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Sustainable and Resilient Earthworks and Unpaved Roads  
in the face of Climate Change.**

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**Session 7:** Sustainable management and financing of road maintenance: Sustainable management and innovative financing for sustainable and resilient roads; Asset management of earthworks;

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**Title**

**Roads4People - A social programme expanding Rural Road Access and Resilience through innovative financing mechanisms and digital solutions for road management and investment.**

**Summarized Abstract**

The Roads4People program, led by UNIDO in partnership with ORIS, seeks to address the complex challenges faced by the road sector in Côte d'Ivoire with the support of digital innovations and sustainable financing. The program leverages AI-powered tools to optimize road planning and prioritization, ensuring cost-effective and climate-resilient infrastructure. By integrating knowledge of construction materials and advanced analytics, the platform enhances investment performance and provides monitoring capabilities, including carbon emissions reporting, to attract international funding.

A key innovation is the Rural Roads Fund, a blended financing mechanism reallocating savings from optimized projects to support rural road development. This approach mobilizes contributions from development banks and donors, enabling the funding of climate-resilient rural networks. Complementing this, capacity-building initiatives equip local stakeholders with the skills to adopt digital solutions and asset management practices.

The Roads4People program represents a scalable model for regional application, supporting economic corridors and cross-border infrastructure. By combining technology transfer, innovative financing, and capacity building, it fosters resilient, inclusive, and sustainable rural road networks that drive economic growth and climate adaptation.

## 1. Introduction

Road infrastructure is fundamental to socio-economic development, particularly in developing nations where it forms the backbone of industrialization and inclusive growth. Yet, rural road networks often remain neglected, perpetuating a divide between urban and rural development. This disparity not only hampers economic growth but also heightens vulnerability to climate change impacts, particularly in unpaved, flood-prone areas.

Côte d'Ivoire's current road network faces substantial challenges itself, with less than 10% paved and the majority classified as vulnerable "earth roads" prone to degradation and frequent flooding, severely restricting mobility and economic activities, particularly in rural areas. Addressing these infrastructure challenges is pivotal to fostering connectivity, and economic growth.

This paper presents the **Roads4People program** as a holistic solution to these challenges, focusing on innovative financing mechanisms, digital solutions, and capacity building to revolutionize road development and resilience, particularly focusing on rural areas, which form a backbone of the country. The Roads4People program is an innovative public-private partnership between the UNIDO, the Government of Côte d'Ivoire and ORIS, **leveraging AI-powered digital tools** for the road industry to support **efficient and low-impact infrastructure**, and to **rebalance investments towards underserved rural networks**.

Enabling digital innovation in infrastructure road programs can support developing countries to advance industrial growth while also addressing environmental and socio-economic challenges. It will reach not only public sector organisations but also local companies, supporting the whole industry ecosystem. Ultimately, the project will be advancing sustainable development goals in the country, supporting the reduction of inequality, enhancing the climate resilience of the rural population and facilitating economic opportunities.

Furthermore, to drive impact over the long term, the project supports the creation of a Rural Roads Fund (RRF), an innovative financial instrument designed to unlock financial resources for rural roads, efficiently rebalancing road investments from large projects towards better finance for rural networks.

## 2. Context: Challenges in Rural Road Networks

Rural road infrastructure are vital for addressing development challenges and enable livelihood development in local communities, particularly for women and youth; yet they are often neglected in infrastructure planning. Currently, 68% of the world's rural population lacks reliable road access, limiting economic opportunities and perpetuating poverty, as 78% of the extreme poor live in rural areas. Rural connectivity in Côte d'Ivoire is also limited, with only 60% of the population living within 2 kms of a road usable year-round in 2020 according to the National Development Plan for 2021-2025.

However, urban areas typically receive the lion's share of infrastructure investment, often at the expense of rural connectivity. This skewed prioritization results in inequitable access to essential services, markets, and opportunities for rural populations, compounding poverty and limiting growth.

Furthermore, Rural networks are particularly susceptible to the impacts of climate change. Flooding, soil erosion, and extreme weather events frequently degrade unpaved roads, disrupting transportation and economic activity. Côte d'Ivoire itself ranks 142/182 countries in the Notre Dame Global Adaptation Initiative (ND GAIN) Index, placing it among the countries with high vulnerability to climate change impacts and low readiness to enhance resilience.

Insufficient funding and planning for road maintenance lead to accelerated degradation of existing infrastructure, further straining already limited resources and increasing costs for rehabilitation and reconstruction. However, improved rural road networks are crucial for enhancing livelihoods by ensuring access to essential services, markets, and jobs. Moreover, enhancing rural connectivity is vital for attracting investment in agribusiness, developing agro-industrial parks, and upgrading value chains. This is particularly relevant for developing countries, whose economies often rely strongly on agricultural activity.

### **3. The Roads4People project**

The **Roads4People** project is a transformative initiative aimed at addressing the complex challenges faced by the road sector in Côte d'Ivoire, particularly in rural areas, which serve as the backbone of the country's economy. By leveraging innovative technologies provided by the United Nations Industrial Development Organization's (UNIDO) partnership with ORIS, the project seeks to create a safe, resilient, sustainable, and inclusive transportation network. Its primary goal is to enhance the efficiency and resilience of infrastructure while fostering rural development and building capacity for tracking progress towards the Sustainable Development Goals (SDGs).

In collaboration with technical partner ORIS, the Roads4People project will integrate a wide range of geographic, socioeconomic, safety, climate, commercial, and materials data into a single, innovative software platform. This will provide road sector stakeholders with a comprehensive decision-making tool that optimizes design, planning, construction, rehabilitation, and maintenance of roads. By incorporating advanced digital technologies, including AI, into the road planning and development progress, the project aims to optimise infrastructure designs and minimize both financial and natural resource consumption.

The project will not only enable the construction of more durable, inclusive, safe, and resilient national roads but will also contribute to the development of sustainable and inclusive rural road networks. Through the optimisation of major roads, potential savings will be partially directed towards the Rural Roads Fund, a financial mechanism designed to support the development of rural infrastructure. Ultimately, the Roads4People project represents an integrated solution that combines economic development with positive social impact, paving the way for resilient and inclusive socio-economic growth in Côte d'Ivoire.

#### **a) Leveraging Digital Solutions and Capacity Building for Sustainable Management of Road Maintenance**

The project supports the digitisation of the road sector in Côte d'Ivoire. Data on the Ivorian road industry and the national infrastructure network is compiled on a digital platform, using innovative

digital technologies to collect and structure quality data and analyse it to generate detailed and highly accurate modelling.

The ORIS platform integrates data on construction materials, climate resilience, and lifecycle costs to create tailored solutions for road projects management.

The platform, transferred to local stakeholders through user licenses, will provide road authorities and private stakeholders with access to relevant data and analysis tools, ensuring efficiency, transparency, coordinated decision-making and enhanced reporting capabilities, thereby supporting sustainable and efficient data-based decision-making, but also enhancing the attractiveness for funding from international financial institutions (IFIs).

Through the programme, government actors in Côte d'Ivoire will be able to increase their skills in utilising digital technologies to rapidly and drastically improve their decisions for the road sector. They will also gain key knowledge and competencies in how to improve road infrastructure planning and construction, which will enable them to optimise the use of public financial resources. Public resources necessary for each road project will be reduced, allowing the government to potentially spend its budget more effectively, and ideally fund more national projects without spending more.

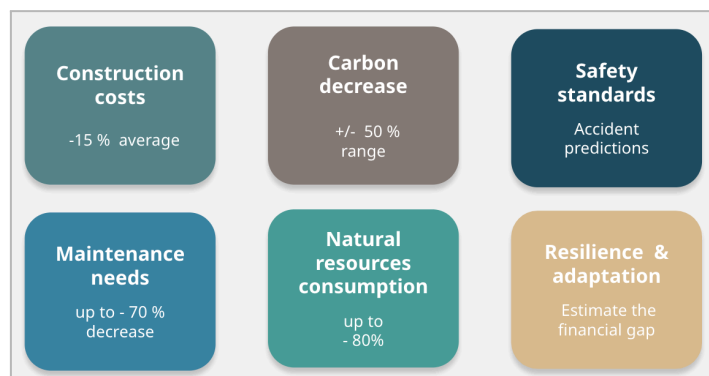
Designs proposed in the ORIS platform will enable the construction of an enhanced and safer transport network. Network and project prioritisation on the ORIS platform will allow us to accurately identify which areas and specific roads and road segments are the most critical to improve rural connectivity and safety.

### b) Efficiency of Road Investment

The Roads4People project will enable the optimisation of road infrastructure investments by leveraging a comprehensive multi-factor assessment through the ORIS platform. The platform will analyse several key factors to create optimised road designs before the tendering and construction phases (at feasibility / design stage).

The multi-factor assessment will consider parameters such as material choice, lifecycle costs, carbon footprint, resource efficiency and climate resilience to generate various alternative road designs for each selected road project.

Figure 1: Impact potential of deploying the ORIS platform on road network



Through machine-learning-enabled modelisation, project optimisations in Ivory Coast can permit to reduce total project costs by 5-10% on average.

Furthermore, the platform enables life cycle cost analysis which include maintenance scenarios allowing to model maintenance over the very long term, and anticipates resilience to critical environmental impacts. Overall, it can reduce maintenance needs up to 70%.

### c) Climate resilience

The project also supports the development of road infrastructure that is more resistant to climate change in Côte d'Ivoire, by integrating advanced climate risk assessment tools and adaptation strategies. In the climate screening, Artificial Intelligence algorithms are employed to treat climate projections using unsupervised clustering to generate climate exposure maps. These exposure maps are coupled with the infrastructure vulnerabilities assessed, i.e. surface layer condition, travel time, and traffic, over the network to understand and map the climate impact on the infrastructure in future scenarios.

Climate projections and infrastructure vulnerability are integrated into the planning process, enabling the relevant authorities to anticipate and mitigate the impacts of climate change on road networks.

#### Case study in Khasakstan

*The application of this AI-driven methodology to the network of the Republic of Karakalpakstan revealed that 25.09% of the whole network (1,948.49 km) is under high to extreme risk and deserves more attention in terms of resilience strategies. Concerning the rural road modernisation project in Jyzzakh and Syrdarya, 30% of the total project cost was dedicated to adaptation and mitigation activities. The results allowed policymakers to make informed decisions in prioritizing road rehabilitation, ultimately contributing to the development of climate-resilient infrastructure networks.*

In Côte d'Ivoire, the methodology for network resilience assessment and prioritisation can be deployed on the rural roads network, in order to allow the Rural Roads Fund to prioritise rural road maintenance and rehabilitation interventions, improving the management of rural road maintenance and resilience of the network.

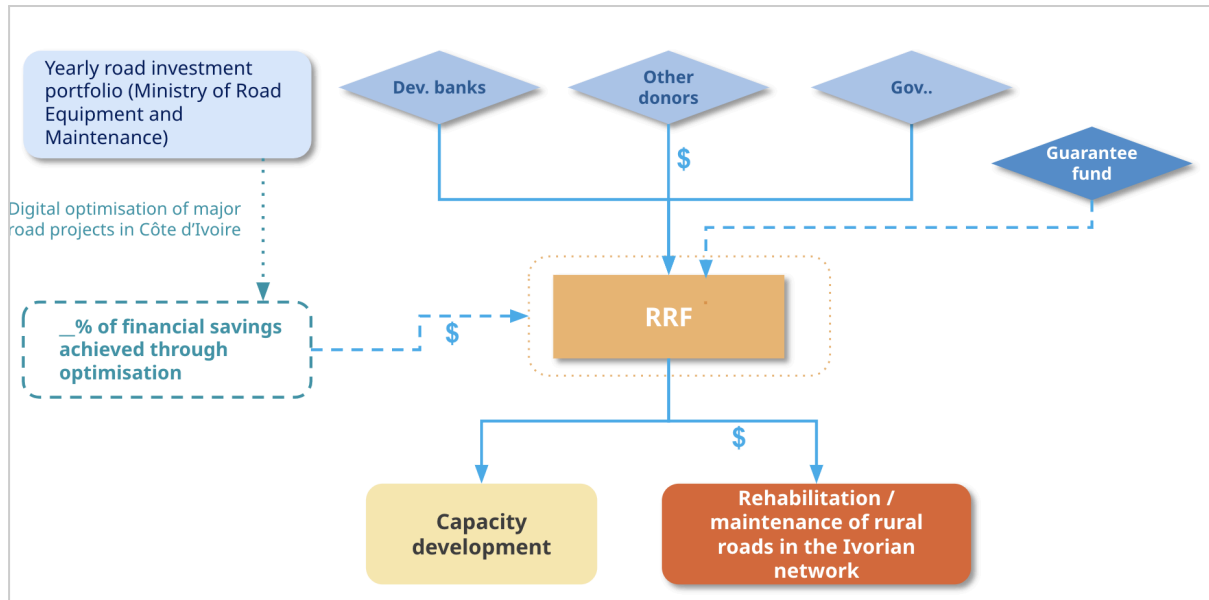
#### 4. The Rural Roads Fund, an innovative approach to financing of road maintenance

A cornerstone of the Roads4People program is the establishment of an innovative financing mechanism designed to address the chronic underfunding of rural road maintenance.

The project will support the creation of a local fund, the Rural Roads Fund, with the aim of channelling the potential financial resources saved through road optimisation activities into co-financing rural road projects, thereby mobilising additional funds for this purpose. The RRF will

use a sustainable funding model, guaranteeing the long-term maintenance and rehabilitation of rural roads. This component will provide a reliable mechanism for continued investment in rural infrastructure, even after project completion.

**Figure 2: Preliminary financial structure of the Rural Roads Fund**



Financial savings realised through the digital optimisation of large road investments are channelled through the RRF, to finance the construction of critical rural roads, allowing Côte d'Ivoire to build more roads using the same resources. By reallocating savings generated through the optimization of large-scale road projects, the fund provides a sustainable source of financing for priority rural road projects. The blended structure of the fund allows it to mobilize contributions from development banks and donors, directing resources toward the rehabilitation and maintenance of the rural network, with a strong focus on climate resilience, social impact and enhanced road safety.

Through the impact of the Rural Roads Fund, the Roads4People project in Ivory Coast will support rural inhabitants to benefit from facilitated access to hospitals, schools, markets, administrative facilities and other key services, which will support long term and inclusive growth for the country.

## 5. **Implementation of the Roads4People Project**

The project will run for three years, and will be implemented in three phases:

**Phase 1:** Activities to digitise road planning, prioritisation and design work in Côte d'Ivoire, in order to optimise major road infrastructure projects. This optimisation will be made possible through the adoption of innovative digital tools in each phase of the process, enabling financial savings to be made, reducing the consumption of raw materials and minimising the carbon footprint on each project, while securing aspects of resilience to climate change and road safety.

**Phase 2:** The second phase consists of creating a financial mechanism to collect the optimisations made, and then amplify this virtuous circle by raising funds for the rural, secondary or agricultural

network. The financial savings generated by optimising road projects in phase 1 will be redirected to a Rural Roads Fund, set up to support inclusive socio-economic development in Côte d'Ivoire. This Fund will be built around and complement existing road financing processes in order to mobilise additional donor funding for rural roads in Côte d'Ivoire.

Phase 3: From the third year of implementation, phase 3 aims to make these operations and mechanisms sustainable over the long term, supported by the 'Roads4People' road fund and the sustainable use of innovative digital tools. The aim is to ensure a more efficient road sector in Côte d'Ivoire with a high social impact in the long term. The sector will thus benefit from sustainable efficiency through capacity building, encouraging the development of rural road networks and sustainably supporting the country's socio-economic growth.

In short, the 'Roads4People' project is a strategic lever for sustainable transformation of the road sector in Côte d'Ivoire, strengthening innovation, resilience and inclusiveness, while catalysing rural socio-economic growth through modern, efficient and sustainable infrastructure.

## **6. Conclusion**

The Roads4People program exemplifies a transformative approach to rural road development. By combining digital innovation, climate-resilient design, capacity building, and sustainable financing, it addresses the critical challenges facing rural road networks in Côte d'Ivoire and beyond. This initiative not only bridges the urban-rural divide but also establishes a replicable model for fostering economic growth, resilience, and sustainability in developing nations. Through its integrated framework, Roads4People sets a new standard for inclusive and sustainable infrastructure development.