Design Durres Port as a Smart Port with Innovative Technologies Oriented to Tourism

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Abstract

Albania's tourism industry has grown rapidly over the last four years, , necessitating upgrades to important infrastructure, especially at entry points that influence visitors' initial impressions. The goal of this study is to turn Durres Port, the biggest and most important seaport in Albania, into a smart port by incorporating innovative digital technology that will improve tourists experiences and operational effectiveness. The study assesses the use of smart port technologies including IoT, AI, VR/AR, and digital twins and examines the difficulties Durres Port faces, such as aging infrastructure, traffic, and sustainability issues. The goal of IoT-based technologies, such as smart luggage handling, passenger flow management, and air and water quality monitors, is to maximize environmental efficiency and sustainability. Automated check-in procedures and AI-powered monitoring enhance security and expedite traveler experiences. While digital twin technology allows for real-time monitoring and modeling of port operations, virtual reality and augmented reality technologies are suggested to enhance visitors and tourists engagement by offering interactive historical insights. A SWOT analysis identifies the port's advantages, disadvantages, opportunities, and threats, highlighting its strategic significance and integration potential for smart tourism. The study also examines Durres Port's current smart infrastructure and suggests improvements including as 5G connection, automated mobility systems, renewable energy sources, and the latest security measures. Finally, a 3D model design of Durres Port is created to show how these smart technologies are integrated, showcasing an innovative method to updating Albania's maritime entryway and solidifying its standing as a global smart port.

Keywords: *Internet of Things, Smart Port, Tourism, Innovative Technologies*

1. Introduction

The tremendous growth of tourism sector in Albania the last 4 years attacks the attention, and tends to think how to improve every institution with the focus on this fact. More reasonable and priority is to care about the places that are directly accessed by tourist, where they have their first impact about the country. Considering this the research paper is focused on designing Durres Port as a strategic point in Albania and the greatest port with the focus to enrich the infrastructure of the port with innovative technologies. From this point of view arise two benefits enforce the position of the port as a smart port internationally and also help and please the tourist.

This paper will be structured in these main parts Methodology, Existing Smart Port technologies in port of Durres, Smart Port Infrastructure technologies, Design with the 3 D model of the port, Benefits and Challenges, Conclusions

2. Methodology

2.1 Port of Durres challenges

After a visit in Durres Port Authority there were identified some challenges related to tourist experience like diversity of smart services, sustainability and green solutions. The technologies that support these needs in the port are IoT, AI, VR-AR and digital twins.[3]

Analyzing one by one the technologies thy will complete the user experience as follows

IoT will help for the equipment of port with sensors that improve the air quality by air pollution sensors that will measure the quality of the air pollution and due to the results will be taken initiatives to improve it, water sensors to measure the clearness of the water, passenger flow management due to movement sensors in order to avoid congestion, berth reservation system to optimize the mooring time and eliminate latency. Baggage management by RFID tags, sensors for waste management to have a clear environment.

AI is used to ensure security in port by video analyzing in a large network of CCTV cameras and also for AI passenger flow management.

VR and AR immersive technologies are used to flourish tourist experience with vivid perceptions and historical data for port and city during the years.

Digital twin as the newest technology is used to create a virtual prototype of a port to optimize the operations by simulations and predictions. Due to the priorities of these technology can be monitored in real time every operation that will be simulates as a copy of the physical one like energy consumption, vehicle and passengers traffic flow, ship schedule.

There are performed two analysis for highlighting the areas of the port that need to be improved toward tourist benefits.

2.2 Analyze the areas of the Durres Port map most sensitive to tourism

There is performed a special analysis evidencing in the map, realized in Autocad software, of the areas that are accessed by tourists and visitors, after some interviews that are performed onsite in port. In General Cargo Terminal there are moored the cruises, which every year increase in number and diversity.

The ferry Terminal area is the terminal of the ferries where the statistics for 2024 are really promising with 996 sailings, transporting 774 000 passengers and 286 000 vehicles. 380,050 disembarked passengers and 394,866 embarked for period January-December 2024

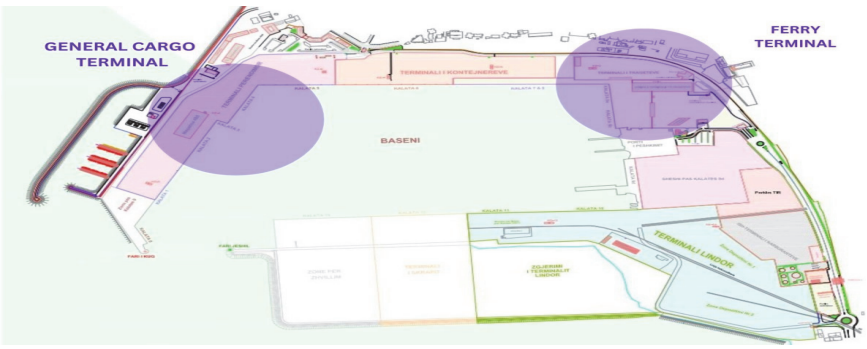

Figure 1: Durres Port map and areas were tourist disembark

2.3 There is performed a SWOT analysis of te port situation detailed as follows:[5],[6]

Strengths (Internal Positive Factors)

Strategic Location: As the largest and most significant seaport in Albania, Durrës Port serves as a vital entry point for trade and tourism in the Adriatic area.

Current Port Infrastructure: The port already has a basic infrastructure that can be updated with smart technology.

Government and EU Support: Modernizing port infrastructure has garnered interest from the Albanian government and the EU, which may help with finance and policy support.[1]

Potential for Growth in Tourism: Durrës is a well-liked coastal location, and intelligent port integration can improve cruise tourism and the experience of tourists.

Tourism has been one of the focus fields of government for 2024 and still is for 2025.[2]

Key Trends in Digital Transformation: Automation, IoT, and AI investments for port operations are encouraged by the growing global acceptance of smart technology.

Weaknesses (Internal Negative Factors)

Outdated Infrastructure: Durrës Port needs major renovations because many areas still use antiquated port management technologies.

The implementation and upkeep of digital systems may be hampered by a lack of technological expertise.

Cybersecurity Vulnerabilities: As the port becomes more digitally connected, it becomes more vulnerable to cyber threats, necessitating strong security measures. High Initial Investment Costs

Adoption of IoT, AI, automation, and green energy solutions requires a significant financial investment. Bureaucratic and Regulatory Challenges:

Slow policy adaptation and regulatory approvals for smart technology integration and AI for port operations may cause delays.

Opportunities (External Positive Factors)

Integration of Smart Tourism: Digital solutions like automated ticketing, real-time tourist information, and AR/VR experiences can increase the port's attractiveness to tourists.

Green and Sustainable Solutions: Using intelligent energy-efficient solutions (such electric-powered port equipment or renewable energy) can help the EU meet its environmental targets.

Public-Private Partnerships (PPP): Working together with logistics companies, tech companies, and tourism players can hasten the development of smart ports.

Enhanced commerce and Logistics Efficiency: Smart technology can increase Albania's participation in regional commerce, enhance cargo handling, and cut down on delays.

Funding Options: Private investments, EU money, and international grants are available for projects involving digital transformation. as well as AI for port operations.

Threats (External Negative Factors)

Economic instability: Investments in smart technology may be limited or delayed by financial crises or a lack of steady funding.

Competition from Adjacent Ports: Ports in Greece, Italy, and Montenegro are also developing smart technologies, which could draw in more shipping.

Opposition to Change: Because they fear losing their jobs, stakeholders (such as unions and traditional port workers) may be resistant to automation.

Cybersecurity Risks: As port operations become more digitalized, there is a greater chance of hacking attempts, data breaches, and cyberattacks.

Regulatory and Compliance Risks: Implementing initiatives and AI for port operations may be difficult if EU maritime and digital security regulations are not adjusted.

3. Existing Smart Port technologies in Durres Port

Relating to port security there are security cameras with video analyzing which can also may be used for the security of the visitors. The exiting cameras are from one of the best brands and cover all the port area, configured second the International Ship and Port Facility Security Code (ISPS Code).

The check-in system of the passengers is modern system which incorporates check-in kiosks, portable devices for scanning the tickets and information monitors for informing the tourists on the details of sailings. The system is enriched the last years by improving the operation for the passengers and vehicles including tourists by reducing the control and check-in time at the first place that they access the port.

Port Community Information System a smart system that covers basic modules, ship notifications, and cargo operations in order to manage in more opportune manner the port mooring areas and elaboration and identification of container units easily divided by cargo.

Installing more electric charging stations in these area to promote zero carbon and green technologies and improve the air quality.

Prioritize the electric vehicles for Taxi Service inside the port.

4. Smart Port Infrastructure Technologies that Enrich Port Toward Tourism Sector

The effects of 5G and IoT (Internet of Things) networks on travel 5G-Tourists and cruise passengers may use digital maps, sophisticated navigation systems, and real-time trip information thanks to high-speed connectivity.

facilitates easy communication between service providers, port officials, and passengers.[7]

IoT (Internet of Things)- To enhance the traveler experience, IoT sensors can track crowd density and direct travelers to less crowded regions.

Smart Wi-Fi areas featuring virtual tour guides for historical sites and attractions that are AR/VR enabled.[8]

Digital Twin Technology - The use of digital twin technology in tourism improves cruise ship docking and visitor flow management by producing a real-time digital model of the port. provides real-time data on ship arrival timings, boarding locations, and transit choices to assist visitors in smoothly navigating the port.

Implementation: By simulating passenger flow, virtual models can enhance logistics planning and facilitate easier embarkation and disembarkation.

Artificial Intelligence - Use **AI-powered security scanners** for automated boarder control to accelerate passenger screening without compromising safety.

AI-powered cameras analyze **passenger flow and suggest optimized travel routes**.

Augmented Reality (AR) & Virtual Reality (VR) Tourism

- Enhances visitor experiences by offering **AR-powered digital guides** that showcase the port's history and nearby attractions.
- **VR experiences** onboard cruise terminals to allow passengers to explore destinations before disembarking.

Smart mobility systems-

- Real-time displays for shuttle services to help tourists plan their next move efficiently
- Deploy electric shuttle buses between the port and major tourist attractions.
- Introduce self-driving minibuses for guided tours around the city.

Green Energy systems-

- Install renewable energy sources (solar panels, wind turbines) to power port operations. Provide electric charging stations for eco-friendly transport services.

Smart safety and surveliance systems-

- Usage of **facial recognition cameras** at key entry points to enhance security for tourist.
- Integrate **drone-based surveillance** for large-scale crowd monitoring.

Emergency response system-

- Deploy **facial recognition cameras** at key entry points to enhance security.
- Integrate **drone-based surveillance** for large-scale crowd monitoring.

4.1 Renewable energy

Implementation of renewable energy resource and enhancement of energy governance rules to unlock existing institutional and technical bottlenecks.[9]

Possible renewable energy resources are solar panels and Wind turbine since Durres is a coastal city and the presence of wind is almost all day.

4.2 Expected Impact of Implementing these Technologies

Impact in tourism

- Passengers experience like auto check-in and smart luggage handling.

- Introduce with historical insight and virtual tour with VR/AR technologies.
- Get information and orientation in the city through the information kiosks.
- Enhance cruise and ferries passengers tourism.

Impact on environment

- Have access on air pollution levels and possibility to manage them.
- Through usage of green technologies the carbon footprint will be lower.
- Control of traffic congestion through AI-driven tools.

Impact on operational functions

- The use of digital twins with the ability of monitoring and prediction will improve the operations and decision making.
- The surveillance with motion detection and more AI tools will increase safety.
- 5 G will enhance transactions in automation and improve communication inside the stakeholders in the port.

Impact on economy growth

- All these efficient technologies will increase port revenue by tourists and investors increase.
- The port will be more competitive in region and more.
- More jobs will be available.

4.3 Examples of ports that have implemented similar technologies and concepts

- Port of Hamburg – smart mobility solutions,ai- powered logistic optimization and green energy applications
- Port of Rotterdam – smart energy grid, digital twin, IoT sensors
- Port of Singapore –Ai driven traffic management, AR/VR, automated check-in system
- Port of Shangai – 5G, automated container terminal
- Port of Los Angeles – cyber resilience center,
- Port of Malmo Copenhagen - use drones for quay inspection, IoT for noise pollution, emissions, waste, energy consumption and climate adaption.[10]

5. Design with the 3 D Model of the Port

Implementation of AR and VR technologies:
For the implementation of these technologies should be a tourist corner inside the port settled in two places where the tourists disembark.

They should be equipped with internet and Wi-Fi spots and contain can be an information kiosk that should have

- Installed AR application that display 3D historical reconstructions of Durrës and highlight key landmarks in each of the terminals.
- Offer **virtual tours** of hotels, museums, and cultural sites in the city through port mobile apps.

Relating to IoT there are recommended sensors to track crowd density and they should be position in areas with access of tourist like the two terminals mentioned before, waiting areas and entry and exit ports at this terminals.

Figure 2: The position of the sensors, CCTV cameras and VR/AR Kiosks in the map

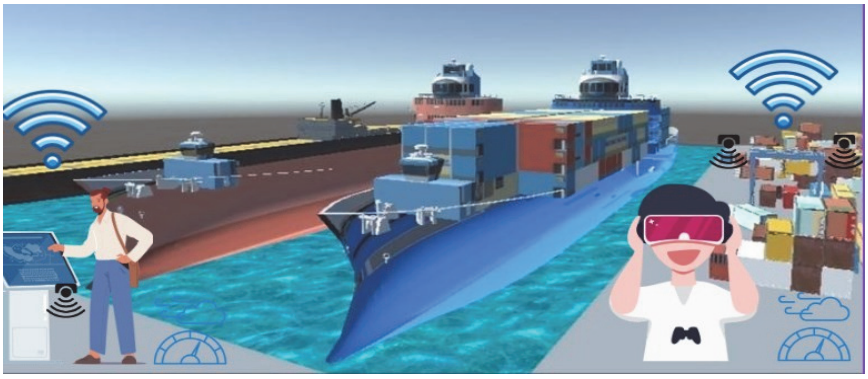

Figure 3: The position of the sensors, wireless, air pollution sensors and VR/AR Kiosks in the 3D model of one of the tourist area in the port

Presenting an example of application of digital twin technology with historical data on the yearly rate for the embarkation and disembark of the passengers. [11], [12],[13]

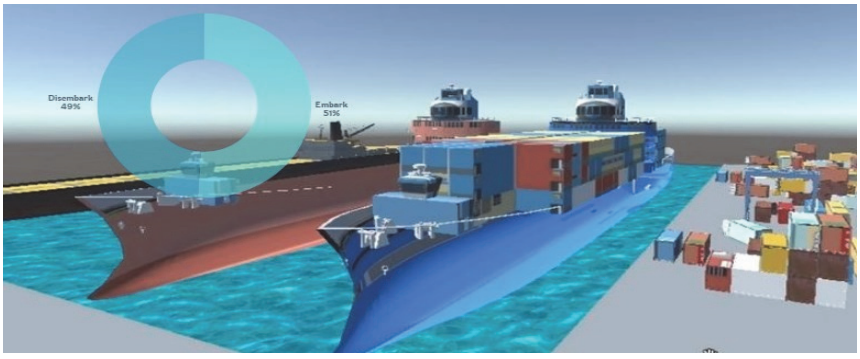

Figure 4: 3 D model of the port with an implementation of the digital twin technology.

5.1 To implement all these technologies that make the transformation there is necessary a financial support

- The EU funds for projects on sustainability and digital transformation
- Albania Government funds focused on smart infrastructure of the ports and tourism
- Public-private partnerships to engage companies with expertise in IoT, AI, AR/VR, digital twins, green technologies.

5.2 Practical Implementation Plan

The practical implementation plan is structured in 5 phases and each phase:

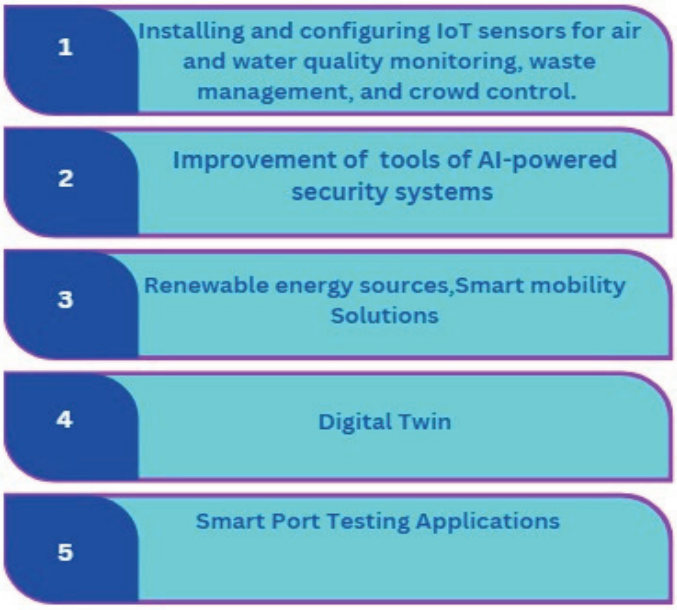

Figure 5: Phases of practical implementation plan

The total duration of the implementation process is foreseen to be 3 years as detailed below:

- Phase 1- lasts 6 moths
- Phase 2- 9 moths
- Phase 3- 9 months
- Phase 4 -9 months
- Phase 5 -3 months

6. Benefits and Challenges of a Smart Port

Benefits

- Be a contemporary port toward the latest technology developments
- Be comparative in region and Europe
- Be a model for the new port that is going to be constructed in Durres
- Possibility of internationalization and integration in many common projects

- Enhance security and safety
- Influence in tourism sector improving the yearly rate of tourist visiting Albania

Challenges

- Needs a lot of investments in staff and money
- Needs policy regulatory for data transactions
- Implementing GDPR for data protection since is very sensitive with the tourists target group.

- Enforce the cybersecurity infrastructure

7. Conclusions

A transformation toward updating Albania's maritime infrastructure and bolstering the nation's expanding tourism industry is the conversion of Durres Port into a smart port. The port can enhance operational effectiveness, security, and the overall experience for stakeholders and visitors by incorporating IoT, AI, VR/AR, and digital twin technologies.

The study emphasizes a number of important conclusions:IoT solutions can improve sustainability and expedite port operations. Examples include automated baggage handling, smart passenger flow management, and sensors for air and water quality.

Automated check-in technologies and AI-powered security systems increase efficiency and safety while cutting down on traffic and visitor wait times. Immersion technologies like VR and AR enhance the traveler experience and promote Albania's legacy by offering historical and cultural insights.

Predictive analytics, energy optimization, and better logistics management are made possible by the real-time virtual depiction of port operations provided by digital twin technology. The strategic significance of smart port transformation is further illustrated by a SWOT analysis, which addresses issues with cybersecurity threats and obsolete infrastructure while emphasizing advantages like Durres Port's location and government backing. The port's potential is further increased by chances for green energy adoption, public-private collaborations, and integration with smart tourism.[14], [15]

A concrete illustration of how digital transformation might alter the port's infrastructure is provided by the Durres Port 3D model design, which acts as a guide for putting these innovations into practice. Durres Port can improve its standing internationally, draw more visitors, and support Albania's environmental and economic sustainability by using these smart technologies.

To guarantee long-term success in making Durres Port a premier smart port in the Adriatic, future studies and investments should concentrate on scalability, legal frameworks, and ongoing digital innovation.

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