between individual public institutions and administrations), as well as in internal barriers.

As a result of the initial workshops in Durban and Cape Town, an additional added value of the GLI:X indicator system was observed in which synergies were triggered between stakeholders, and a common understanding of the foundational requirements for successful data gathering and sharing between all involved partners was established.

5.2.2 Workshops in November 2019: regional specific indicators / data availability

To deepen the discussion on regionally specific indicators for mapping regional goals and challenges, as well as to discuss the data situation on GLI:X indicators at the regional level, two additional workshops were held in Durban and Cape Town in November 2019.

5.2.2.1 2nd Workshop in Durban

The second workshop in Durban, "GLI:X- Green Logistics Indicators for South Africa - Towards the Formation of GLI:X for eThekwini / Durban", took place on November 28th, 2019. Present were delegates from the Gauteng Department of Roads and Transport, Harbour Carriers, RFA and eThekwini Transport Authority. The discussion focused on strengthening the freight and logistics corridor between the Durban KwaZulu-Natal region and the Johannesburg - Gauteng region, as well as prioritizing the GLI:X indicators, structuring the process for collecting the required data, and the conditions for building a successful and continuous collaboration between local partners and the two regions.

Main findings

- The national strategy paper "Durban-Free State-Gauteng Logistics and Industrial Corridor (SIP2)" contains many relevant targets and indicators for the "GLI:X Smart Corridor".
- In order to make freight transport along the corridor more efficient, massive investments in road and rail infrastructure are needed.
- The intermodal split should be measured with the GLI:X indicators; the GLI:X indicators should be subdivided into the individual transport goods (freight).
- Multimodal planning is playing an increasingly important role in South Africa; this also applies to freight transport (rail/road) and requires the involvement of relevant stakeholders in the corridor, such as Transnet or the KZN Department of Transport.
- The workshop further demonstrated the importance of active participation with the province of KwaZulu-Natal as a key stakeholder in the GLI:X partner network, particularly for the implementation of the GLI:X indicators in the region.

5.2.2.2 Interviews in Cape Town

Based on the results of the first workshop in Cape Town, and the importance of identifying key contact persons and stakeholders as a foundational step in the process, it was decided to first conduct several expert interviews to better understand the potential interfaces for the implementation of the GLI:X Logistics Indicator system in Cape Town.

The starting point for the selection of interview partners and opportunities for networking and exchange of experiences was provided by Gauteng City Region Smart Logistics Freight Seminar "Gauteng a City Region of Smart Mobility" (October Transport Month), on October 31, 2019, where the GLI:X-Team presented the project approach followed by a discussion. As a result of this engagement, three key experts were identified, and interviews were conducted with the following stakeholders:

- Mr. Donald Grant, Advisor to the Premier of the Western Cape Province
- Councilor Ms. Felicity Purchase, City of Cape Town, Member of the Mayor's Committee on Transport and Urban Development; Mr. David Gretton, Office Manager Mayor's Committee on Transport and Urban Development
- Prof. Dr. Jan Havenga and Ms. Anneke De Bod, University of Stellenbosch, Cape Town, Chair of Logistics
- Several background sessions with Mr. Jacob Mamabolo, MEC for Public Transport and Road Infrastructure, Gauteng

5.3 Initiation and participation to the Workshop “GLI:X Developing an Open Data Strategy for Smart Cities”, Juni 26th,2019

In order to win over the small but very committed digital community in Gauteng for the topic of logistics, the Department of Road and Transport Gauteng (GPDRT) invited to a workshop "GLI:X Developing an Open Data Strategy for Smart Cities" in order to be able to place the topic of transport in the larger urban context and the sustainability dialogue that is already more widespread in this context. Measured by the very engaged contributions to the discussion of the approximately 40 participants, this approach was highly successful, and it was agreed to use logistics and transport in accordance with 2-5 indicators from the GLI:X Logistics Indicators to develop an initial digital strategy with reference to these indicators. Gauteng would be the leading body in these efforts.

5.4 Workshop Johannesburg, November 29th, 2019

The workshop “Digital applications for the optimization of the movement of freight and logistics service provision” on November 29th ,2019, in Johannesburg focused on key questions concerning data acquisition. The workshop was attended primarily by representatives from the GDRT, the Road Freight Association (RFA), Intelligent Transportation Systems South Africa (ITSSA), the University of Pretoria and GeoSys.

Main goals of the Workshop

- The creation and implementation of an application tool with the capacity to identify potential improvements in monitoring freight vehicle movement, effective safety for the road freight transport and to identify opportunities for greater efficiency and higher productivity.

- To agree on a proposal for the development of a data collection app (for GLI:X indicators)
- To discuss how to build a data platform to store and analyse the collected data.

Important findings of the workshop

Results from the questions and discussions raised during the workshop represented detailed responses to the potential challenges, opportunities and goals for the long-term vision and practical implementation of data gathering application tools. Specific and detailed points were raised, some of which have been listed below for reference:

- Importance of establishing agreements concerning both short-term achievable goals and the long-term vision
- Any data to be collected could be sensitive (and misused for illegal purposes)
- Data collection should start with a simple tool and topic that can be used to easily collect data and put it into a data platform (The existing "panic button" in trucks could serve as a useful data source)
- An online survey of truck drivers could provide initial baseline data
- Data that is already available, should be used for modelling
- Other partners (such as private freight forwarders) need to be involved
- The app could also be a management app that supports the Ministry of Transport in its tasks.

5.5 Workshop series “Smart Corridor Development” 2020/2021

After the first workshops and expert discussions, it became obvious that the participating stakeholders are highly interested in the GLI:X indicator system and regard it as a foundation for the development of a database for the optimization of freight transport. Its application is considered especially useful on the transport corridors between Johannesburg and Durban and Johannesburg and Cape Town. Furthermore, it became obvious that the interaction with the private sector, municipalities, academia and civil society organizations such as trade unions on a provincial as well as on a national level needs to be significantly strengthened. For the national level, it was suggested to schedule a "data session" with the twenty most important stakeholders from politics and science. There is also a need for action to create the technical basis for the development of the database, for the already initiated development of tools for the collection of partly regionally relevant transport data (app), and for capacity building for their application.

For South Africa's city regions, the major freight corridors are the country's central linkages and lifelines. These are thus not only an issue of transregional (national) transport policies but are also in the direct spotlight of the city-regions. In order to consider and utilize the interaction of national, provincial, city and international levels, an iterative process of dialogue and development with stakeholders was necessary. The workshop activities, which were structured and separated in terms of time, thus had to be thought of as much more dynamically intertwined and adaptively adjusted. A key role for South Africa's trade and thus the competitiveness of the South African economy is played by the South African port cities of Durban, Cape Town and Port Elisabeth, which play a decisive role in the further development of the corridors between the port cities and the economic centers and mining regions inland. Consequently, the focus was set on the elaboration of a potential indicator strategy for the transnational corridors between Johannesburg-Durban, Port Elisabeth and Cape Town. After the consultation with the potential partners in Durban, Kwa-Zulu-Natal, Cape Town and Western Cape several discussions withing

the Core GLI:X team – consisting of representatives of GPDRT and the Berlin team – took place in the weekly online-meetings to set the path for the next steps to take. Mainly caused by the limitation of existing personnel and financial means, but also caused by different degrees of interest of possible partners, it has been agreed to focus on one corridor to develop in a first step. This 'Smart GLI:X Freight corridor' should be serving as a pilot project to be replicated with other important freight corridors going out of the Gauteng province. This first corridor to be subject of development was decided to be the corridor between the Province of Gauteng to the international trade port in Durban.

In order to implement first steps a series of online workshops was initiated together with the most important stakeholders from the public sector along the corridor.

General aims of the workshop series were the following:

- Define an overall vision and key objectives
- Identify the relevant Indicators for the Smart Corridor
- Identify the key stakeholders and requirements
- Form a core team and build a network of stakeholders / experts.

The workshops were developed in collaboration with the participants. Specialist experts from South Africa and Europe provided insight into existing practical examples, challenges and key factors that play an important role in implementing a smart logistics corridor.

Due to the corona pandemic, the workshops were held online using tools, such as Microsoft Teams and Padlet. These tools offered flexible options for presentations and discussions (panel or small group discussions) that allowed for a productive working atmosphere.

The workshops were originally planned as small-group collaborative discussions, with a selection of ten to fifteen participants each. However, as the invitation of participants and delegation of representatives from participating organizations were carried out by the partners from the Gauteng Department of Transport, the workshops ultimately consisted of a larger group of participants, ranging from 25-60 individuals. As such, the workshops frequently utilized small-group discussions in order to allow all participants to engage with one another and contribute to answering the key questions from each workshop.

5.5.1 Workshop 1: Kick-Off Workshop

The first online Kick-Off-workshop in December 2020 focused on creating a common vision between all involved partners between the Provinces Gauteng and KwaZulu-Natal as well as on identifying the necessary key features for a Smart Freight Corridor on a regional level. Also, the main topics for working on the development of a smart corridor roadmap were elaborated. Thus, the first Workshop set a starting point in conjointly developing a roadmap for the implementation of this freight corridor and the application of adequate GLI:X indicators to measure the success of the project.

Key questions Kick-Off workshop 1:

- What is the overall vision for the GLI:X Smart Freight Corridor? What impact do we want to achieve from implementing it? What are the concrete objectives for the first implementation phase?

- What are the necessary key features / requirements for a Smart Corridor between Gauteng and KZN?
- Which are the key topics for the next Workshops?

During the Kick-Off Workshop, participants were presented with an expert input concerning key components of smart freight corridors. Using the example of the TEN-T corridor network in Europe, an expert from the Senate of the Free and Hanseatic City of Hamburg illustrated that the successful development of efficient and environmentally sustainable freight corridors relies upon the establishment of and continued cooperation between a network of officials, freight forwarders and politicians. Additionally, the expert highlighted the necessity of understanding which data is available to analyse and operate the corridor. The expert further indicated that the work to be conducted through the GLI:X workshop series represents a solid foundation for continued cooperation and the potential for data sharing.

Participants were then invited to join in a discussion concerning the key questions outlined above. The participants came to an agreement that the topic of data collection, management and sharing should represent the first and most crucial topic for future activities pursued by the GLI:X Smart Corridor development. Other important topics for discussion included dealing with financial and budgeting issues, as well as setting up a government structure for the stakeholders that will be involved in the preparations for the corridor and in its implementation.

Figure 16: Results of the survey: Topics for the workshops - Ranking

Source: own survey (Mentimeter), nexus

5.5.2 Workshop 2: Data Gathering / Data Sharing

The Kick-Off Workshop held in December resulted in the identification of topics to be deliberated upon within the following series of workshops. Within the context of the GLI:X Smart Freight Corridor development process, it was agreed that the topic of data collection, management and sharing is essential as a first step for discussion. As a result, the second

Workshop held on May 14th, 2021 focused on primary questions concerning the collection, governance and sharing of data.

Key questions workshop 2:

- Who is collecting the data?
- Who is processing the data?
- Who has data sovereignty?
- Who will use the data?
- How will they use the data?

During the Workshop, key questions concerning data governance, acquisition, storage and usage were addressed as a result of the discussion, and further questions and areas for discussion were established through the active participation and collaboration of the participants. Additionally, it was proposed that establishing workstreams with stakeholders would enable for a more efficient and targeted development in answering the primary questions associated with data acquisition, management and usage that were raised during the Workshop. As such, the GLI:X team was tasked with determining which stakeholders would be able to work together to address targeted questions that will need to be addressed in the development of the roadmap and sought to initiate parallel workstreams in the following weeks.

5.5.3 Workshop 3: Key development components and requirements

The third Workshop, held on June 4th, 2021, addressed key development components and requirements for the Smart Corridor, with particular emphasis on the target values for the GLI:X Indicator system and cost-estimates for the establishment of a smart corridor. Additionally, the topic of Workstreams was discussed, which would serve the purpose of identifying stakeholders that can work collaboratively to address key components for the development of the roadmap and implementation of the smart corridor.

Key questions workshop 3:

- What workstreams need to be implemented? Which topics are essential? (Stakeholder management & Governance, Policy development & Legal framework, Data, Key Components, Financing)
- Who could contribute to which workstream?
- Organization of the workstreams as a stakeholder platform?

During the workshop, steps were made in identifying key questions for the Workstreams, as well as development components that will be essential in the implementation of the Smart Freight Corridor. The primary objective of the Workstreams was agreed upon, through which stakeholders will be able to work collaboratively to answer key questions and deliver proposals for the smart corridor community in each of the five thematic areas.

5.5.4 Workshop 4: Stakeholder management and Governance structure

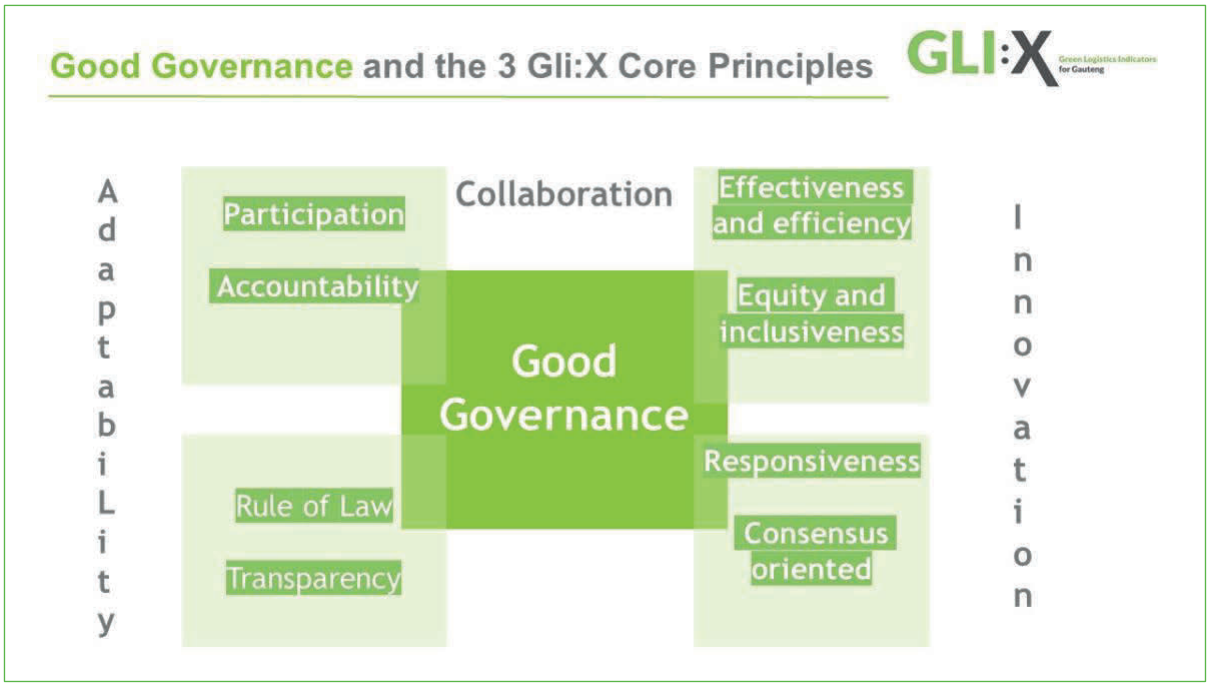
The fourth and final Workshop held on July 2nd focused on the Governance structure for the GLI:X Smart Freight Corridor development and implementation.

In particular, the Workshop dealt with:

- Specification of good governance / cooperation principles
- Definition of guiding goals and mission statement
- Approaching a timeline for the implementation of the GLI:X Smart Freight Corridor
- Develop working methods of the workstreams as a community building tool.

The workshop was held in an active way, providing inputs from data experts as well as incorporating panel and small group discussions, that allowed us to examine the subject from different angles (overarching dimensions): overall vision, (legal) framework, stakeholder involvement and data management.

Figure 17: Presentation slide: Good Governance and the 3GLI:X Core Principles



Source: own illustration, GESI

Key questions workshop 4:

- How can we ensure cooperation according to good governance principles?
- What are our short-term / long-term guiding governance goals?
- Which milestones should we set for future cooperation and governance of the GLI:X Smart Freight Corridor?

During the Workshop, the participants were able to identify key goals and steps that must be taken in order to ensure good governance and cooperation in the implementation of the GLI:X Smart Corridor. In particularly, it became clear that the first and most crucial step to be taken will be to integrate existing memorandum of understanding (MoU) and create an inclusive MoU incorporating all involved stakeholders and partners. The MoU will form the foundation for ensuring trust and transparency for the work to be carried out in the Workstreams, and ultimately in the implementation of the smart corridor. Additionally, further steps to incorporate an independent corridor management institution could be made in order to ensure a trustful equal opportunity for all partners and collaboration.

6 Data Gathering / Implementation Advice

Data gathering and management has been repeatedly identified at several stages in the entire GLI:X project as a crucial component for the successful implementation of the GLI:X Smart Freight Corridor, which depends heavily on whether or not said data is available and up-to-date. Furthermore, the evaluation of the application of the GLI:X indicator system will similarly depend on the availability of and access to data. As such, the requirements and objectives of these work packages are intrinsically related and can be developed in tandem.

Diverse goals of this work package can be summarized as follows:

- Provision of support for the Gauteng Department of Roads and Transport in its efforts to establish a collaborative method of data collection along the corridor, as well as the sharing of methodological experiences and assistance in questions dealing with data collection, data analysis and application.
- Provision of support for the Gauteng Department of Roads and Transport in advancing the GLI:X indicator system. Particular emphasis should be put on the digitization of logistics information, data collection in a smart corridor, and the political process in South Africa.

Activities performed to achieve these goals were manifold. Additionally, planned activities were continually adjusted to represent developing framework conditions at various stages throughout the lifetime of the project, including the effects from the pandemic crisis, political changes in the leadership of the participating provinces, and changes of staff members of the operating teams.

The activities performed and their results can be summarized as follows:

Adjustment of GLI:X indicator system for the initial application of the Smart Freight Corridor: In 2019, the GLI:X team in Berlin, together with the team from Gauteng Province, performed an analysis of the availability of data referring to each of the 51 indicators comprising the GLI:X indicator system. Various methods of data gathering were applied, such as desktop research, expert consultations and carrying out “data workshops”. The information gathered was compiled in a table according to the five indicator groups and was published together with further information in the report “State of Data Availability and Data Assessment” in March 2019. Overall, the data collection process revealed a critical lack of data in the South African logistics sector. While data exists in certain sectors, there are other sectors in which data are not collected at all, are not available in the necessary format, or are challenging to be collected and obtained. The process of data collection therefore proved to be complex and time-consuming. Another significant challenge was a lack of a data-sharing culture between institutions in South Africa - even between individual public institutions. Data sharing is treated as a sensitive issue that requires legal and political support.

The results of the data gathering analysis led to a fundamental shift in our approach to data gathering. The GLI:X team decided to focus on building data-sharing structures and partnerships as a starting point, thereby providing the foundation for an expanded partnership, which would ultimately be capable of building a data storing and analyzing platform in which relevant logistics data could be regularly updated. Furthermore, it was established that the data gathering work should be focused primarily along the smart freight corridor between the provinces of Gauteng and Kwa-Zulu-Natal. Lastly, it was agreed upon to begin data collection with data that targets the most important and accessible GLI:X Indicators.

This led to a selection of 13 of the 51 GLI:X indicators that should be assessed first:

Table 2: Initial GLI:X indicators for the application of GLI:X indicator system at the smart freight corridor

Indicator Category	Sub-category	Indicator
Environment	Emissions	CO_2 Emissions
	Transport Mode	CO_2 Emissions
Cost-Effectiveness	Efficiency	Capacity Utilization Trucks
		Capacity Utilization Rail
	Costs	Share of Logistics Cost in GDP
Time and Speed	Timeliness	Share of Deliveries on Time: Aggregate
	Speed	Avg. Transport Time: Aggregate
Safety and Security	Security	Security Incidents (e.g., hijacking) during road transport/Trucks
		Security Incidents (e.g., theft) during Rail transport
Equitability	Quality of Life	Share of Jobs within Regular Reach
	Inclusion	Share of HDI/BBBEE in Management
	Skill Development	Completed Trainings

Source: own illustration, nexus

Data workshops

Another important activity to explore different methods of gathering relevant data for the GLI:X indicator were the workshops held from 2019 to 2021. These workshops included experts and representatives of local governments and administrations and were dedicated primarily to addressing topics concerning data collection, management and governance. Although the topic of data was raised and discussed in many meetings and workshops, there were two workshops that allowed for a deeper engagement with the central questions and goals concerning data.

Firstly, the workshop "Digital applications for the optimization of the movement of freight and logistics service provision" held on November 29, 2019, in Johannesburg, focused on data acquisition and explored how application tool could identify potential improvements in terms of monitoring freight vehicle movement, safety for road freight transport, and opportunities for greater efficiency and higher productivity. The second workshop dedicated to the discussion of data was the second workshop of the 2020-2021 workshop series that was held on May 14th, 2021. In this workshop, expert inputs and discussions were focused on primary questions concerning the collection, governance and sharing of data.

In both workshop the participants agreed that the establishment of a centralised data gathering system is essential for the application of the GLI:X indicators along the smart corridor. It also was agreed upon to establish workstreams with teams consisting of relevant stakeholders to develop a system for data acquisition, management and usage. Both workshops are described in detail above.

Furthermore, several workshops addressed the specific topic of data gathering. Within these workshops, contributions from external speakers provided participants with an understanding of the importance of establishing partnerships to share data and information and how these structures can be organized and built. These contributions are as follows:

- Presentation held by a representative of the Senate of the Free and Hanseatic City of Hamburg, during the Kick-Off-Workshop of the Smart Corridor Workshop series in December 2020. He expounded upon the existing energy and transportation corridors associated with the TEN-T Core Network, and discussed the institutional framework, financial structure, and international cooperation agreements that form the basis for the network. With a particular focus on the port city of Hamburg, and its role as a crucial node in several trans-European corridors. He emphasized the importance of international harmonization throughout the process of planning and construction for the corridors. He ultimately recommended, for the construction of the Smart Corridor between Gauteng and KwaZulu-Natal, that international agreements and structures be taken into account during the planning process in order to ensure longevity and sustainability for the corridor.
- Presentation held by a representative of DAKOSY Datenkommunikationssystem AG during the workshop "Key development components & requirements" in May 2021, that was part of the Smart Corridor workshop series 2020-2021. She gave an overview on the DAKOSY Hamburg port community system, which was established in 1982 and sought to standardize and integrate data access and usage across the supply chain. She presented an outline of the growth and development of DAKOSY community, included key hurdles and important considerations concerning data sharing, stakeholder management, technological requirements, and impartial communication. She focused on the information flows between the connecting data platform and individual customers. The DAKOSY platform acts as a kind of clearing window that allocates and forwards the relevant information to each customer.

More information on the these and other presentations that were held during the workshop series, as well on the contents of discussions and results, can be found in the documentation attached "Documentation of the Online GLI:X-Workshops: GLI:X Indicators & Smart Corridor Development" (This documentation is available from the project team and the UBA upon request).

Intended visit to Germany of Representative of the two South African provinces Gauteng and KwaZulu-Natal

A visit of the MECs for transportation of the two South African provinces of Gauteng and KwaZulu-Natal was planned in order to share experiences made with the development, implementation and operation of existing smart fright corridors in Europe. The further objectives of this visit were to enable a deeper understanding and knowledge exchange concerning airport logistics hubs (Frankfurt a. M.: Hessen), traffic control management experiences, Smart Harbor management (Hamburg), and enable strategic political discussions.

Due to the Covid-19 crisis, the visit of the South African delegation had to be postponed.

Regular meetings have been held on a weekly basis with the GLI:X team from Berlin, the team from GPDRT and one representative of the corresponding administration unit of the province of KwaZulu-Natal. Frequently discussed topics comprised of:

- The formation of working teams and their topics
- The drafting and signing of MoUs between the existing team and new partners in KwaZulu-Natal, City of Ekurhuleni, City of Durban and divisions of Transnet and SANRAL

- Sharing of advice on methods and applications for carrying out online workshops under COVID-19 conditions
- Key topics, content preparation, expert inputs, and technical implementation requirements for GLI:X Workshop series
- Research conducted on existing Smart Freight Corridors, data gathering application tools, and COVID-19 learnings in the logistics and freight industries
- Updates concerning ongoing developments in the freight and logistics sector in South Africa and Germany, with particular reference to those related to the COVID-19 pandemic.

The Berlin team assisted with drafting MoUs and presented the GLI:X project to new possible partners. One important result of the discussions in these internal team meetings was the agreement to focus in the beginning of forming a data collection and sharing system involving partners from the public sector. The private sector, represented i.e., by car manufacturers, private logistic companies, or suppliers of technical equipment, should be involved at a later stage once the process of forming the basic core partnership between the provinces and cities along the freight corridor between Johannesburg and Durban has been concluded.

Data gathering opportunities during pandemic crisis

Another attempt at exploring how freight and logistic data can be accessed for the implementation of the GLI:X smart freight corridor was to observe the data gathering performed as a response to the pandemic crisis. Relevant projects and mechanisms tracking mobility data have been compiled by the Berlin team and shared with the team in Gauteng. One example is the COVID-19 contact tracing app that is being used in Germany to warn people in the case they are approached by infected people. Another example consists of the measures taken to manage long waiting times at borders for trucks. In order to identify a concrete relation to the work carried out within the GLI:X project, data that was collected in the context of these 'Corona-measures' has been described and corresponding GLI:X indicators were assigned, for example:

- Air quality in cities: In urban areas, the highest NO2 concentrations are typically measured near the main emission source, on busy roads. In addition to traffic, there are other sources - such as industrial plants, power stations, manufacturing industry, private households - which lead to an average basic load of 20 to 30 µg/m^3 (annual average) in urban areas. Measures to contain the corona virus are associated with reduced road traffic and reduced industrial processes. Buses in public transport and private cars are still on the road in cities. An increased volume of delivery traffic must even be expected. However, emissions from private households could also be increased as more people stay at home. A real "crash" of NO2 concentrations in cities cannot therefore be expected everywhere. But studies from one region in Germany showed a reduction of NO2 concentrations by about 40 percent at stations, which is attributed to the reduced traffic volume. (https://www.umweltbundesamt.de/faq-auswirkungen-der-corona-krise-auf-die#welche-auswirkungen-hat-die-corona-krise-auf-die-feinstaub-belastung (17/7/2020)
- GLI:X Indicator: Environment - Emissions

In total 14 stories describing COVID-19-related developments have been compiled during the first year of the pandemic. Details can be found in the report: "Covid-19 experiences made in Germany - Selection of stories and possible GLI:X indicator relation" in the attachment (cp Appendix C).

Research Findings

The GLI:X activities during the last working period experienced several challenges, of which the pandemic crisis had the strongest impact on the work performed. However, it can be concluded that the workshops proved to be a successful method in the further development the GLI:X project, the cooperation between partners and especially the development of the GLI:X Smart Freight Corridor between the provinces Gauteng and KwaZulu-Natal. The stakeholder analysis was finalized and the most important stakeholders that need to be involved in the partnership were identified. The majority of the stakeholders were contacted and the process to formally include them in the GLI:X partnership was initiated. The establishment of a trustful and reliable partnership structure is essential for the successful foundation of a data gathering and sharing system. Thus, the project agreed to start by building this partnership before data and information for the GLI:X assessment can be started. The addition of new partners also led to a simplification of the GLI:X indicators and to the focus on indicators that are relevant for assessing specific events and impacts along the corridor. This is also to be regarded as an ongoing process that depends on several factors, such as the provision of and accessibility to data or infrastructure and technical developments.

Specific outcomes of the various workshop and meetings that took place were that the participants could identify key goals and steps that must be taken in order to ensure good governance and cooperation in the implementation of the GLI:X Smart Freight Corridor. In particular, it became clear that the first and most crucial step to be taken will be to integrate existing MoUs and create an inclusive MoU incorporating all involved stakeholders and partners. These MoUs will form the foundation for ensuring trust and transparency for the work to be carried out in the workstreams, and ultimately in the implementation of the Smart Freight Corridor. Additionally, further steps to incorporate an independent corridor management institution could be made in order to ensure equal opportunity for all partners and collaboration.

Moreover, it can be concluded that the project is currently in a crucial stage. The workshop series and continuous meetings should not be interrupted in order to demonstrate continuity and to build trust between the existing and new partners. This ultimately represents the most important basis for the collection and sharing of data.

The roadmap framework for developing the Smart Freight Corridor also represents an important step during the project. It is essential to follow up with its development and to adjust it to changing conditions so that it becomes a useful plan to guide the implementation of the corridor. Likewise, the research and presentation of good examples of freight-related data gathering systems has proved to be highly useful for the participants and partners in the consortium. Identification of these data gathering systems should be continued to complement and specify specific data gathering issues that are part of the roadmap framework for developing the GLI:X Smart Freight corridor.

7 Strategy and implementation roadmap framework for further development of the GLI:X indicator system on a national level: GLI:X Smart Freight Corridor

Based on the findings of the workshops described in sections 5.1 to 5.3, the vision of a Smart Freight Corridor between a port in South Africa and Gauteng as the most important economic hub in southern Africa was identified for implementation during the stakeholder participation process.

At its core, the Green Logistic Indicators (GLI:X) address the issue of measurability of indicators in South Africa for creating policy instruments for a lower-emission transport flow in logistics. It was found that the core problem is the fundamental lack of accessible and high-quality data. This makes it impossible to create an effective supply chain (smart supply chain). Consequently, the economic development of South Africa is currently being further impeded by the Covid-19 pandemic due to massive logistical bottlenecks, causing even more social tensions (unemployment, poverty) and the impossibility of implementing a strategy to reduce emissions through inefficient transport chains. Therefore, the economic, ecological, and political pressure is extremely strong in South Africa to come up with new control instruments. However, this is only possible if smart digital solutions are used. Thus, the topic of logistics was on the agenda of the German-South African government consultations planned for March 2020 in Pretoria at the initiative of GESI, together with, among others, the associations, the German Chamber of Commerce Abroad (AHK) and also the German government – however, this initiative ultimately had to be postponed due to the COVID-19 pandemic.

The roadmap framework introduced in this paper emerged from the ongoing exchange with the key stakeholders involved in GLI:X and has the full commitment and support of the local partners (governments of Gauteng, Durban, Cape Town, potential IT cooperation partners, partners from logistics such as Road Freight Association (RFA), DHL and German companies from the automotive sector such as VW). As a pilot topic with a potential for high impact and low entry barriers for the development of a data strategy, the Smart Green Logistic Corridor has emerged as the next step.

The roadmap framework was first developed and designed for the national transport corridor from Durban to Johannesburg/ Gauteng (From the point of view of the South African partners, this can then easily be taken transnationally in a next step). The assumption is that the multi-faceted nature of the GLI:X indicator system may promote inter-ministerial cooperation and coherent policy goal setting with regard to the logistics sector.

Considering existing policies and objectives and integrating them into the GLI:X indicator was one of the necessary steps during the development process. Based on the literature research already conducted (see Section 2), the existing strategies and objectives for sustainable logistics in South Africa were expanded and examined in greater depth, analyzed in particular with regard to the smart corridor and digitalization in logistics, and compared with the current design of the GLI:X indicator system.

This made it possible to identify which parts of the current GLI:X process and indicator system are transferable to the national level and which elements may be missing and need to be supplemented on a contextual basis. Through these steps, relevant further, region-specific, influencing variables for the indicator development were recorded and included in the further development and systematization of the GLI:X approach. The findings are summarized in this concept paper with a focus on the development of a GLI:X Smart Freight Corridor as a

recommendation for a roadmap, which describes information on the actors to be involved, suitable methods, and first steps for implementation. Of particular importance throughout the process was the close involvement of South African stakeholders in the development process by the GLI:X team to ensure the sustainable implementation and use of the indicators.

Thus, the roadmap framework is planned as an implementation guideline that can also be used independently and is based on broad expertise. This is intended to provide the participating administrations in South Africa with a tool that can also be used independently in the future.

As for the details please refer to the document "Strategy and implementation roadmap framework for further development of the GLI:X indicator system on a national level: GLI:X Smart Freight Corridor". (cp Appendix A).

Research Findings (Stakeholder perceptions of the vision to develop the GLI:X Smart Freight Corridor)

1. The discussion with stakeholders revealed that a third-party key stakeholder forum such as the GLI:X Workshop series is needed to enable significant changes in the structure of freight transport.
2. It was pointed out by several stakeholders that communication and coordination between responsible private and public stakeholders is indispensable not only in the development of a green sustainable freight logistics concept for South Africa but also in bringing it to life in an acceptable timeframe. For any successful integrative approach, communication and coordination is essential. Public authorities from Gauteng and Kwa Zulu Natal will play an important role in catalyzing and establishing such processes.
3. The focus on corridors is necessary. Establishing freight corridors is a useful approach, not only for technical reasons but also for enabling the organizational structures that are needed to convene the relevant stakeholders in a coherent and efficient way. Efficient governance structures with clear leadership are needed to successively develop the corridors.
4. It is important to communicate the added value of ~~a~~ smart corridor management to all participants of the corridor in order to achieve the desired contributions from the stakeholders (such as: Development of a traffic management system that allows to reduce peak traffic times by decongestioning traffic patterns and to develop last mile solutions / Enable performance benchmarking / Enabling improved coordination between corridor participants /Reducing time delays and improving asset utilization /Reduction of avoidable costs).
5. It is important to communicate the overall benefits to the public and other actors. The connection between a high-quality transport system and improved quality of life needs to be emphasized.
6. Better communication of the advantages for a modal shift in the freight sector is not only relevant to generate acceptance for the implementation of infrastructures but also to generate political acceptance for public funding.
7. Cooperation and alliances between stakeholders need to be promoted to set up a trustful work environment. Trust-building in order to achieve sustained collaborations is essential for success.
8. Efficient feeder traffic and smoothly functioning port terminals are also essential components. The problem of the first / last mile is a serious obstacle to the successful implementation of a smart corridor and must be considered.

8 Process and outcome evaluation

As mentioned before in this report, the processes to implement the GLI:X indicators or, more recently, to plan and implement the GLI:X Smart Freight Corridor, have varied considerably throughout the project lifetime. Several events occurred that could not be foreseen and that either had a positive or negative impact on the current project processes. In order to assess these impacts, the GLI:X team performed interviews with two key persons that accompanied the project from the beginning to its current state. The persons are:

- The Chief Director, Transport Policy and Planning at Gauteng Provincial Government, City of Johannesburg, Gauteng, South Africa
- The Director at Gauteng Department of Transport, City of Johannesburg, Gauteng, South Africa

The interviews have been held at the project end (July 2021) according to the process evaluation method as described in the handbook, 'Evaluation matters: A practitioners' guide to sound evaluation for urban mobility measures'[6]. During the interviews, the clear focus was set on the experiences made during the project from the perspective of GPDRT as the key institution of the project.

Questions asked

- Question 1: What were the main objectives of GLI:X during the project lifetime (chronologically)?
- Question 2: Which important barriers occurred in the process of reaching these objectives?
- Question 3: Which important drivers occurred in the process of reaching these objectives?
- Question 4: How did you react on these positive (drivers) or negative (barriers) events?
- Question 5: What could you learn from these processes?

The replies of both interviews can be summarized as follows:

Objectives

Addressing logistics challenges: The primary objective of the GLI:X project was to address provincial and national freight and logistics challenges, such as congestion on the roads, environmental pollution from trucks, and inefficient systems of movement, which result in higher costs for the consumers and delays in the value chain, damages or externalities that we experience in terms of the adverse effects that the movement of freight has on infrastructure.

Establishing a baseline scenario: When the program was introduced, the indicator system that was developed was intended as a baseline to measure the current state of logistics in the province, as well as its developments over time. Additionally, initial goals were established to evaluate the challenges and goals of various stakeholders, and to explore smart solutions for meeting these challenges.

Policies for economic development: A further objective of GLI:X was to establish freight as a prominent perspective in governmental policy as a driver of economic development. The GLI:X project assisted the team in the province as well as the respective stakeholders to promote the

[6] Katrin Dziekan, Veronique Riedel, Stephanie Müller, Michael Abraham, ..., "Evaluation matters: A practitioners' guide to sound evaluation for urban mobility measures", Waxmann Verlag MÃnster / New York / München / Berlin2013, p. 79 - 93

issues surrounding freight and increase governmental awareness, with the ultimate goal of developing policy solutions.

Forming partnerships: One of the primary objectives of the GLI:X project was to establish cooperation and synergies between partners involved in freight and the movement of goods. This collaborative component of the project was part of the initial objectives of the GLI:X project and was continued to result in the engagement of stakeholders to discuss the development of the Smart Freight Corridor.

Addressing sustainability issues: Additionally, a key objective of the GLI:X project was to consider the sustainability component of freight and logistics and address questions related to which systems are being put in place, how they impact the environment, and how they are contributing to the reduction of emissions.

Defining a common vision: An initial objective was to define the vision of the project and establish goals for what will be accomplished. This objective has now shifted in its second phase to determine what is intended to be accomplished through the implementation of the Smart Freight Corridor.

Barriers, and reactions on them

Limited access to data: In the initial processes, after the co-creation process of the indicator system, a key barrier was in the collection and sharing of data. This showed the importance of data in the process, and how governmental institutions may have certain data, however they may not know where to find the data, are not sure if they are able to share the data, or the data may not be packaged in a way that it could be utilized. Additionally, the sharing of data was very difficult and sensitive, particularly for private companies. Establishing trust between institutions – especially between private companies and governmental bodies – and ensuring motivation for collaboration and the sharing of data was difficult. Also, private companies seem to be reluctant to share data due to competition between other private companies, as well as due to bureaucracy and the willingness of institutions to participate and share data for a project outside the scope of their concern. As a result, a report was also written concerning the limitations experienced in data collection and sharing. Finally, this barrier was addressed successfully in relations between private sector organizations such as Transnet through the signing and continuous revision of Memorandums of Understanding.

Complexity of partner structures: The complexity of organizational structures of several partners was perceived as extremely complex and highly bureaucratic. This slowed down the accomplishment of the objective to find appropriate partners and contact persons for sharing the necessary data. One way of addressing this barrier was to initiate processes that resulted in the signing of a Memorandum of Understanding. Continuous engagement with those organizations, and elevating discussions to higher levels within the organization allowed for increased participation from the private sector and the ultimate signing of the MoU. A further step in the work to be carried out in the next phase of GLI:X will be to collaborate in the development and signing of policies for data sharing with both governmental and private sector organizations to ensure data sharing and cooperation as well as increased trust.

Complexity of the indicator system: A further challenge came from the lack of institutionalization and understanding of the indicator system and the overall objectives of the project. The indicator system was not given enough time to be tested and implemented before moving on to the next phase. The intention of the second phase was originally to select one or two indicators for implementation and testing; however, this objective fell by the wayside as the objective of developing a Smart Corridor became more important. Recent political support for

the project from the new MEC has enabled increased cooperation and convince other partners and stakeholders to participate.

Lack of personal meetings during pandemic situation: Another key challenge has been in the limited scope of discussions enabled through the online format of the workshops compared to face-to-face meetings. Although discussions in the workshops enabled further developments for the 'Roadmap for implementation of the Smart Freight Corridor', they did not allow for informal discussions that are often present during face-to-face meetings. It is intended to address this challenge through ~~a~~ MEC visits and in-person meetings that could take place as part of the next phase of the GLI:X project.

Drivers, and reactions to them

Co-creation helped finding solutions: The co-creation of the indicators was an important milestone, particularly in forging strategic partnerships with different stakeholders. As the indicators were created through collaboration between multi-sectoral engagement and stakeholders (e.g., academia, private sector, governmental institutions), this allowed involved actors to come together and look at problems that manifest in projects that are currently in process and to come up with possible solutions. Especially the collaboration with municipalities has been perceived as an important driver in the work completed through GLI:X. Additionally, deeper engagement with Transnet, as well as with KZN, has represented a significant step in future collaboration and cooperation.

Increasing awareness for holistic goal setting: As the GLI:X project and indicator system incorporated other issues, such as safety and security, environmental impact, and equitability and inequality, awareness could be increased for these issues. This was perceived as helpful for the provision of a systematic process of assessment for these goals.

Pilot Projects: The realization of the objective of developing smart solutions and pilot projects (e.g., e-Cargo bikes) that could address issues of last mile delivery helped to convince possible partners to contribute to GLI:X and helped to obtain a better understanding of which goals must be prioritized. The utilization of this technology to address congestion, last-mile delivery, and environmental issues was a very important milestone. Although there are still challenges from the regulatory point of view to test and implement projects of these types on a larger scale, pilot projects like this will be a key component of further implementation for GLI:X.

Learnings

Setting up Governance Structures: A key learning from the GLI:X project has been the importance of setting up governance structures at the beginning of the process. This allows for the possibility for stakeholders to comfortably engage and cooperation with a clearly defined structure and goal for the collaboration. Additionally, within this structure, it is important to have specific and concrete goals regarding what is to be achieved through the project and ensure consistency in personnel structure throughout the project life.

Keeping it simple: Simplification and institutionalization of the indicator system allows for more implementation and evaluation of the indicators, as well as further usage by governmental departments and private partners.

Pilot Projects to demonstrate benefits: Concrete pilot projects could have been further implemented and upscaled in order to more clearly demonstrate the advantages of smart solutions for last mile delivery and congestion issues.

A clear vision for clear objectives: A key learning from the GLI:X project has been the importance of obtaining support and commitment for the vision and goals of a project. It is only with this support and commitment that it is possible to begin working towards the project goals.

Exchange of knowledge: The exchange of knowledge through international cooperation was an important component of the project, as it allowed for contact between technological developments in different parts of the world, which can be transferred to regional developments. Additionally, this international exchange of knowledge can lead to the implementation of innovative technological tools.

Since the process evaluation method mentioned above is most suitable for the assessment of people who have been involved in the project for a long or the entire duration, only a few interviews could be held. Thus, several expert interviews have also been conducted. These were held according to the following key methodological principles[7]:

Experts can be understood as individuals that function either as *external specialists*, *decision makers*, or *practitioners*. External specialists are called such due to their function, knowledge, and privileged expertise outside the evaluated field. Decision makers can often belong to the evaluated field and hold leading positions that allow them to make decisions that are significant for the design, implementation, and realization of particular measures. Lastly, practitioners are usually not found at the management level, but rather in practically relevant positions, and obtain expert status through their insights into processes and communication structures significant to the implementation of the activities and evaluation.

Advantages of the method[8]:

- Gaining insights into internal courses of action, interactions, processes, and structures (according to Bogner et al. “process knowledge”).
- Reconstructing interpretations (according to Bogner et al. “interpretive knowledge”)
- Experiencing, comparing, and contrasting perspectives and opinions
- Opening the field, i.e., gaining formal and informal knowledge about the dynamics in the field and thus indications of important players and potential interlocuters.
- Making the results more internally relevant through knowledge of the field.
- Making the results more externally relevant by legitimizing them via experts
- Experts for the interviews were found during discussions at the conference: “Gauteng City Region Smart Logistics Freight Seminar - Gauteng a City Region of Smart Mobility" on October 31, 2019, in which the GLI:X project, including the plan to implement the indicator system on an exemplary transport corridor, was presented. Several participants expressed interest in the topic and revealed to be experienced stakeholders from the government, freight and logistics industry. Other experts were selected from previous research of relevant stakeholders undertaken by the GLI:X team in the first working phases.

Results of the expert consultations

The participants of the meeting showed great interest in the idea of the GLI:X Green Logistics Indicators with its cross-sectoral and multi-stakeholder approaches but were not surprised

[7] Bogner, A., Littig, B. & Menz, W. (Hrsg.), (2009). Experteninterviews. Theorien, Methoden, Anwendungsfelder. Wiesbaden: VS-Verlag

[8] Vgl. Bogner, A., Littig, B., & Menz, W., (2014). Interviews mit Experten. Eine praxisorientierte Einführung. Theorien, Methoden, Anwendungsfelder. Wiesbaden: VS-Verlag, S. 18ff

when we told them about our difficulties in presenting the GLI:X Indicators System during the first workshop in Cape Town. Especially in Cape Town, the success of a presentation of a project seems to depend on approaching the right people in administration and politics. But nevertheless a project like GLI:X, which operates from a politically and economically "neutral" position, has the potential to create a situation in which the stakeholders can approach each other in a new environment in a neutral, unencumbered way and bridge the gap between politics and practice.

A provincial government official stated that the development of a corridor management policy has been one of the projects the Western Cape has supported since 2015. However, he said that the priority area of action for him initially was the development and improvement of road safety, given the poor road conditions and many traffic accidents on the corridor between Cape Town and Gauteng.

He stressed that systemic change in the Western Cape province would only be possible through relevant and coherent action by government departments in cooperation with the private sector, municipalities, academia and civil society organizations such as the trade unions.

Another expert from the city government explained, that the Western Cape Province government adopted a freight strategy in 2019 with a focus on reviewing the city's freight policy. Freight network inefficiencies in particular, and the resulting lack of economic development, are a major problem in the region. Historically, freight has not played a major role in the city planning of Cape Town, as the central government, through Transnet, has a monopoly on all land-based freight modes, with the exception of road. However, the problems currently facing South African logistics have significant implications for the efficient functioning of the city. The low performance of the various Transnet units results in trucks queuing at the port, which affects the competitiveness of South African business, threatens the livelihood of small transport companies, causes congestion and parking problems, and leads to environmental and health problems. These issues all affect the functioning of the City of Cape Town, and the city government believes that the city needs to be more directly involved in freight and logistics issues. The lack of cooperation and willingness to talk from Transnet as the port operator and the corruption issues in the sector presented the city with challenges that are difficult to resolve.

A senior university expert outlined that current South African policy makers have already identified the need to develop a data strategy and the corresponding urgent need for action as a driver of South Africa's economic and social development.

Results from the process evaluation interviews and the expert consultations, can be summarized by the following key points

The implementation of the GLI:X indicators system is highly relevant and can contribute to South Africa's competitiveness. The implementation of the GLI:X Smart Freight Corridor between the provinces Gauteng and Kwa-Zulu-Natal can thereby be regarded as a pilot project to demonstrate the system’s benefits. Establishing data gathering and processing systems plays a crucial role for this implementation.

Exchanging knowledge to find best solutions is very helpful for building a roadmap for the implementation process. It can be facilitated through international cooperation, presentation of innovative technological tools or though conducting multi-stakeholder sessions on national level.

Setting up governance structures is one of the mayor key elements for the exemplary implementation of the GLI:X indicator system along the GLI:X Smart Freight Corridor.

Stakeholders should conjointly develop a common vision and clearly derived objectives of what is to be achieved. Also, there should be consistency in personnel structures wherever possible.

To build this partnership the GLI:X project and its team provides a "neutral" position to address and combine existing corridor and logistics strategies, identify and develop new topics and motivate potential partners that are important for the process of building the corridor to join the initiative.

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A Appendix: Roadmap: A Framework for a GLI:X Smart Freight Corridor (GLI:X Corridor) Gauteng (Johannesburg) - KwaZulu Natal (Durban)

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A.1 Introduction

The GLI:X III project: Implementation and Development of GLI:X Green Logistics Indicators in South Africa contributes to the transformation of the South African freight transport system towards greener resource efficiency, and efficiency and seeks to strengthen business to promote the economy and thus improve sustainable social development in the long-term. This subsequently stimulates job creation, which opens up employment opportunities in South Africa.

During the first two phases, the GLI:X project developed more than 50 indicators that can be applied to a better, more sustainable freight logistics.

The practical implementation of the indicators was assessed in the current third phase by developing the vision of a smart green freight corridor in the pilot corridor area between KwaZulu-Natal/Durban and Gauteng/Johannesburg. As a result of this third stage, this roadmap - as a guideline for the development and implementation of a green, safe and efficient "smart" transport corridor concept with practice-oriented application possibilities - was developed, which addresses the interface and connection with between urban and long-distance freight transport.

To accomplish this roadmap framework, it was essential to engage key stakeholders in a carefully moderated workshop series, consisting of four parts, as well as through other consultation measures, to identify their views about the related challenges, barriers, trends, opportunities and win-win potentials.

This roadmap framework provides an overview of current recommended practices and highlights some of the critical components for the planning, design and development and maintenance of the GLI:X Smart Freight Corridor[9]. It represents the current state of the work between the partners that developed it.

Thus, it should be seen as a document that provides first directions for the development of the smart corridor, rather than a complete and final plan.

Note: The overall process has been accompanied by increasing political attention throughout the project period, as a result of which, among other things, a cooperation agreement between the MEC of the Departments of Public Transport and Road Infrastructure, Gauteng, and the MEC for Public Works, Roads and Transport, KwaZulu Natal, will be used to apply key objectives of the GLIX Logistics Indicators to the to-be-developed Smart Freight Corridor N3.

[9] As for a detailed description of all necessary steps and components you may refer to Kunaka, Charles, and Robin Carruthers. 2014. Trade and Transport Corridor Management Toolkit. Washington, DC: World Bank. doi: 10.1596/978-1-4648-0143-3. License: Creative Commons Attribution CC BY 3.0 IGO

Figure 1: Planning and Concept Phase Main Tasks

Source: NCHRP report 899 - Broadening Integrated Corridor Management Stakeholders

A.2 Definitions of smart trade and transport Corridors (cf. Joint Africa-EU Strategy) 10

"A trade and transport corridor is a coordinated bundle of transport and logistics infrastructure and services that facilitates trade and transport flows between major centers of economic activity. A formal trade and transport corridor is typically coordinated by a national or regional body, constituted by the public or private sectors or a combination of the two."[11]

Thus, in accordance with the Joint Africa-EU Strategy,[12] a "Smart corridor" is understood as consisting of the following elements:

SMART stands for "Safety, Mobility and Automated Real-time Traffic Management". This represents a transport corridor with quality infrastructure to carry intraregional and international cargo; Intelligent Transport Systems (ITS) for real-time information; and the implementation of WTO and REC trade and transport facilitation tools, policies etc.

- ITS – Intelligent Transport Systems: Software and hardware technology implemented on the corridor to rationalize, simplify, and automate processes in order to save time and money.

  ITS further entails technologies that provide access to information through telecommunications, which includes the network infrastructure and communication tools used to interface stakeholders' various operational systems.

[10] https://www.africa-eu-partnership.org/sites/default/files/userfiles/t1.1interconnecting_africa_-_smart_corridors_programme_auc.pdf

[11] Kunaka, Charles, and Robin Carruthers. 2014. Trade and Transport Corridor Management Toolkit. Washington, DC: World Bank. doi: 10.1596/978-1-4648-0143-3. License: Creative Commons Attribution CC BY 3.0 IGO

[12] https://www.africa-eu-partnership.org/sites/default/files/userfiles/t1.1interconnecting_africa_-_smart_corridors_programme_auc.pdf

The following features should be included:

- Provide real-time information on corridor traffic movements to stakeholders to enable them to manage the necessary processes effectively.
- Enhance corridor efficiency through trade and transport facilitation; reduce cargo transportation time and costs, increase safety and security of transport services.
- Ease the opening-up of trade for landlocked countries.
- Enhance corridor countries' competitiveness.

In the context of South Africa, a "Smart Corridor" has the following spatial and infrastructural references: Ship routes, port accessibility, unloading/loading of cargo, and from there truck/rail, transport truck/rail, unloading/loading at freight hubs or at the customer, distribution and last mile.

A.3 Vision for the GLI:X Smart Freight Corridor

- Develop a green, efficient (modal split) transport corridor concept for the N3 Gauteng - KZN Corridor that is resilient, resource efficient, climate and environmentally friendly, safe and smooth
- Create a smart supply chain that is secured by a data collection and processing system and allows reductions in peak traffic times by decongestioning traffic patterns and the development of last mile solutions
- Develop a traffic management system in the corridor area that makes better use of the existing infrastructure capacity of the highway by equalizing peak traffic time and additional measures

A.4 Selected Best Practice examples (Examples of typologies of smart corridors)

The overall aim of this chapter is to illustrate how smart freight corridors could be achieved in selected geographical areas, and what measures were taken. These exampled served as an orientation towards developing the GLI:X Smart Freight Corridor roadmap framework.

This detailed research report is on hand at the project team and the UBA and will be provided upon request (Research document: Smart Corridor Developments).

A.5 GLI:X Smart Green Logistic Corridor Roadmap Project main questions

- How can we leverage the existing infrastructure to create a green, more efficient, safer, and sustainable logistics solution?
- What are the recommendations for first steps?
- Which milestones are suitable to track progress (short-/ long-term)?

These main questions were broken down by the participants in the workshop series into several topics to be addressed:

- The most striking is the high degree of interest in data collection/data management/data sharing. It is seen as a key factor in the development of the smart corridor (especially the combination of private owned and public data. Tracking data also plays a role in this context, although it was rated as somewhat less important.
- Budget/finance and stakeholder involvement/governance structure are also seen as very important for implementation. They are necessary to ensure the sustainability of the project.
- The definition of the overall vision/key objectives is considered as the basis and fundamental condition for the development of smart corridors and is necessary to set clear objectives.
- In addition, it is important to address the legal framework and existing agreements to ensure targeted implementation. It is important to know the framework. Thus, it is helpful to consider the international perspective to ensure that the national smart corridor is embedded in the international network (transnational relationships).
- The key development components / technical and infrastructural requirements to develop the corridor are discussed as less urgent.

A.6 Framework and challenges of corridor development in South Africa

A.6.1 The Political and Economic Framework

The vision of transitioning South Africa towards a green economy has been declared at the highest political level and the green economy agenda is articulated in the macro-economic policy framework and national development vision. Green economy is seen as an important means to respond to a wide range of critical and intertwined development challenges that range from unemployment, poverty and inequality to climate change.

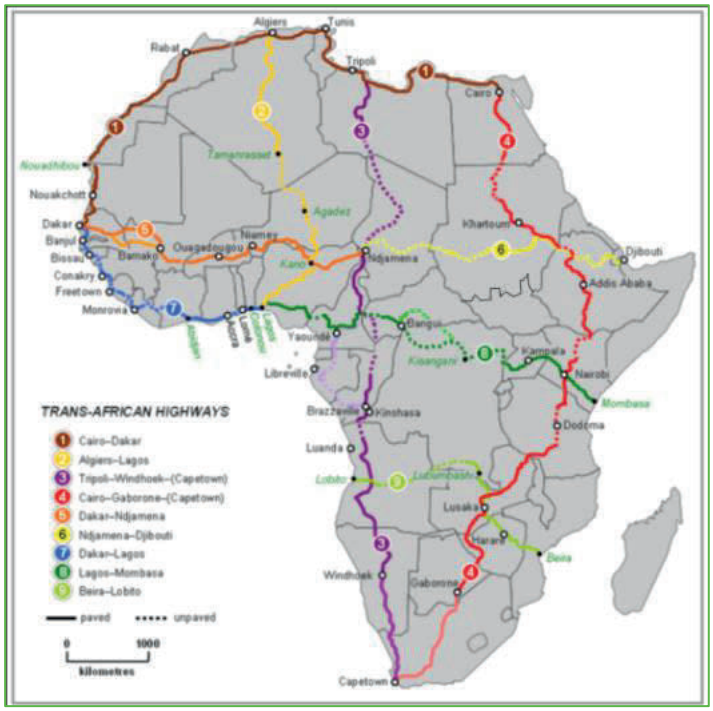
In recent years, South Africa has developed extensive national policies and strategies to support a green economy[13], outlining the current policy and regulatory framework that provides the foundation supporting the greening of the freight logistics sector.

The government of South Africa, specifically highlighted in its National Transport Master Plan (NATMAP) 2050[14] on Corridor Policy, the regional development of corridors within the COMESA-EAC-SADC tripartite free trade area.

[13] National Development Plan (NDP) Vision 2030 /White Paper on National Transport Policy)National Transport Master Plan (NATMAP) 2050 / Green Transport Strategy (GTS) / Road Freight Strategy 2017 / National Rail Policy Draft White Paper 2017

[14] Republic of South Africa, Department of Transport (2016): National Transport Master Plan, NATMAP 2050. http://www.transport.gov.za/de/natmap-2050 (viewed 29.04.19)

Figure 2: The Trans-African Highway Network



The Trans-African Highway network comprises transcontinental projects in being developed by the United Nations Economic Commission for Africa (UNECA), the African Development Bank (ADB), and the African Union in conjunction with regional international communities.

Source : https://de.wikipedia.org/wiki/Trans-African_Highways

This area consists of 22 countries stretching from Cape Town to Cairo. NATMAP highlights several challenges in the area of tri-partite transport and transit facilitation, including the lack of policy and regulatory harmonization and corruption. They result in poor working conditions for professional drivers, high transportation costs, lack of punctuality and speed, and low competitiveness. "Reducing transportation costs and cross-border challenges, improving corridor efficiency, and logistics are central to regional integration" (NATMAP 2050, p. 7-6). To achieve this goal, "strategies are required to improve modal integration, corridor development, and improved regional national coordination and alignment of transportation agencies, and authorities" (NATMAP 2050, p. 6).

The Durban/Gauteng corridor is to be upgraded both by rail and by road. To this end, a state development company has been set up to manage investments in infrastructure. However, the development of a digital infrastructure alongside the transport corridors, which is quite expensive according to standard concepts, is lacking and has not yet been planned due to cost limitations. Thus, alternative digital and significantly more cost-effective, low-tech solutions are needed to generate a high user benefit for all sides (truck drivers, logistics service providers, infrastructure operators) at low cost, leading directly to higher efficiency in logistics and, at the same time, to significant reductions in emissions through congestion reduction and improved traffic management. To increase efficiency and thus reduce emissions, the Smart Corridor requires the development of digital applications that can be installed and made usable in an adapted manner with little effort.

The future of freight transport is based upon a change of the modal split, an increasing shift to rail, combined with an improvement of the highways[15]. However, this will take time and require

[15] The 2017 National Rail Policy Draft White Paper drives a long-term vision 2050 agenda and is aligned with the National Development Plan 2030 in supporting the government's broader objectives to an intermodal shift. To reposition rail to play its future

high investments, which cannot be ensured in a short-term perspective against the backdrop of the current tight financial budget. In addition, many bottlenecks in road, rail, sea and air transport in today's infrastructure cannot be transformed to create new connections. Therefore, other short-term solutions must be identified that will lead to more efficient freight logistics on already existing infrastructures.

In this regard, the GLI:X Smart Green Logistic Corridor roadmap framework focuses on the highway as a first step. In the next step, which should take place in the near future, the question of how to achieve a shift from road transportation to rail transportation will be addressed. This is a key element in achieving a sustainable reduction of several environmental impacts, such as the reduction of CO2 emissions (cp. Chapter 6.3).

The key issues of the highway (Highway N 3) are its erratic congestion due to various peak times, presumably due to variable arrivals of vessels at the port(s), serious traffic accidents (closures) and security issues such as frequent incidents of theft, etc.

Consequently, the slow or standstill traffic leads to further emission pollution, indefinite delivery times, and high transport as well as follow-up costs. Ultimately, this also endangers the competitiveness of the locations involved through the migration of important enterprises, e.g.in the field of logistics or of very on-time, supply-chain-dependent enterprises (such as the automotive companies) further north across the national borders.

The design of the smart corridor needs to be low-tech, easy to implement and user-friendly in the beginning, and must be cost-effective, technically not very vulnerable, and easy to operate and use.

As the two endpoints, Durban and Gauteng, are connected without significant intersections and exits and entrances along the highway, the N3 corridor is particularly suitable as a pilot area.

A.6.2 The environmental impacts on logistics transportation

The project area in the Gauteng Province, South Africa, is the economically strongest region in Africa, with a gross national share of about 10%.

The Durban to Gauteng freight corridor (N3 Corridor) forms the backbone of South Africa's freight transportation network, carrying more than 40 million tons of freight annually, with approximately 9,000 heavy vehicles using the national highway daily, and is critical to supporting the country's economic growth. The main components of the bulk freight corridor consist of the Port of Durban, well-developed road, rail and pipeline links to Gauteng, and inland freight terminals to serve the extended Gauteng area and countries north of the border. Durban is considered the country's most important gateway port and is a handling point for about two-thirds of South Africa's containers, as well as the majority of liquid fuel and car cargoes. On the other hand, South Africa is the 14th largest global emitter of CO2 in the Greenpeace ranking. For this reason, a CO2 tax was recently introduced in South Africa. Unfortunately, e-mobility likely does not represent a possibility for rapid alleviation of this issue, as coal-fired power generation still accounts for the lion's share of energy production. For this reason, further solutions must be identified, particularly in the freight corridors, as to how emissions can be reduced and energy use can be made more efficient through optimized logistics processes and an increase in

role as preferred land transport freight mode and backbone with which all other transport modes integrate, the paper states that a comprehensive modernization approach is needed. At the same time the imbalance between road and rail usage has to be leveled and competitive neutrality between road and rail pricing has to be set up. (Executive Summery, Department of Transport, Pretoria 2017, National Rail Policy Draft White Paper 2017)

infrastructure utilization, thus boosting economic growth and reducing the high unemployment rate.

Smoothly functioning mobility and goods transport are not only a basic prerequisite for the economy, but also for people's everyday lives, for social participation, flourishing economic exchange and quality of life. Urban and economic growth thus leads to urgent sustainable logistics solution needs, as road freight transport is the second largest contributor to carbon emissions in South Africa after electricity.

A.6.3 Challenge of CO2 emissions in road freight transport

South Africa's total annual CO2 emissions for 2015 were approximately 417,160 kilotons (European Commission, 2016). Of this, the transport and logistics sector accounts for approximately 10.8% of South Africa's national greenhouse gas emissions[16] (approximately 47,600 kilotons of CO2 emissions). The pure CO2 emissions from road freight transport can now be quantified at more than 16.8 million tons per year - over one-third of total road transport emissions[17].

Freight transport in South Africa is dominated by two modes of transport: road and rail. The majority of freight, about 89% of the country, is transported by road (CSIR 2018). The current dominance of road transport is not only related to high-value goods, perishable goods, or short transport distances, but has also recently been extended to freight transport of low-value bulk commodities such as coal and iron ore, which used to be the domain of rail transport. This is due to the low quality and lack of maintenance of rail infrastructure, as well as the current perception of unreliability (vandalism, theft, unpunctuality, etc.). In addition, companies prefer to shift freight transport to road, as road deliveries can offer flexibility to both suppliers and customers (just-in-time delivery). Only an estimated 7.5% of this road freight could be shifted to rail[18].

Statistically, an average of 47,610,000 tons of freight is transported by road each month in South Africa (calculated from data from Jan 2008 to Nov 2019[19]). In comparison, freight transported by rail averages only 17,472,000 tons monthly.

Therefore, freight corridor policy is faced with the particular challenge of making freight logistics faster, more efficient and more reliable on the one hand, while also placing the environmentally sustainable climate goal of CO2 reduction at the central focus of its further development strategies.

The South Africa Road Freight Strategy (Policy Guideline, 2017) emphasizes the need to leverage international best practice systems, technologies, and efficient management to not only achieve high quality standards for a sustainable road freight sector, but also reduce environmental impact. It explicitly emphasizes that a reliable indicator system is urgently needed with regard to road freight transport in the corridors, as there is no readily available information on the origin and destination volume of road freight transport due to the lack of systems to collect such

[16] vgl. Department of Transport (2017): Green Transport Strategy 2017-2050

[17] vgl. Lee-Anne Terblanche, A framework for sustainable road freight decarbonisation in South Africa, Universität Stellenbosch 2019

[18] Havenga, J.H.; Simpson, Z.P.; King, D.; de Bod, A.; Braun, M. (2016): Logistics Barometer South Africa 2016

[19] Statistics South Africa, https://www.ceicdata.com/en/south-africa/freight-transportation-volume-transported-and-income/freight-transportation-land-ton-road)

data[20]. Most of the information that has been published comes from calculations based on surveys and industry data.

A.7 Data management as the key to smart governance decisions in logistics

Bringing together and using data is the most important basis for managing complex systems such as logistics chains, traffic loads, efficiencies, and energy use. The savings potential in South Africa is estimated to be up to 30% if only the high number of e.g., empty runs can be reduced by goods and logistics management and e.g., a common marketplace. Only based on reliable and meaningful data (smart data instead of big data) can good policy decisions be made, and appropriate measures developed to improve logistics processes, as well as their effects analyzed. Thus, the issue of data management has become the central focus of the Gauteng government over the past six months. The lack of data availability and data management was also repeatedly identified as one of the major barriers to Africa's economic development at the most important African railroad congress (Africa Rail) held in Johannesburg on June 19-20, 2019 (where the GLI:X indicators were also presented). Therefore, if the envisaged pilot corridor project succeeds, it will have a high multiplying effect for many African logistics spaces and transport corridors far beyond national borders.

A.8 Concept Development - Approach

A.8.1 The Model Corridor

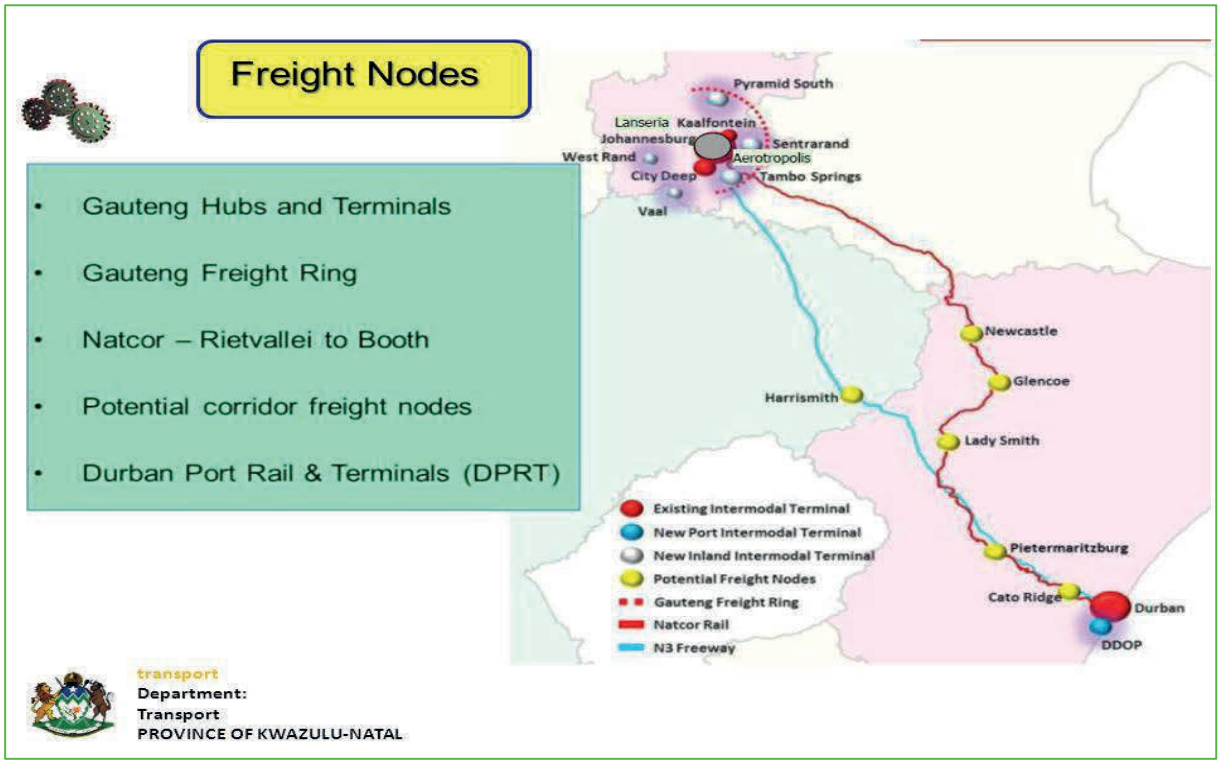
The model corridor area is the N3 national route between KwaZulu-Natal (KZN) with the port city of Durban and Gauteng, Johannesburg. This freight corridor forms the backbone of South Africa's freight transportation network and is vital in facilitating economic growth for the country. The main components of the bulk freight corridor consist of the Port of Durban, well established road, rail and pipeline links to Gauteng, and inland freight terminals to service the broader Gauteng area and countries to the north of our border.

Here, more than 39 m tons/year are transported both by rail and road/highway between ports with their connections to global trade routes and the economic center and logistics hub of Gauteng.

The two provincial governments, KwaZulu-Natal and Gauteng, are seeking close cooperation in the development of the pilot project.

[20] Department of Transport (2017): Road Freight Strategy, S.33

Figure 3: Durban – Gauteng Corridor Structure



Source: Department: Transport, Province of KwaZulu-Natal

Route information:

Length: 578 km

Maintained by Sanral[21], N3STC[22], eThekwini Metropolitan Municipality[23]

The N3 is divided into 12 sections, starting with section 1 in Durban and ending with section 12 in Johannesburg. Between the two cities, the road bypasses most cities in between (except Pietermaritzburg).

A 415 km section of the N3 transport corridor is only usable upon the payment of a toll, which will be maintained by the he N3 Toll Concession (RF) Proprietary Limited (N3TC), who entered into a 30-year toll road concession contract with the South African National Roads Agency (SOC) Limited (SANRAL) However, most of the toll areas can be avoided by using the R103[24].

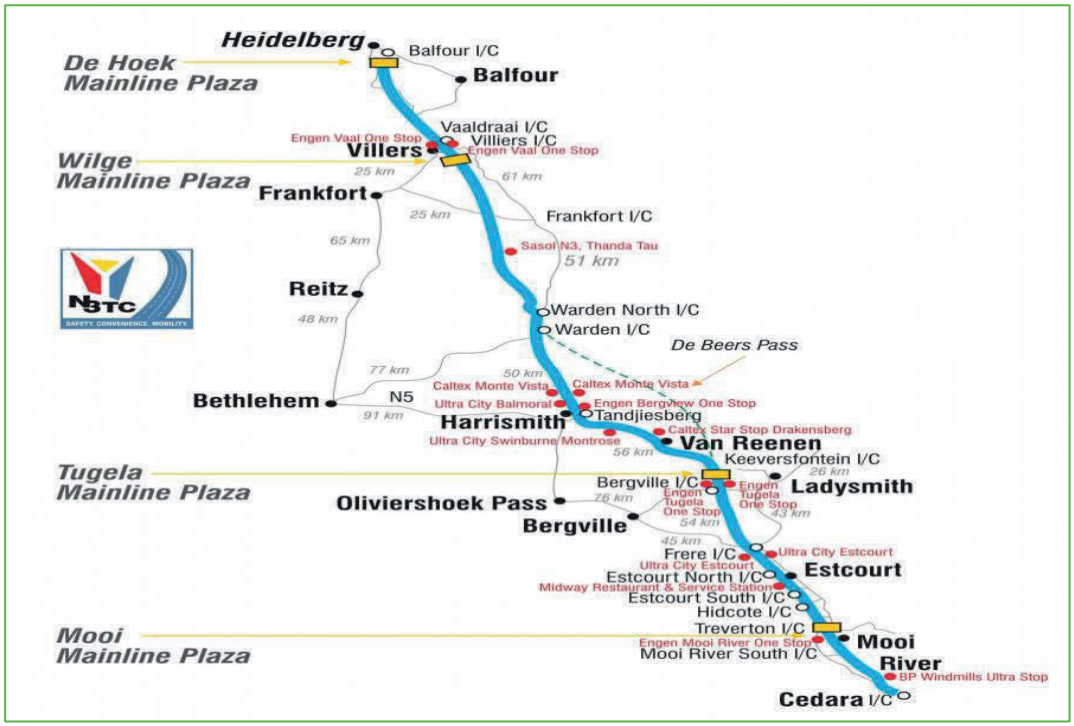
[21] Website SANRAL: https://www.nra.co.za

[22] Website N3 Toll Concession (RF) Proprietary Limited (N3TC) , http://www.n3tc.co.za

[23] Website: http://www.durban.gov.za/Pages/default.aspx

[24] the R103 is a Regional Route in South Africa that is the designation for some of the old sections of roads that were previously the N3 prior to upgrading. It only has 3 sections, from Hillcrest to Ladysmith, from Warden to Villiers and from Heidelberg to Johannesburg.

Figure 4: N3 Toll Route



Source: http://www.n3tc.co.za

A.8.2 Current Challenges of N3 Corridor Development

According to literature analysis and discussions with several key stakeholders along the corridor, the main challenges on the current corridor are the following:

- Lack of up-to date information and data on movements of goods, persons, and associated services along the corridor to inform policy, investment, business decisions and an efficient traffic control management
- Perceived costs of doing business
- Corridor competitiveness
- Importance of building trust between the stakeholders involved
- Data confidentiality and security
- Political and economic framework: national / provincial
- Lack of data management policies

South Africa is one of the few countries in Africa with a widespread rail network. Thus, it is also aiming to shift freight from road to rail. However, this will only be possible in the medium or long term, as rail is currently only of limited use as an alternative transport system to relieve the N3. The reasons for this are lack of funding and a rail logistics system that is not optimally set up.

However, it is still essential to conduct a detailed assessment of the current infrastructure of the N3 corridor and its hinterland for each section before starting the pilot project in order to

identify the corridor's traffic problems, diagnose the underlying causes of the problems, and develop ways to work around them.

A.8.3 Key Corridor Stakeholder Participation

Building a team of stakeholders to assist with the planning and design of the smart corridor is an important first step in moving forward.

Figure 5: Integrated Corridor Management Stakeholder Examples

Source: own illustration GESI/nexus (based on "NCHRP report 899 – Broadening integrated Corridor Management Stakeholders Example")

Stakeholder Involvement: It is important to involve all potential stakeholders early in the process and encourage them to participate. Even if some of them do not want to participate initially, they should all be nevertheless invited.

Those who do not want to participate initially should be kept in the loop about the ongoing process and the decisions that will be made. Initially reluctant parties may later turn out to be strong contributors.

Stakeholder benefits: It is important to identify and communicate the benefits of participation to the stakeholders, as this can help them to justify committing to the project. Thus, there is a need to understand the business models of every partner to find incentives for them to become involved.

Stakeholder agreements: Another important point is to initiate stakeholder agreements (Memorandum of Understanding (MoU): In the early stage a general MoU describing the shared vision, roles, responsibilities, and tactical agreements made among all key stakeholders is suggested. It is thereby assured that they all share the same understanding and are committed to active participation in the process. In the second step, individual MoUs with each stakeholder, depending on the role, level of participation and individual needs might be necessary.

Contributions requirement by participating stakeholders: Provide description of available data and information on operations.

Stakeholders already involved in the GLI:X Smart Corridor development

- Public Sector: Ports (Johannesburg/ Durban), Customs, Rail Operator (Transnet), Road Operator (Sanral), Road Freight Association, Police, Provincial and Local Government, Gauteng, KZN
- Private Sector: Logistics Companies, Shipping lines, Manufacturer

Note: The detailed report (GLI:X III Overview Stakeholders Corridor Development) is available to the project team and UBA and may be provided upon request

A.8.4 Conceptual Stakeholder Approach

Our basic assumption was that political and economic decisions should be based on a broad understanding of the perspectives of all relevant stakeholders, and that coordinated and collaborative efforts would be more efficient than trying to arrive at these decisions on one's own. The providers and users of transportation services are the ones who ultimately decide which transportation modes will be used. Only if they, together with service and infrastructure providers as well as regional governments, share their views on the key criteria required for a successful implementation of a smart green corridor, can important insights be gained, contributing to create a win-win situation for all parties. The process of developing this roadmap was therefore designed to elicit these views and facilitate the emergence of synergistic ideas.

Thus, a key feature of this GLI:X Project was the emphasis on stakeholder dialogues in order to arrive at policy recommendations that are feasible to implement and effective in reaching their goals. During the duration of the project, a series of workshops was held, each with a limited number of carefully selected stakeholders. These events were complemented with one-to-one interviews to obtain in-depth expert knowledge that cast light on the feasibility of different policy instruments and possible solutions. Furthermore, we presented the GLI:X III project ideas at the 22nd Africa Rail Conference 2019, from the 19th-20th of June 2019 in Johannesburg, as well as in seminars.

Another key issue throughout the project was the analysis of how barriers to adoption and implementation could be overcome. In this process, the views and standpoints of the stakeholders had to be considered to develop recommendations for potential solutions.

As a result, this roadmap is primarily based on the stakeholder debates that took place during the GLI:X 3 workshop series.

A.8.5 Conceptual Infrastructure Approach

The current conceptual infrastructure approach is oriented toward optimal utilization of currently existing infrastructures. In the long term, a significant shift toward intermodal solutions is desired and necessary. For this, integrative approaches must be developed.

A.8.6 Identification and Establishment of First Goals

Identifying Goals

Goals reflect key priorities for desired outcomes for the transportation system and/or society. The vision of the GLI:X Smart Freight Corridor is to achieve significant improvements in the

efficient movement of people and goods on transportation networks through aggressive and proactive integration of existing infrastructure along the N3 corridor. By applying an intelligent management system approach, it is possible to manage the corridor as a multimodal system and make operational decisions for the benefit of the corridor performance.

As discussed, and identified by the stakeholders, the main the goals of GLI:X Smart Freight Corridor project generally involve:

- Improving travel time
- Increasing corridor flow
- Improving travel time reliability
- Improving incident management
- Enabling intermodal travel decisions
- Improving safety for all travelers

Goals to reduce negative impacts on transportation network performance can include decreasing delay (freeway mainline, ramps, arterials), vehicle hours traveled, peak period duration, emissions, fuel consumption, speed variability, and primary and secondary incidents. Goals to maximize benefits for the traveling public can include increasing capacity, speeds, transit ridership, and transit on-time performance (these will be the possible objectives of the already envisioned first pilot Project GLC).

Establishing Objectives

Objectives are specific, with the GLI:X indicators[25], measurable statements that support the achievement of goals and play a key role in shaping investment and policy priorities. The following table maps some example objectives to the addressed goal areas and the corresponding GLI:X Indicators:

Table 1: Establishing Objectives Examples

Goal	Objective	GLI:X Indicators
Eco-friendly freight service	Reduce CO_2 emission Resource sfficiency Rethink transport mode	Indicators 1-6
Improve travel time	Provide alternative route and mode options Reduce impacts of incidents Reduce construction work during peak times	Indicators 7-28
Improve travel time reliability	Facilitate the movement of people and goods with minimal congestion and time delays, and greater predictability. Enabling and enhancing ITS (e.g., dynamic traffic signal control and vehicle sensor systems.)	Indicators 7-28

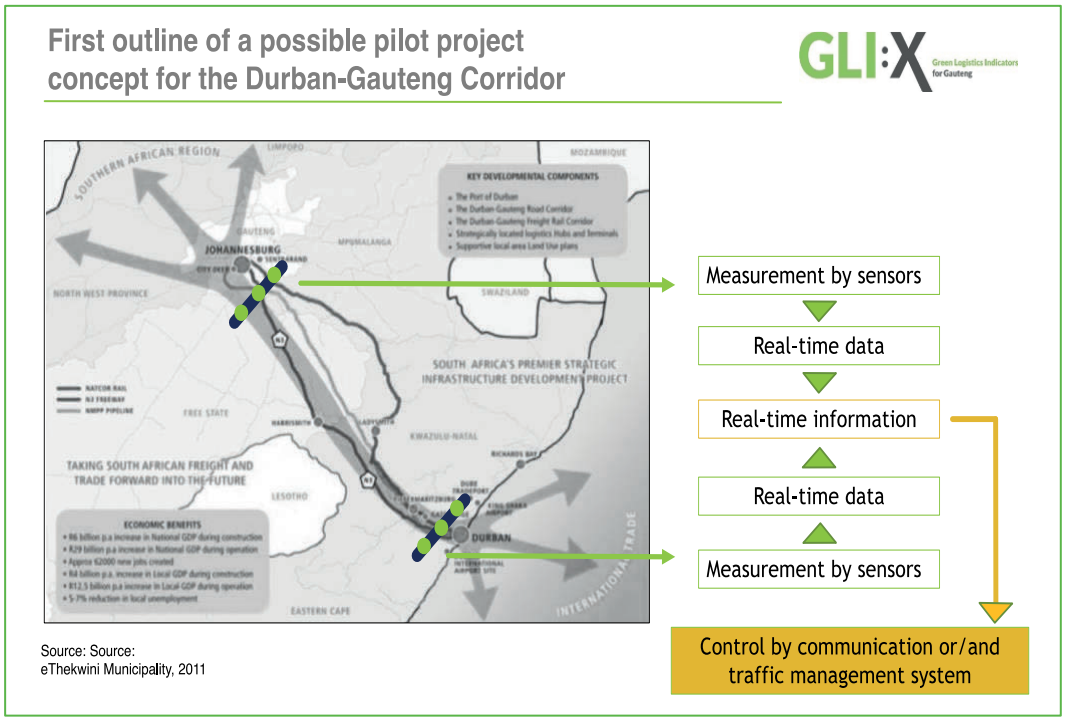
[25] A detailed description of the GLI:X indicators can be found at: GLI:X, Green Logistics Indicators for Gauteng, South Africa.

Goal	Objective	GLI:X Indicators
Improve Safety and Security	Reduce Incidents Reduce incident response times Reduce assaults and hijackings	Indicators 32-39
Social Equitability	Inclusion (e.g., Share of HDI/BBBEE in Management)	Indicator 45

Source: own illustration GESI/nexus

A.8.7 Significance of using Intelligent Transport Systems (Sensor Technology and Data Sharing)

Figure 6: Outline of a possible pilot project[26]



Source: own illustration, GESI (based on picture source: eThekweni Municipally 2011)

As described above, the GLI:X Smart Freight Corridor will initially make use of the already available infrastructure. Using advanced information and communication technology, it is possible to optimize the efficient management of transport operations and supply chains. This requires data to be generated on a much larger scale than is currently the case. Efficient supply chain management and intelligent logistic systems therefore have an additional impact on security and carbon footprint reduction.

[26] This model assumes that the two provinces involved have to collect data independently of third parties, so that there is no PPP cooperation in which privately collected data (e.g., through tracking or from Sanral) would be made available for joint mobility management.

Preliminary steps required to set up an Intelligent traffic and transport management system

Analysis of legal instruments: Establish data sharing / security laws and regulations[27].

- Data Availability / Quality: As it became apparent during the GLI:X processes that all currently accessible governmental data is outdated, there is a need to identify the data sources already available from all stakeholders for a detailed assessment of each corridor segment in terms of its potential for operational strategies.
- The quality of these data needs to be determined.
- Data sharing: Agreements on how to share the data are essential.
- Database: The development of a corridor-wide database is a core element of the smart corridor development process.
    - Address stakeholder concerns about data confidentiality and security: The authorization level of operators and users of a database must be strictly regulated and constantly updated as the project progresses, and necessary modifications must be identified and implemented.
    - Data exchange must be one-way only.
    - No data from individual participants shall be displayed - only aggregated statistics.
    - No competitors shall have access to each other's data.

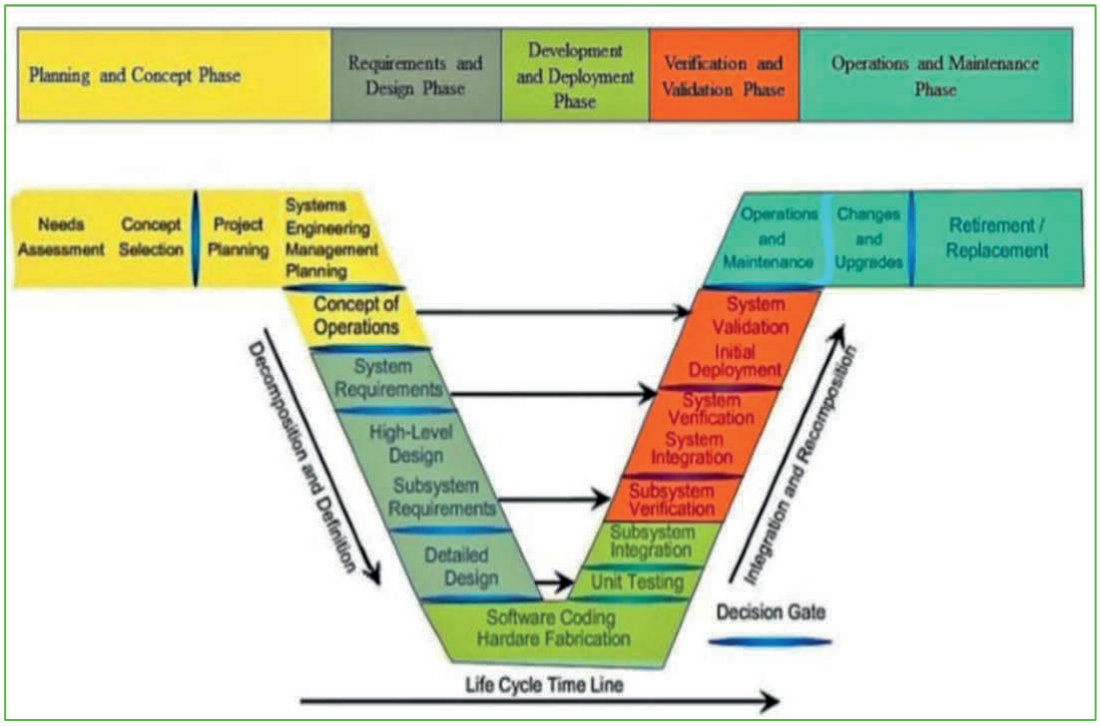
During the discussions in the workshops, it became clear that there is still a great need for coordination with the main stakeholders on these aspects.

Preferred Layout method for the Traffic Management System for the GLI:X Smart Freight Corridor

- Keep it simple
- Real-time Data
- Easy use
- Low infrastructure requirement

[27] For detailed explanations of the current status of legal developments in the area of data management and data security, please refer to the presentation "Gauteng Province-Wide Transport
Data Sharing Policy" by GPDRT, Workshop 2, May2021 (the presentation is on hands to the project team and UBA and may be provided upon request)

Figure 7: The V-Systems Engineering process to a structured ITS implementation approach[28]



Source : FHWA ICM Implementation Guide[29]

A.8.8 Data Sources that could be used

In correspondence with the set goals, it is necessary to identify the necessary data sources for a detailed evaluation of each corridor segment with respect to its potential for operational strategies.

Table 2: Potential Data Sources

Data Source	Stakeholder	Performance scope
Cross-border	Customs authorities	Time to cross borders
	Freight forwarder	
	Truck GPS tracking	
Overload control	Toll Agencies/ Road agency weighbridges	Evasion of weighbridges
		Percentage overloaded

[28] The "V-Diagram" Systems Engineering Process shown in in this figure has been used in the last 20 years to guide the planning, design, and deployment of all types of ITS including the early stages of ICM. In this framework, there are five phases. The first, the Planning and Concept Phase, includes Needs Assessment, Concept Selection, Project Planning, Systems Engineering Management Planning, and development of the Concept of Operations. (Source: FHWA ICM Implementation Guide, https://connected-corridors.berkeley.edu/sites/default/files/fhwa_implementation_guide_v2.pdf)

[29] Source : FHWA ICM Implementation Guide, https://connected-corridors.berkeley.edu/sites/default/files/fhwa_implementation_guide_v2.pdf

Ports	Port operators	Truck waiting time at port gates
	Truck GPS tracking	Percentage customs infractions
	Truck GPS tracking	Number of route deviations
	Traffic cameras	Accidents / Construction work / Traffic congestion

Source: own illustration GESI/nexus

A.8.9 Monitoring and Evaluation: GLI:X-Indicator System as a Monitoring-Tool for the sustainable GLI:X Smart Freight Corridor

Measuring the impact and benefits of the designed ITS is important for continuous improvement of the ICM system, for communicating its benefits to policy makers, and to ensure the system is operating as expected.

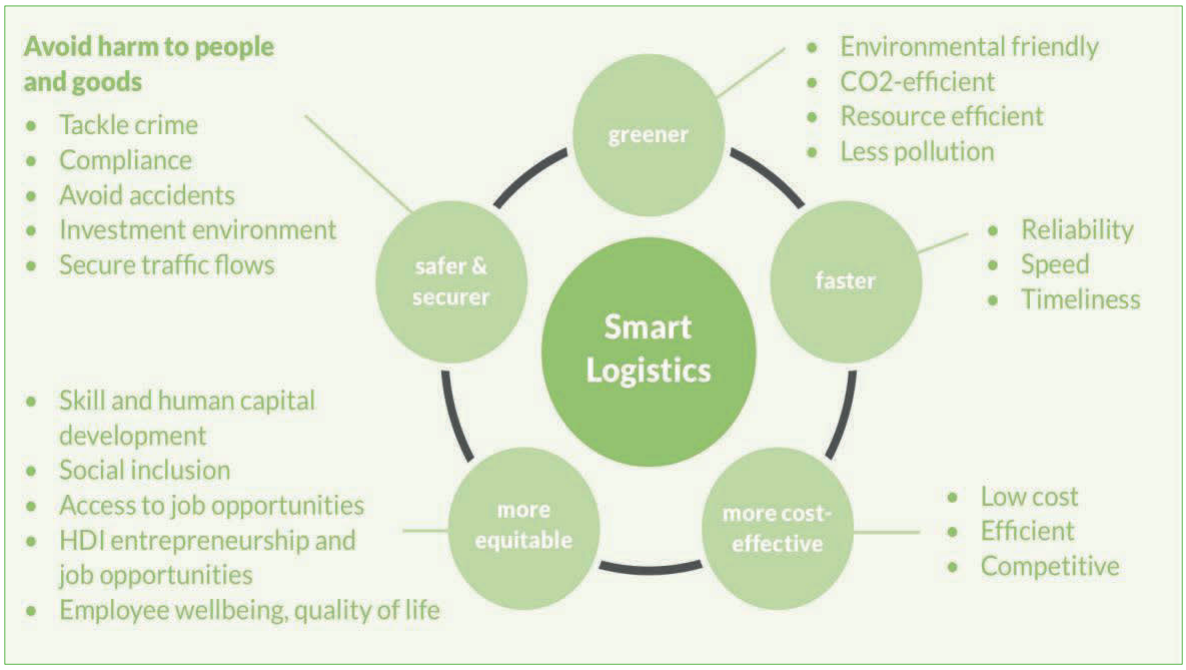
With the Green Logistic Indicators (GLI:X)30, which is at the core of the question of the measurability of indicators in South Africa for the instrumentation of a lower-emission transport flow in logistics, an efficient tool was provided that allows for the verification of the set targets to be achieved.

Thus, it meets the request of the South Africa Road Freight Strategy (Policy Guideline, 2017), which explicitly emphasizes that a reliable indicator system is urgently needed with regard to road freight transport in the corridors, as there is no readily available measurement tool to control the emphasized impact to policies and measure the corridor performance[31].

[30] As for a detailed description of the GLI:X Green Logistics Indicator refer to: https://nexusinstitut.de/wp-content/uploads/2019/03/Broschüre-Green-Logistics-Indicators.pdf

[31] A strategy for road freight transport 2017, S.33

Figure 8: The GLI:X Indicator System



Source: own illustration, GESI/nexus

A.8.10 Corridor Management Institutions[32]

To develop the GLI:X Smart Freight Corridor and ensure that it functions efficiently and coordinates the numerous parties involved in a corridor, the establishment of a corridor management system is necessary.

Corridor management is about getting the various parties to work together to create plans and strategies and implement actions that complement efforts to improve the overall performance of the corridor. This can be a complex undertaking, however, as it involves balancing the often-conflicting interests of all stakeholders. Patience and long-term consultation and a willingness to reach a consensus are important to ensure that solutions are acceptable to all involved parties. Convincing the partners that the smart corridor is necessary is essential to making the corridor management successful in the long run.

In the last workshop on roadmap development, a lecture by a representative of the former Maputo Corridor Management Institute[33] stated that there are several options for corridor management, both at the state (provincial) level or by an independent third party, and that all models have advantages and disadvantages.

Regardless of the level of governance structure, the point was made that stakeholder need to be in agreement concerning the following questions before making a decision:

- What is best suited for the GLI:X Smart Freight Corridor - a management structure or a monitoring structure?

[32] For a detailed toolkit refer to: Adzigbey, Y., C. Kunaka, and T. N. Mitiku. 2007. "Institutional Arrangements for Transport Corridor Management in Sub-Saharan Africa." SSATP Working Paper 86, World Bank, Sub-Saharan Africa Transport Policy Program, Washington, DC.

[33] For details, please refer to: B. Mommon, The Development of a Smart Corridor between KwaZulu-Natal and Gauteng_2 July 2021.pdf (The presentation is available to the project team and UBA and may be provided upon request)

- How should a governance structure be formalized and empowered to manage the corridor (Public/Private/Public-Private-Partnership), and what power do its decisions have over governments?
- How should the governance structure be funded (possible options include national contributions based on a fixed budget, assignment of experts from the country providing the space, and international grants)?
- Where will the structure be based, and where are its jurisdictional boundaries (immunities)?

During the following discussions amongst the participants, it became clear that there is still a great need for coordination with the main stakeholders on these aspects.

Possible Business Model Examples

- Public Private Partnership
- Public
- Partners
- Collective (Hamburg Model)
- Fee

A.9 Funding Strategy

To develop the funding strategy[34], all intended Smart corridor projects or applications should first reviewed to determine all the types of components included in the projects. All potential funding sources then need to be researched at the international (e.g., World Bank, African Development Bank) federal, state, provincial, and local level, as well as with consideration of private funding sources, and assigned as potential funding sources to each project or application. It is suggested to bundle projects, or applications, into packages based on funding cycles, project readiness, cost, etc. and included as part of an overall phasing plan.

A.10 Milestones

- Milestone 1: Development of a database by 2022
- Milestone 2: Development of a successful pilot project by end of 2022
- Milestone 3. Successful implementation of the GLI:X Smart Freight Corridor main goals as described in chapter 8.6 by 2023

[34] For a detailed toolkit refer to: Kunaka, Charles, and Robin Carruthers. https://documents1.worldbank.org/curated/en/719971468325781473/pdf/Trade-and-transport-corridor-management-toolkit.pdf, Page 103ff

A.11 Outlook / Future Corridor Development

Development of a joint traffic control center for the GLI:X smart corridor with the Gauteng-KwaZulu Natal interfaces.

A.12 Research Findings (Stakeholder perceptions of the vision to develop the GLI:X smart green freight corridor)

1. The discussion with stakeholders revealed that a third-party key stakeholder forum such as the GLI:X Workshop series is needed to enable significant changes in the structure of freight transport and the joint development of a smart freight corridor.
2. It was pointed out by several stakeholders that communication and coordination between responsible private and public stakeholders is indispensable not only in the development of a green sustainable freight logistics concept for South Africa but also in bringing it to life in an acceptable timeframe. For any successful integrative approach, communication and coordination are essential. Public authorities from Gauteng and Kwa Zulu Natal will play an important role in catalyzing and establishing such processes.
3. The focus on corridors is necessary. Establishing freight corridors is a useful approach, not only for technical reasons but also for enabling the organizational structures that are needed to convene the relevant stakeholders in a coherent and efficient way. Efficient governance structures with clear leadership are needed to successively develop the corridors.
4. It is important to communicate the added value of smart corridor management to all participants of the corridor in order to achieve the desired contributions from the stakeholders (such as: Development of a traffic management system that allows to reduce peak traffic times by decongestioning traffic patterns and to develop last mile solutions / Enable performance benchmarking / Enabling improved coordination between corridor participants /Reducing time delays and improving asset utilization /Reduction of avoidable costs)
5. It is important to communicate the overall benefits to the public and other actors. The connection between a high-quality transport system and improved quality of life needs to be emphasized.
6. Better communication of the advantages for a modal shift in the freight sector is not only relevant to generate acceptance for the implementation of infrastructures but also to generate political acceptance for public funding.
7. Cooperation and alliances between stakeholders need to be promoted to set up a trustful work environment. Trust-building to achieve sustained collaborations is essential for success.
8. Efficient feeder traffic and smoothly functioning port terminals are also essential components. The problem of the first / last mile is a serious obstacle to the successful implementation of a smart corridor and must be considered.

A.13 Further suggested readings

National Academies of Sciences, Engineering, and Medicine 2020. Planning and Implementing Multimodal, Integrated Corridor Management: Guidebook. Washington, DC: The National Academies Press. https://doi.org/10.17226/25906.

Kunaka, Charles, and Robin Carruthers. 2014. Trade and Transport Corridor Management Toolkit. Washington, DC: World Bank. doi: 10.1596/978-1-4648-0143-3. License: Creative Commons Attribution CC BY 3.0 IGO. https://documents1.worldbank.org/curated/en/719971468325781473/pdf/Trade-and-transport-corridor-management-toolkit.pdf

Note:

All power point presentations and documentations mentioned in this paper that cannot be found are available to the project team and UBA and may be provided upon request.

B Appendix: GLI:X Indicators and Governmental Goals

Goal	Category	Indicator	Governmental Goal	Corresponding Strategy/ Policy Paper
Environment	**Emissions**	CO_2 Emissions	The strategy aims to reduce the transport sector greenhouse gas emissions by at least 5%	Green Transport Strategy/ NATMAP
		PM10 Emissions	To reduce fossil-fuel related emissions in the transport sector by promoting norms and standards for fuel economy and putting in place regulations that promote improved efficiency in fossil fuel-powered vehicles and improved environmental performance of fossil fuels In conjunction with cities, DoT will assist with draft regulations requiring 10% of the Municipal fleets to be converted annually to energy efficient vehicles	Green Transport Strategy
		NO_x Emissions	To reduce fossil-fuel related emissions in the transport sector by promoting norms and standards for fuel economy and putting in place regulations that promote improved efficiency in fossil fuel-powered vehicles and improved environmental performance of fossil fuels In conjunction with cities, DoT will assist with draft regulations requiring 10% of the Municipal fleets to be converted annually to energy efficient vehicles	Green Transport Strategy
	Resource Efficiency	Land Use Logistics Sector	To develop best practice guidelines to ensure that integrated, climate-friendly transport options are incorporated into land use and spatial planning at national, provincial and local levels	Green Transport Strategy

Goal	Category	Indicator	Governmental Goal	Corresponding Strategy/ Policy Paper
		Primary Energy Use	20% reduction in the average vehicle energy intensity (measured in MJ/km) of the South African road vehicle fleet	National Energy Efficiency Strategy
	Transport Mode	Freight Modal Split	Achieve a 30% shift of freight transport from road to rail in the next 5-7 years	Green Transport Strategy
Cost-Effectiveness	**Efficiency**	Capacity Utilisation Trucks	To optimise current capacity and maintain and develop the road network	National Transport Policy White Paper
		Capacity Utilisation Rail	To improve South Africa's competitiveness and that of its transport infrastructure and operations through greater effectiveness and efficiency to better meet the needs of different customer groups, both locally and globally	National Transport Policy White Paper
		Capacity Utilisation Hubs	To improve South Africa's competitiveness and that of its transport infrastructure and operations through greater effectiveness and efficiency to better meet the needs of different customer groups, both locally and globally	National Transport Policy White Paper
	Economic Sustainability	Average Return on Investment (ROI)		
	Costs	Share of Logistics Cost in Producer Price of End-Product	To enhance the quality, productivity and cost-effectiveness of road freight transport services by providing transport customers with a safe, secure, reliable and cost-competitive system	National Transport Policy White Paper
		Public Infrastructure Cost Due to Logistics	To invest in infrastructure or transport systems in ways that satisfy social, economic or strategic investment criteria	National Transport Policy White Paper

Goal	Category	Indicator	Governmental Goal	Corresponding Strategy/ Policy Paper
		Share of Logistics Cost in GDP	A key goal is to build South Africa's competitiveness in international trade by ensuring that the region's competitive advantages can be accessed and marketed. The transport element in the cost of agricultural products, raw materials, and manufactured goods can be a significant and deterring factor in the final cost of both exports and imports.	National Transport Policy White Paper
Time and Speed	**Timeliness**	Share of Deliveries on Time: Road	To enhance the quality, productivity and cost-effectiveness of road freight transport services by providing transport customers with a safe, secure, reliable and cost-competitive system	National Transport Policy White Paper
		Share of Deliveries on Time: Rail	Vision: Rail as an affordable, competitive, effective, integrated, reliable, safe, sustainable and valued transport mode that provides the backbone of South Africa's freight logistics and passenger mobility systems and strengthens its economic growth and social development by 2050	National Rail Policy
		Share of Deliveries on Time: Aggregate		
		Avg. Standard Deviation of Transport Time: Road	To enhance the quality, productivity and cost-effectiveness of road freight transport services by providing transport customers with a safe, secure, reliable and cost-competitive system	National Transport Policy White Paper
		Avg. Standard Deviation of Transport Time: Rail	Vision: Rail as an affordable, competitive, effective, integrated, reliable, safe, sustainable and valued transport mode that provides the backbone of South Africa's freight logistics and passenger mobility systems and strengthens its economic growth and social development by 2050	National Rail Policy
		Avg. Standard Deviation of Transport Time: Aggregate		

Goal	Category	Indicator	Governmental Goal	Corresponding Strategy/ Policy Paper
		Avg. Standard Deviation Trans-loading Time: Bulk	Enhancing the performance of seaports and inland terminals	National Development Plan
		Avg. Standard Deviation Trans-loading Time: Container	Enhancing the performance of seaports and inland terminals	National Development Plan
		Avg. Standard Deviation Trans-loading Time: Packages	Enhancing the performance of seaports and inland terminals	National Development Plan
	Speed	Avg. Transport Time: Road	To enhance the quality, productivity and cost-effectiveness of road freight transport services by providing transport customers with a safe, secure, reliable and cost-competitive system	National Transport Policy White Paper
		Avg. Transport Time: Rail	Vision: Rail as an affordable, competitive, effective, integrated, reliable, safe, sustainable and valued transport mode that provides the backbone of South Africa's freight logistics and passenger mobility systems and strengthens its economic growth and social development by 2050	National Rail Policy
		Avg. Transport Time: Aggregate		
		Avg. Trans-Loading Time: Bulk	Enhancing the performance of seaports and inland terminals	National Development Plan
		Avg. Trans-Loading Time: Containers	Enhancing the performance of seaports and inland terminals	National Development Plan

		Avg. Trans-Loading Time: Packages	Enhancing the performance of seaports and inland terminals	National Development Plan
		Condition Index Transnet	Vision: Rail as an affordable, competitive, effective, integrated, reliable, safe, sustainable and valued transport mode that provides the backbone of South Africa's freight logistics and passenger mobility systems and strengthens its economic growth and social development by 2050	National Rail Policy
		Share of Cases Solved	To optimise road transport law enforcement and promote and implement efficient, integrated, and coordinated road traffic management systems in the country, involving the role-players in all functional areas of road traffic management	National Transport Policy White Paper

Goal	Category	Indicator	Governmental Goal	Corresponding Strategy/ Policy Paper
		Value of Insurance Claims	The safety, security, and quality of service of some modes of transport are currently below acceptable levels. The government is committed to a concentrated and integrated effort to bring the quality in line with international best practice. Particular attention will be paid to road and rail safety. Improved safety and security are critical for achieving a shift of traffic from road to rail. This includes the protection of the rail system from theft and vandalism of rail assets and rail goods in transit.	National Transport Policy White Paper
		Security Incidents (eg Heists) at Warehouse and Logistics Hubs	The safety, security, and quality of service of some modes of transport are currently below acceptable levels. The government is committed to a concentrated and integrated effort to bring the quality in line with international best practice. Particular attention will be paid to road and rail safety. Improved safety and security are critical for achieving a shift of traffic from road to rail. This includes the protection of the rail system from theft and vandalism of rail assets and rail goods in transit.	National Transport Policy White Paper
		Security Incidents (eg Hijacking) at Road Transport/Trucks	The government is aiming to achieve a 50% reduction in fatalities in 2020	Action for Road Safety 2011-2020
		Security Incidents (eg Theft) at Rail Transport	Improved safety and security are critical for achieving a shift of traffic from road to rail. This includes the protection of the rail system from theft and vandalism of rail assets and rail goods in transit.	National Transport Policy White Paper
	Safety	Avg. Response Time to Incidents: Road	The safety, security, and quality of service of some modes of transport are currently below acceptable levels. The government is committed to a concentrated and integrated effort to bring the quality in line with international best practice. Particular attention will be paid to road and rail safety. Improved safety and security are critical for achieving a shift	National Transport Policy White Paper

Goal	Category	Indicator	Governmental Goal	Corresponding Strategy/ Policy Paper
			of traffic from road to rail. This includes the protection of the rail system from theft and vandalism of rail assets and rail goods in transit.	
		Workplace Incidents and Injuries Caused by Truck Accidents	The safety, security, and quality of service of some modes of transport are currently below acceptable levels. The government is committed to a concentrated and integrated effort to bring the quality in line with international best practice. Particular attention will be paid to road and rail safety. Improved safety and security are critical for achieving a shift of traffic from road to rail. This includes the protection of the rail system from theft and vandalism of rail assets and rail goods in transit.	National Transport Policy White Paper
Equitability	**Quality of Life**	Daily Commuting Cost	To enhance the competitiveness of South African industry and the quality of life of its citizens by providing for the protection, safety and security of consumers, as well as meeting accessibility, reliability and mobility needs by providing transport infrastructure.	National Transport Policy White Paper
		Share of Jobs Within Regular Reach of public Transportation	To enhance the competitiveness of South African industry and the quality of life of its citizens by providing for the protection, safety and security of consumers, as well as meeting accessibility, reliability and mobility needs by providing transport infrastructure.	National Transport Policy White Paper
		Daily Working Hours	Fair and acceptable labour practices, workers' rights, job creation and security, sound working conditions, health and safety, and welfare benefits of employees in the industry will be promoted and, where appropriate, regulated.	National Transport Policy White Paper
		Share of Employees with Health Insurance	Fair and acceptable labour practices, workers' rights, job creation and security, sound working conditions, health and safety, and welfare benefits of employees in the industry will be promoted and, where appropriate, regulated.	National Transport Policy White Paper

Goal	Category	Indicator	Governmental Goal	Corresponding Strategy/ Policy Paper
	Inclusion	Relative Turnover of HDI SMME Against Non-HDI SMME in Logistics Sector	Qualifying Small Enterprises (QSEs) as defined in this charter, will also commit to: • Increase the ownership base of their companies and ensure that a minimum of 25% of economic interest is in the hands of Black people: • 25%+1 voting rights, or equivalent thereof, are in Black hands, • Ensure that the net economic value of the Black equity participants is 25% equity share of the enterprise within 5 years. If this is achieved, it will be deemed that Ownership Fulfilment has been achieved.	Integrated Transport Sector Broad-Based Black Economic Empowerment (B-BBEE) Charter
		Share of HDI/BBBEE in Management	Increase the representation of Black people in senior management positions so that a minimum of 53% of people at this level are Black within 5 years; 26% should be Black women.	Integrated Transport Sector Broad-Based Black Economic Empowerment (B-BBEE) Charter
		Shift from Informal to Formal Occupation		
	Income	Median Real Wage	Fair and acceptable labour practices, workers' rights, job creation and security, sound working conditions, health and safety, and welfare benefits of employees in the industry will be promoted and, where appropriate, regulated.	National Transport Policy White Paper
	Job Security	Share of Jobs Retained	Fair and acceptable labour practices, workers' rights, job creation and security, sound working conditions, health and safety, and welfare benefits of employees in the industry will be promoted and, where appropriate, regulated.	National Transport Policy White Paper

Goal	Category	Indicator	Governmental Goal	Corresponding Strategy/ Policy Paper
		Average Tenure	Fair and acceptable labour practices, workers' rights, job creation and security, sound working conditions, health and safety, and welfare benefits of employees in the industry will be promoted and, where appropriate, regulated.	National Transport Policy White Paper
	Skill Development	Completed Trainings	Required skills and technologies will be identified, including defining current levels and methods for achieving those needed in the future, such as training and education through a variety of mechanisms.	National Transport Policy White Paper
	Skill Intensity	Share of Employees with Specialised Education	Required skills and technologies will be identified, including defining current levels and methods for achieving those needed in the future, such as training and education through a variety of mechanisms.	National Transport Policy White Paper

C Appendix: Covid-19 experiences made in Germany - Selection of stories and possible GLI:X indicator relation

Table of content – Appendix C

C.1 Study on the consequences of the Corona crisis: A sustainable urban traffic is possible

The study analyzes the consequences of the Corona crisis regarding urban traffic and the need for political action. It was conducted by the German Institute for Urban Studies (Difu) and "Agora Verkehrswende" (Smart Energy for Europe Platform) in collaboration with municipal associations, transport companies as well as scientific and political consultants. They recommend a broad reform and investment offensive to support a sustainable urban mobility. According to the study the corona pandemic can be seen as an opportunity to accelerate the transformation towards a climate-friendly and resilient mobility.

The study shows that the individual traffic in cities has increased – whether on foot, by bike or by car. Traffic activities had temporarily shifted to the afternoon and to the immediate residential environment. Home office and more flexible work time models could lead to new commuting routines in the long term. The willingness to rethink habits and accept digital offers has increased. Since the beginning of the pandemic, the local politics and administrations have shown determination and agility in order to implement (temporary) measures. According to the study, the main risks are the weakening of public transportation and trade as well as the decline in tax revenues for local authorities.

Main guidelines / Recommendations

- Municipalities as well as the federal and state governments use the Corona crisis as an opportunity to make urban traffic more resilient and sustainable.
- A resilient and sustainable urban traffic management strengthens the city as an attractive living and economic area.
- Public transport companies win back passengers and expand their services with support from the state and local governments.
- The digitization of traffic is pushed and serves to optimize traffic flows and to strengthen an environmentally friendly mobility.
- Pedestrian and bicycle traffic are given more space because they are sustainable and have proven themselves in the pandemic.
- Politics and administrations are ready to experiment more and accelerate innovation.
- The government improves the framework conditions and increases the financial and human resources for the mobility transition.

https://www.agora-verkehrswende.de/presse/newsuebersicht/?tx_news_pi1%5Bnews%5D=1655&cHash=a2c26e2a73f6c346277ca89111977b14 (accessed 23/9/2020)

GLI:X Indicator: Through the digitization of traffic various data could be collected in the indicator fields. Emissions, Timeliness, Speed, Quality of Life (i.e. Daily Commuting Cost

C.2 Freight Transport to and from Coronavirus high risk areas

Air cargo: In order to maintain air transport services, the Federal Ministry of Transport and Digital Infrastructure sent delegates to Asian countries to ensure that crews of air carriers are exempted from the quarantine regulations. Major efforts are made to ensure that crews of air

carriers which stayed in designated risk areas will not be quarantined in Germany. There is currently no nationwide regulation.

In the cargo-only sector, German air carriers do not issue non-availability declarations until further notice since all air cargo capacities are required to maintain the transport of goods. All reasonable efforts are undertaken to continue ensuring secure supply chains for air cargo to and from Germany.

There are possibilities that the Federal Aviation Office can grant exemptions, at least until 31 December 2020 if certain criteria are being kept. These comprise for example aviation security training courses or giving certifications to well-trained screening staff.

The approvals of carriers, known consignors and regulated agents which expire in the course of the next few months will be prolonged - as from their date of expiry - for a limited period of six months for the time being, without an on-the-spot check. Moreover, the Federal Aviation Office is in close contact with German air carriers in order to provide a practicable approach on how to observe flight times and rest periods and to grant exemptions to the possible extent without disregarding safety issues.

Road freight: Most information on road freight concerns quarantine regulations for (foreign) lorry drivers, driving hours and rest hours. Since the coronavirus spreads dynamically across the globe with some countries experiencing an acceleration while in others the virus seems to be spreading much slower, the country specific rules are made on a case-by-case basis.

https://www.bmvi.de/SharedDocs/EN/Articles/K/Corona/faq-freight-and-logistics-during-corona.html (accessed 19/8/2020)

C.3 Classification of international Covid 19 Risk Areas

Following is the definition of Robert -Koch -Institut (https://www.rki.de/EN/Home/homepage_node.html) about the classification of a cover-19 risk area:

"Classification as a risk area is the result of a joint analysis and decision-making process by the Federal Ministry of Health, the Federal Foreign Office and the Federal Ministry of the Interior, Building and Community. This classification as a risk area is based on a two-step assessment. Initially, it is determined in which countries/regions there were more than 50 new infections per 100,000 inhabitants in the last seven days. In a second step, qualitative criteria are used to determine whether or not countries/regions that might nominally fall below this threshold could nonetheless still present an increased risk of infection. As part of the second step, particularly the Federal Foreign Office and, where relevant, the Federal Ministry of Health and the Federal Ministry of the Interior, Building and Community, provide qualitative reports based on reporting by the local German diplomatic representations, which also covers measures taken to halt the spread of the coronavirus pandemic. Key factors in this assessment are above all the numbers of infection and the type of outbreak (local or wide-spread), testing capacities and the number of tests carried out per capita as well as the measures taken to contain the spread of infection (hygiene regulations, contact tracing, etc.). Similarly, this also takes into account individual countries where reliable information may not be readily available. "

https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Transport/Archiv_Risikogebiete/Risikogebiete_07082020_19_45_en.pdf?__blob=publicationFile

(accessed 21/8/2020)

The Robert-Koch-Institut has an English website (https://www.rki.de/EN/Home/homepage_node.html**)** where you will find a daily covid-19 situation report. Todays report: https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Situationsberichte/2020-08-21-en.pdf?__blob=publicationFile

(accessed 21/8/2020)

Information on covid-19 from the European Center for Desease and Control including risk assessments: https://www.ecdc.europa.eu/en/covid-19-pandemic

(accessed 21/8/2020)

C.4 Coronavirus contact tracing app

Germany's COVID-19 app for contact tracing is available since June 16, 2020. The app was developed SAP and Deutsche Telekom AG with the participation of about 25 other companies to contain the COVID-19 pandemic. It uses the interfaces of the operating systems of Apple and Google and the protocols of Decentralised Privacy-Preserving Proximity Tracing (DP-3T) and Temporary Contact Numbers (TCN). According to government figures, the app cost €20 million ($22.7 million) to develop and will require a further €2.5 million to €3.5 per month to operate.

The app has 4 main functions: reporting the infection, risk determination, risk assessment, information and recommendations for action.

Notification of infection

If a person is classified as likely to be infected with the SARS-CoV-2 virus, usually through a PCR test, they will receive a QR code or TAN in the app from the local health authority or test laboratory. This authorizes the app to transmit daily keys from the last 14 days to a central verification server.

Risk determination

If a smartphone user has activated the "Risk Determination" option in the app's menu, the smartphone with sends identifiers via Bluetooth four times per second. The identifiers are derived in the smartphone at short intervals in different encryption from a key that is changed at midnight ("day key"). At the same time, the app checks whether there are other smartphones in the vicinity where the app also sends such identifiers. If this is the case, and if conditions are met for this contact which, make a virus transmission possible, the identifiers, the signal strength as well as the date and time and the duration of the reception are stored on the receiving smartphone for 14 days. Due to the short-term changing encryption of the transmitted identifiers, neither the receiving smartphone nor third parties who might intercept the data exchange receive information about the identity of the respective sending smartphone or its user.

Risk Assessment

An epidemiological approach was chosen for the risk assessment of contacts, which can be modified on the basis of newly gained knowledge and transferred to the app by updates.

Information and recommendations for action

The app informs the user about the result of the matching of identifiers and based on that makes recommendation for action:

Low risk: no contact with individuals known to have contracted the virus. The person is informed about physical distancing rules and hygiene recommendations.

Increased risk: encounters with at least one person who has tested corona-positive within the past 14 days. Only the day of the encounter is reported. The person receives instructions to go home or stay at home (if possible), as well as to contact GP, the medical on-call service or the public health department to discuss the course of action.

Unknown risk: If the risk determination is not activated long enough, no risk of infection can be calculated.

https://www.bbc.com/news/technology-52650576

(accessed 13/5/2020)

https://www.dw.com/en/day-one-of-using-germanys-coronavirus-tracing-app/a-53828730

(accessed 16/6/2020)

Update as of August 8th, 2020: "Corona-Warn-Apps should work across borders":

The national (German) corona warning apps should remain functional when travelling to another EU country. To ensure that this can be achieved, the EU member states have agreed on a number of technical specifications with the support of the EU Commission. This allows information to be exchanged securely between national contact tracking apps using a decentralized approach. Currently, there are five other member states besides Germany that have already launched a decentralized warning app. Another eleven Member States intend to introduce it in the near future.

General information about the corona warn app: https://www.bundesregierung.de/breg-de/themen/corona-warn-app/corona-warn-app-englisch

(accessed 22/08/2020)

https://ec.europa.eu/germany/news/20200616-corona-warn-apps_de

(accessed 16/6/2020)

GLI:X Indicator: tbd. / The procedure of developing and implementing the data collection structure and the App is interesting for a possible introduction of a GLI:X App

C.5 New rules in last mile delivery of parcels

Since the start of the pandemic several service providers have implemented a selection of these rules:

- provision of masks and hand disinfectant for couriers who cannot observe physical distancing guidelines
- contactless delivery (no need to sign for parcels anymore)
- delivery only to front door (in an apartment building that would mean the downstairs front door)
- workers in distribution centers and couriers are divided into smaller teams to work in shifts. This way they are able to comply with social distancing rules

https://www.eurotransport.de/artikel/kontaktlos-pakete-zustellen-corona-veraendert-kep-lieferung-letzte-meile-corona-covid-19-zustellung-logistik-11161421.html (15/5/2020)

GLI:X Indicator: Time and Speed - Share of deliveries on time

C.6 Pandemic clause for insurance

Insurance brokers have developed pandemic clauses for traffic liability and transport insurance together with insurance companies. The goal is to give freight forwarders and logistics companies more legal certainty with regard to certain insurance contractual obligations. For example, the pandemic clause confirms that the contactless delivery of goods, merchandise or packages does not constitute a breach of obligation, even if, for example, there is no signed receipt. Unnecessary contact is thus avoided without jeopardizing the insurance cover.

https://www.eurotransport.de/artikel/versorgung-der-lkw-fahrer-an-der-autobahn-baden-wuerttemberg-listet-offene-infrastruktur-auf-11157601.html (23/4/2020)

GLI:X Indicator: Equitable Development - Quality of Life: daily working hours + share of employees with health insurance

C.7 Passenger aircraft used as cargo jets

The cancellation of many passenger flights, especially on long-haul routes, is becoming an increasing problem. A large part of the global cargo volume - Frankfurt Airport estimates that it accounts for about 40 percent - is normally transported in the bellies of wide-body jets. In many cases, the major airlines now use the jets for pure cargo flights without passengers. The first Lufthansa flight landed in Frankfurt already in March. A major remaining problem for the industry in times of border closures are bureaucracy and national solo efforts. Especially different entry and quarantine regulations, which are a burden for the crews of the industry, most of which operates intercontinental, and make planning difficult.

https://www.airliners.de/passagierflugzeuge-cargo-jets/54450 (25/3/2020)

GLI:X Indicator: Time and Speed - Share of deliveries on time

C.8 Pop-Up-bike lanes in Berlin

The Corona pandemic has succeeded in doing something that was not possible for a long time: creating more space for cyclists and pedestrians. As car traffic decreased by up to 40 percent, with many employees working from home, the bicycle has become the preferred crisis transport mode. Even many politicians recommend switching to the bicycle to avoid full lanes.

The implementation of the new so-called pup-up bike-lanes went very fast because road traffic regulations did not prevent the administration to act. Local parliaments in city districts were not involved in the process, if they had been this pandemic resilient infrastructure would have taken much longer or had not been implemented at all.

https://www.dw.com/de/corona-die-pandemie-schafft-platz-fürs-rad/a-53134694 (18/4/2020)

Paris:

https://www.forbes.com/sites/carltonreid/2020/04/22/paris-to-create-650-kilometers-of-pop-up-corona-cycleways-for-post-lockdown-travel/#22f166cc54d4 (22/4/2020)

https://www.marketresearchfuture.com/report/covid-19-impact-electric-cargo-bikes-market (12/2019)

C.9 Measures to deal with long waiting times at borders for trucks

As Europe came to an increasing standstill in the wake of the corona virus, IT developers got together to create a live map of border crossing time for trucks. With this initiative, they want to help to better plan the supply delays in supply chains in the corona pandemic.

In addition, a temporary relaxation of driving and rest times was decided at federal level. The measure applies to road haulage of everyday goods, including food, medical equipment and fuel, and was only temporarily valid. Other measures included:

The possibility of extending driving time to 10 hours five times a week.

The possibility of taking two consecutive reduced weekly rest periods within four weeks.

https://covid-19.sixfold.com

https://www.dvz.de/rubriken/land/detail/news/ueberblick-was-corona-mit-dem-strassengueterverkehr-in-europa-macht.html (no longer available for free)

The official EU Guidance for cross-border measures during the coronavirus pandemic:

https://ec.europa.eu/home-affairs/sites/homeaffairs/files/what-we-do/policies/european-agenda-migration/20200316_covid-19-guidelines-for-border-management.pdf (16/3/2020)

EU Commission Mobility and Transport - Overview of transport measures by member state:

https://ec.europa.eu/transport/coronavirus-response_en

GLI:X Indicator: Time and Speed - Share of deliveries on time

C.10 Rail safer than road

In addition to important raw materials, the freight railways also transport food and medical products. The trains carry large quantities of goods by rail with little effort. While under normal circumstances the main advantage of rail freight is its lower environmental impact, during the corona pandemic the lower personnel deployment has become its major asset. A freight train replaces between 30 to 50 truck journeys, a locomotive driver thus replaces 30 to 50 truck drivers. The closure of the borders also does not affect rail freight traffic as much as road traffic. At the borders, train drivers can switch change and the freight continues its journey.

https://www.allianz-pro-schiene.de/themen/aktuell/bahn-corona-update/

GLI:X Indicator: Safety and Security - share of security costs

C.11 Air quality in cities

In urban areas, the highest NO2 concentrations are typically measured near the main emission source, on busy roads. In addition to traffic, there are other sources - such as industrial plants, power stations, manufacturing industry, private households - which lead to an average basic load of 20 to 30 µg/m^3 (annual average) in urban areas. Measures to contain the corona virus are associated with reduced road traffic and reduced industrial processes. Buses in public transport and private cars are still on the road in cities. An increased volume of delivery traffic must even be expected. However, emissions from private households could also be increased as

more people stay at home. A real "crash" of NO2 concentrations in cities cannot therefore be expected everywhere. But studies from one region in Germany showed a reduction of NO2 concentrations by about 40 percent at stations, which is attributed to the reduced traffic volume.

https://www.umweltbundesamt.de/faq-auswirkungen-der-corona-krise-auf-die#welche-auswirkungen-hat-die-corona-krise-auf-die-feinstaub-belastung (17/7/2020)

GLI:X Indicator: Environment - Emissions

C.12 The Corona Virus safes lifes

This is the case at least for the streets. The number of traffic accidents and fatalities has fallen sharply in the pandemic - in Berlin and across the country. There were 23 percent fewer accidents in Germany in March than in the same month last year. And the number of fatally killed people on traffic dropped to the lowest monthly figure since the German reunification in the year 1990.

https://www.automobilwoche.de/article/20200525/AGENTURMELDUNGEN/305259940/im-marz-so-wenige-verkehrstote-wie-nie-seit-wiedervereinigung (25/5/2020)

GLI:X Indicator: Safety and Security - Security incidents at warehouses + share of security costs

C.13 Inclusion of digital tools in supply chains to create flexible business processes

Many logistics businesses regarded digital tools like software enabling electronic signatures or shipment location tracking as unnecessary expenses prior to the emergence of social distancing guidelines. The COVID-19 pandemic is now prompting renewed interest and accelerated uptake. COVID-19 is showing that some of those technologies have bigger impacts than we thought originally."

Companies are likely to emerge from the crisis with more digital operations, the pandemic has demonstrated a need to think about supply chains in new ways. Companies cannot simply look at past data to create models on which they can base long-term predictions. They are instead limited to short-term predictions and seeing what they can learn to guide them during future crises.

Key lessons are already emerging, however, including the need to build backup options into supply chains and create flexible business processes.

https://shippingandfreightresource.com/supply-chain-strategies-post-covid-19-impact-survey/#: 42% will change supply chain strategies post COVID-19 – Impact Survey (21/4/2020)

GLI:X Indicator: Time and Speed - Share of deliveries on time

C.14 Recommendations for handling freight logistics from “BG Verkehr” (accident insurance a German corporation under public law)

Keep minimum distance

For freight transport companies, it is generally recommended that a distance of 1.5 meters be maintained between employees, including in the depot, and of course in break and rest areas. Office work should be moved to the home office. Adjustments should also be made to the use of traffic routes so that sufficient distance is maintained. Freight documents and other documents should be exchanged contactless between dispatching and driving personnel (incoming and outgoing baskets). Also, in break rooms the distance should be maintained.

Shift work in administration and disposition

Another recommendation is to check whether shift work can be introduced in administration and scheduling, with a time lag between the end of the first shift and the start of the second shift. Where teamwork is unavoidable, the same employees should always work together. With social distancing, you can minimize the risk of an entire department falling ill or having to go into quarantine because of an infection in the workforce.

In order to make loading and unloading procedures safe, it should be agreed with the consignors and consignees that drivers do not need to have personal contact with the staff at the ramp. One example would be inbound and outbound baskets for the freight documents.

Observe hand disinfection

In addition, drivers at the loading points should also be given access to sanitary facilities, or at least running water, soap dispensers and disposable towels should be provided. If employees do not have the possibility of hand disinfection at all during transport, companies should provide a hand disinfectant, or a sufficiently large water canister and hand soap, as well as paper towels and bin liners.

Cleaning vehicle interior

Vehicle cleaning is also an issue when the vehicle is driven by several drivers in turn - cleaning the surfaces with fat-dissolving household cleaners is recommended, textiles such as curtains should be dry-cleaned or washed in the washing machine at 60 degrees. Subsequent ironing contributes to disinfection. The driver's cab should also be thoroughly ventilated before another driver takes over the vehicle.

https://www.bg-verkehr.de/coronavirus/tipps-fuer-unternehmen-und-ihre-beschaeftigten

(accessed 19/8/2020)