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Table of Contents

List of Figures

List of Tables

Glossary of terms and abbreviations used

Abbreviation / Term	Description
5G	5th Generation
AGV	Autonomous Ground Vehicle
AI	Artificial Intelligence
AR	Reality
BG	Background
CSP	Communication Service Provider
ER	Exploitable results
ETSI	European Telecommunications Standards Institute
FG	Fore Ground
I4	Industry 4.0
ICT	Information and Communication Technology
IDS	Intrusion Detection System
IoT	Internet of Things
IP	Intellectual Property
IPR	Intellectual Property Rights
KER	Key Exploitable Results
ML	Machine Learning
MNO	Mobile Network Operator
MVNO	Mobile Virtual Network Operator
NAAS	Network As a Service
NAO	Network Application Orchestrator
NetworkApp	Network Application
NBI	North Bound Interface
OSS	Operations Support System
PoC	Proof of Concept
SBI	Sound Bound Interface
SDN	Software Defined Networking
SLA	Service Level Agreement
SWOT	Strength, Weakness, Opportunities, Threats
UAV	Unmanned Aerial Vehicles
UC	Use Case

Executive Summary

5G-INDUCE aims to provide an end-to-end orchestration platform over enabling experimentation infrastructures for advanced 5G NetworkApps that can be applied for the realisation of extensive 5G use cases in the broader Industry 4.0 sector, leading to technological and business validation of 5G technologies by multiple collaborating tenants (e.g. manufacturing, logistics, maintenance power management, security/surveillance and more). Focus is given on validation of the 5G-readiness of both telecom operators and applications providers (on behalf of the related collaborating industries), aiming to bridge identified gaps in their interaction through a solution that is going to facilitate smooth porting of NetworkApps in 5G Industry 4.0 ecosystems.

The "New business models and market potentials" document will summarize the research performed by the project exploring the positioning of the 5G-INDUCE technology in the 5G market, presenting the potential business models, as well as the individual plans of the industrial partners of 5G-INDUCE, identifying their role and potentials in these models.

This document provides an account for:

- An analysis of 5G Market landscape with the market trends, business models, key players with their roles and interaction.
- An initial analysis of the connection between 5G and Industrial Sector and the revolution it undergoes (Industry4.0)
- The IPR Management of the members of the consortium
- The Individual and joint exploitation plans
- Business modelling and SWOT analysis of 5G-INDUCE technologies.
- An overview of the Market Potentials and opportunities of 5G-INDUCE.

1 Introduction

The 5G-INDUCE project represents a significant advancement in the development and deployment of 5G technologies for industrial applications. This document provides a comprehensive overview of the project's outcomes, highlighting its contributions to the field of 5G orchestration and network applications. The project has successfully demonstrated the potential of 5G technology to revolutionize various industrial sectors through the development and implementation of advanced Network Applications (NetworkApps).

1.1 Purpose of the Document

The primary purpose of this document is to summarize the key findings, achievements, and impacts of the 5G-INDUCE project. It aims to provide stakeholders, including industry partners, researchers, and policymakers, with a clear understanding of the project's contributions to 5G technology and its applications in Industry 4.0. The document also serves to highlight the potential for future developments and commercial applications of the technologies and methodologies developed during the project.

1.2 Structure of the Document

This document is organized into 6 sections

- Section-1. Introduction.
- Section-2. 5G-INDUCE Market analysis: An overview of the market ecosystem and the key players of 5G service provisioning in the revolution of the Industrial sector (Industry 4.0). An overview of their roles, their interaction and the view of their future placement.
- Section-3. Exploitation and IPR Management. Analysis of the IPR Management, KER and Individual and Joint Exploitation Plans of the partners
- Section-4. Business Modelling and Analysis: LEAN canvas and SWOT analysis of 5G-INDUCE innovations.
- Section-5. Market Potentials and opportunities. An initial overview for the placement of the 5G-INDUCE innovations in the market ecosystem.
- Section-6. In this Section there is the conclusion.

2 5G-INDUCE Market Analysis

5th Generation Mobile Networks (5G) is not just a new piece of technology, but it is also a catalyst for business model change for operators. There is a need to explore new sources of value and revenues to support the significant investments needed to deploy 5G. 5G builds on existing investments being made to create more agile networks and operations by utilizing the capabilities of SDN, network slicing and virtualization, edge computing, etc. Enterprises believe that significant incremental value will be generated from 5G, and there is strong demand for solutions that leverage new network capabilities, providing operators with an opportunity to participate in this. System vendors, cloud operators, and application developers are attempting to capture value from the fast-growing 5G market disrupting the existing ecosystem.

2.1 5G Market

The transformation of business models through 5G technology requires the identification and engagement of key partners within the 5G ecosystem (Figure 1). These partners play crucial roles in various aspects of the ecosystem, including infrastructure deployment, application development, and service delivery. Collaboration between network operators, application developers, service providers, and other stakeholders is essential to leverage the full potential of 5G technology.

Operators face significant choices in transforming their business models to capitalize on 5G infrastructure investments. Operators need to identify where the value lies within the 5G infrastructure and devise strategies to monetize these investments. This includes exploring new revenue streams and enhancing existing ones through innovative services and applications. The traditional model of monolithic network ownership and plain-vanilla services is evolving. Operators must shift towards providing innovative value-added services that cater to specific market needs and consumer demands. This transition involves leveraging 5G capabilities to offer differentiated and customizable services. As the focus shifts away from mere network ownership, operators need to concentrate on developing and offering applications tailored to various industry verticals. This approach allows operators to create targeted solutions that address the unique requirements of different sectors such as healthcare, manufacturing, and transportation.

All the above are already starting to encourage business model change. Following an analysis of the business players in the 5G ecosystem the main ecosystem actors are: Communication Services Providers (Passive/Active Network, RAN/FH-BH, Services), System Vendors (Hardware/Software), Edge/Cloud Providers (Computing/Storage), Applications Developers and Vertical end-customers.

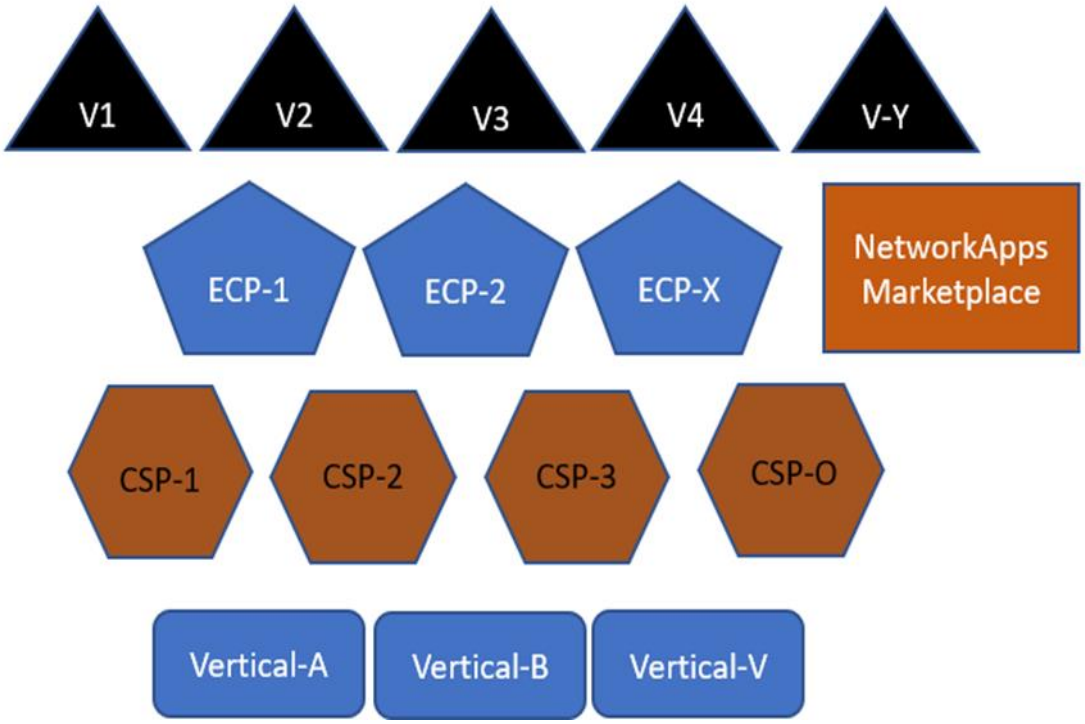

Figure 1: Main 5G service ecosystem actors.

The goal is to create win-win business models for all participants in the value chain. Effective 5G use-case realizations hinge on CSPs' ability to collaborate and co-innovate with other ecosystem partners. Given the market size and the number of verticals, it is necessary to develop specialized offerings and ensure the coexistence of multiple CSPs, CPs, and vendors. An effective partner ecosystem can help CSPs close capability gaps, accelerate innovation, and better support their customers' needs with more comprehensive solutions.

Comparing the traditional and emerging Business Models we come to these conclusions:

Business to Consumer (B2C) - these offerings will focus on using the capabilities and characteristics of 5G networks to strengthen service offerings to end customers, such as Fixed-Wireless and content, and will also include increasing bundling of partner services. The monetization elements in these offerings will be QoS-based data, goods and subscriptions including content, media, and partners.

Business to Business (B2B) - this is a large area of potential growth for service providers who will attempt to increase value they bring to industry verticals and help drive Industry 4.0. Here they will attempt to monetize embedded connectivity, managed connectivity, VNFs like security, as well as facilitate intelligent operations and automation. They may also bring partners to the table and enable advanced use cases like AR guided technical support.

Business to Business to Any (B2B2X) - this may be the biggest potential growth area for operators. The flexible, virtual nature of 5G networks will enable service providers to equip application developers and device manufacturers with embedded connectivity and virtual network functions as a service, in order to power their products. This has the potential to be a new wholesale service for operators that can provide open platforms to these customers to onboard themselves, equip themselves with services and settle with the operator, easily and efficiently.

5G pushes operators and the ecosystem to change their business strategy approach. Operators lack the resources and management bandwidth to develop the necessary capabilities to serve the needs of various industries beyond basic connectivity. Even providing connectivity at the level of private 5G networks might become too labor-intensive for them. Therefore, each operator will need to make strategic decisions about which verticals they plan to serve, their roles in the ecosystem, how they want to compete and add value, and which customers they will serve and how. Additionally, other key market players, such as equipment vendors, hyperscalers, and industries, are altering their strategies in response to 5G capabilities and new market conditions. Consequently, operators need to shift from a "horizontal" to a "vertical" strategy, focusing on innovative business models. Operators/CSPs need to utilize new business models to achieve monetization on their 5G investments. They need to co-develop partner ecosystems and attempt to achieve monetization in a collaborative way.

2.2 Network Operator Market

Private networks have the potential to unlock significant value by providing tailored connectivity solutions for specific industrial and enterprise applications. There is no doubt that a promising area for 5G monetization lies in industrial campuses, where 5G private or hybrid networks could be deployed. However, network slicing over public networks is another viable option. 5G private networks are not exclusive to operators and can be deployed by various players. Dedicated solutions offer benefits such as optimal site coverage, reinforced security, data control, redundancy, and SLA management, ensuring guaranteed availability and application response times suitable for the most demanding processes. Operators offering 5G private or hybrid networks need to think beyond mere connectivity to monetize Industry 4.0-focused 5G networks. For such networks, a new generation of actors may emerge, integrating the entire value chain, including applications, software, IoT sensors, and connectivity through MNO-VNO partnerships.

Deciding between 5G slicing and 5G private or hybrid networks depends on the specific needs and objectives of the enterprise, as both options offer distinct advantages in terms of flexibility, control, and customization. There is an ongoing debate about the potential of 5G slicing over public networks compared to 5G private or hybrid networks. In either case, connectivity offerings by CSPs need to be augmented by value-added services and applications (Figure 2). 5G NetworkApps can provide a differentiation advantage for all competing players, leading to significant gains across the entire 5G market and high prospects for 5G NetworkApps developers. A clear opportunity is foreseen for a NetworkApps orchestrator and BSS system to capitalize on this potential.

As the telecom industry shifts its focus from network ownership to providing specialized applications, vertical industries stand to benefit from more tailored and innovative solutions. Operators believe that network ownership gives them a competitive advantage in the services that run on their networks. However, this is not the case in the 5G era. Most successful innovations and services are developed and deployed by third parties and tend to be largely independent of the network. Therefore, operators should focus on developing platforms and solutions that work on any network, and then integrate successful services with a multi-purpose, programmable network. Moving beyond connectivity opens up a wider array of commercial and business models for operators, which will determine their success in offering services more efficiently, rather than competing based on traditional technological network differentiation, such as coverage. 5G NetworkApps will bring significant value to certain industries by enhancing productivity, improving safety and security, and creating efficiencies.

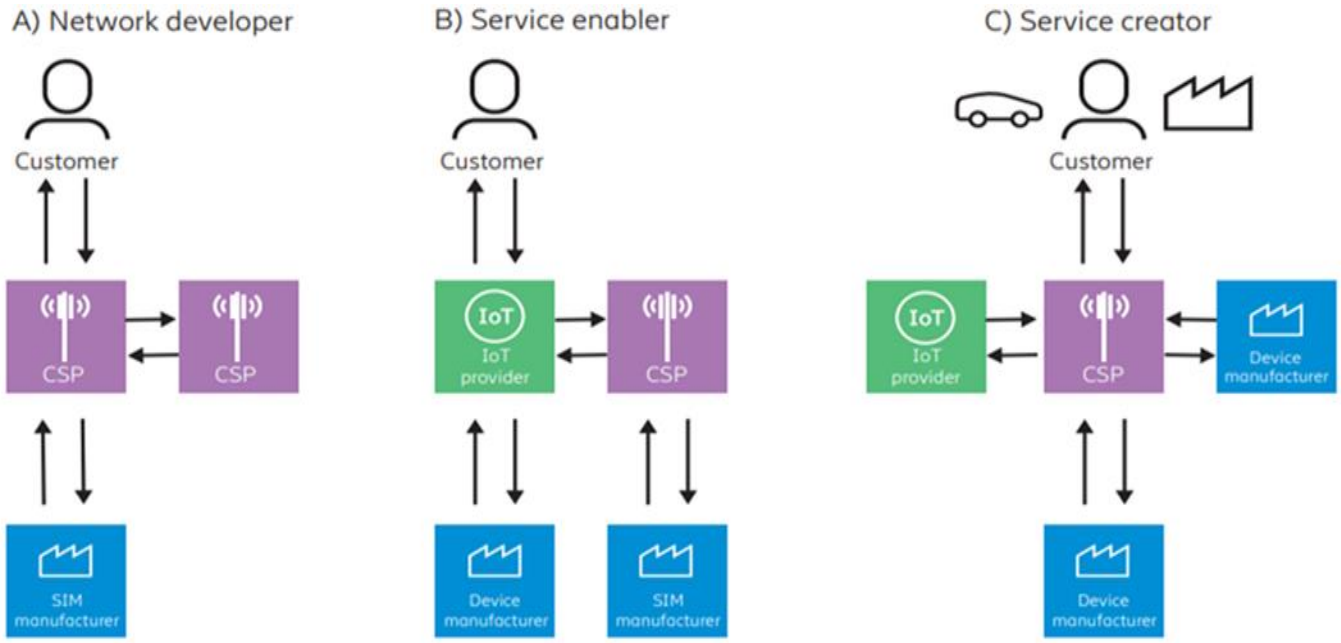

Figure 2: The evolving role of CSPs in the 5G ecosystem [1].

In the 5G era, operators are shifting their focus towards leveraging advanced technologies to deliver innovative and value-added services beyond traditional connectivity. Operators are starting to offer "Network-as-a-Service" (NaaS), allowing customers to deploy their chosen services in partnership with specialized service providers. They may also attempt to generate and control an ecosystem that is more coordinated, aiming to serve their targets and the needs of end-customers more efficiently. The objective is to increase the overall market size rather than simply gaining a larger market share. To achieve this, operators need to enable a 5G NetworkApps ecosystem that utilizes NaaS, based on new business models that rely on innovative interactions among end-customers, service integrators, system vendors, and application developers. In this evolving marketplace transformation, the role of a NetworkApps Orchestrator is becoming crucial.

In this landscape, operators are redefining their strategies and priorities to meet the demands of this groundbreaking technological paradigm. For some, providing Network-as-a-Service solutions may suffice, while others may opt to add value to specific verticals by specializing in offerings based on network slicing and NetworkApps. Certain operators may strive to establish a dedicated 5G NetworkApps ecosystem, leveraging it to facilitate the aggregation of applications from ecosystem players and provide enablement services to end-customers in collaboration with other market players. Alternatively, some operators may choose to independently extend into the development of their own solutions and applications, customized for end-customers. However, determining the appropriate path requires careful consideration. Operators should assess the fundamental size and growth potential associated with each market choice (Figure 3,4), the competitive landscape, the alignment with existing skills, and the availability of relevant partners.

	Revenue & profit pool	Market & competition	Fit with current skills
Applications and solutions	70+%	Fragmented specialists, intense competition	Low
Application enablement	20-25%	Consolidated, large tech players, intense competition	Medium
Network-as-a-service	5-10%	Consolidated, large telcos, intense competition	High

Source: STL Partners

Figure 3: Revenue and competition.

Understanding the role characteristics is paramount for navigating the complexities of interdependent relationships. In the realm of 5G, numerous use cases demand expertise beyond the conventional strengths of service providers. To effectively tackle these challenges, CSPs must cultivate new expertise or significantly broaden their collaboration with partners. Partnerships are crucial, particularly in B2B2X scenarios (Figure 5), where they can offer end solutions integrating offerings from the service provider and potentially multiple other partners. Various models exist, including scenarios where the service provider assumes the lead role, selling solutions that incorporate components from these partners.

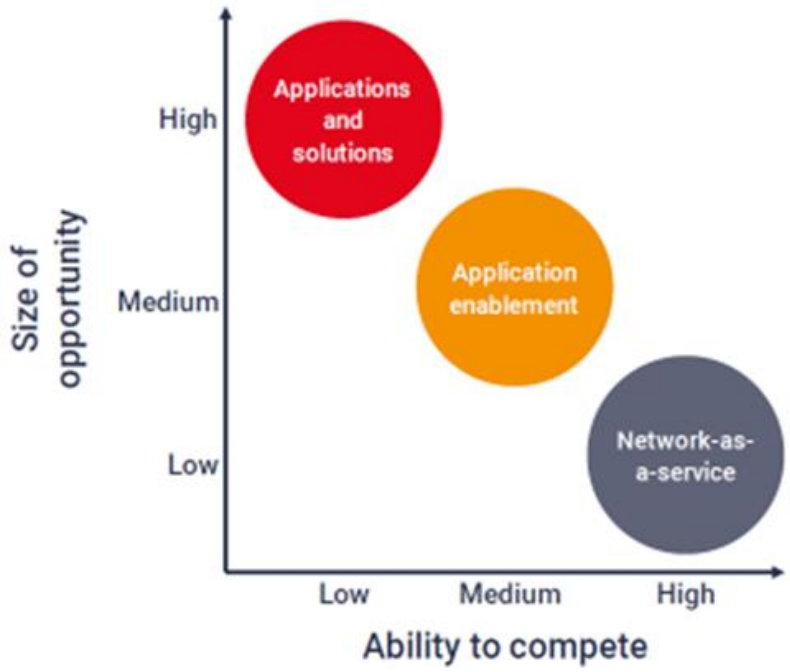

Figure 4: Size of opportunity to ability to compete.

As we transition from the models of the past to the innovative frameworks supported in the 5G era, the landscape of telecommunications undergoes a profound evolution. Operators that wish to compete effectively must move beyond network platform deployments and horizontal network services' offering and provide tailored platform and software capabilities to specific vertical industries (alone or with partners).

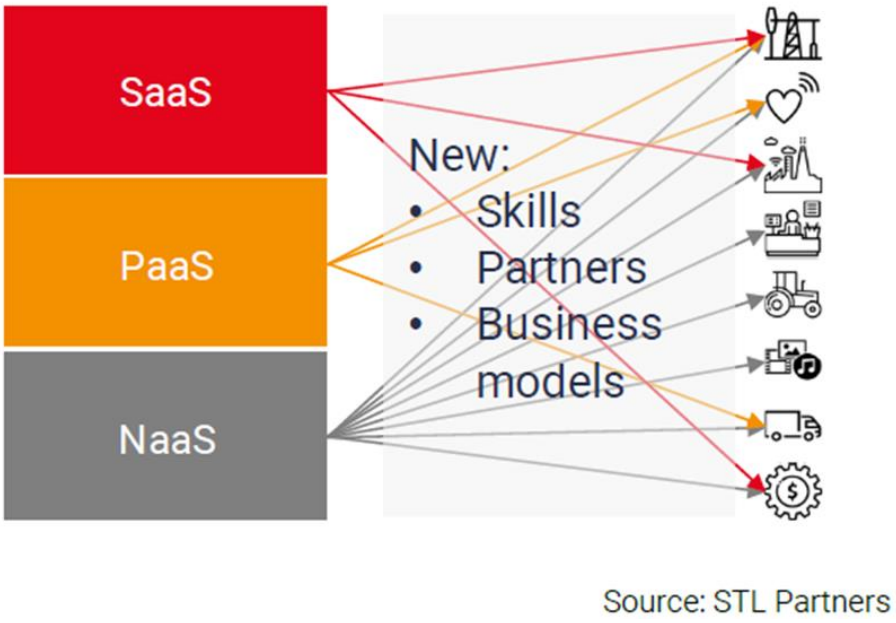

Figure 5: XaaS Relations with Industries.

2.3 Smart Industries Market

The Industry 4.0 (I4.0) concept was introduced as a revolution related to the way that quality, productivity, customization, and safety processes -among others- are designed, deployed, executed, and automated in manufacturing environments [2]. I4.0 (Industry 4.0) has developed over a similar timeline to that of 5G (Fifth Generation) technology. As a matter of fact, I4.0 and 5G have had and keep having a major influence on each other: 5G technology is regarded as a key enabler for supporting the communication needs demanded by the I4.0 vision while I4.0 is the most renowned and rapidly growing vertical sector for 5G deployments. 5G technology is a critical enabler for Industry 4.0 due to its high performance, reliability, and flexibility.

This reciprocal relationship between I4.0 and 5G meets the communication needs of I4.0, while I4.0 serves as a major vertical for 5G deployments. The benefits of 5G for I4.0 include efficient data flow, resource optimization, and enhanced maintenance through VR integration, leading to production time reductions, cost savings, and improved security. Key technological considerations encompass mobile robotics, edge computing, machine learning, IoT/IIoT, deterministic networking, and hybrid cloud. Investment models for I4.0-5G projects range from co-investment and public funding to individual company investments. Ensuring security and privacy is paramount, necessitating collaboration with ecosystem partners and adherence to standards.

The economic impact of Industry 4.0 (I4.0), enabled by 5G, is profound. Key points include substantial cost savings through resource optimization, efficient data flow, and reduced production times. Embracing I4.0 with 5G can significantly boost productivity by enhancing factory automation, maintenance, and supply chain processes. The adoption timeline indicates that most industrial sectors will integrate I4.0 with 5G between 2025 and 2029. Critical technologies, such as 5G eMBB, IoT/IIoT, and edge computing, are pivotal in this transformation. Overall, the synergy and convergence between I4.0 and 5G will drive innovation, competitiveness, and sustainable growth across various industrial sector, creating new business opportunities and transforming the market.

2.4 Network Application Market

Network application developers play a major role in shaping the market, by creating innovative solutions and providing services utilizing the advanced features of 5G technology. Those services they offer can meet various verticals and use cases' KPIs over the industry, enhancing communication, automation, and efficiency. Through vertical integration, developers bridge the gap between network technology and industry demands. Network Application developers create solutions that address emerging challenges, driving the evolution of 5G and beyond.

Network applications as a set of software component can be distributed to the ecosystem in various ways. To enable the interaction of these software components with the players of the ecosystem the Application Programming Interfaces (APIs) must be monetized. Here are listed some of the common methods for API monetization:

- Subscription Plans
- Developer Revenue Sharing
- API Usage Fees
- Data Licensing
- Freemium Model
- Partner Programs and Add-ons
- Customization and Consulting Services

Choosing and selecting the right monetization strategy depends on various factors, including the target market, competition, value proposition, and the specific needs of the developer or user community. A combination of different methods might also be employed to maximize revenue and cater to different customer segments [3].

3 Exploitation & IPR Management

3.1 IPR Management

The subsequent paragraph will elucidate some fundamental definitions pertaining to the management of Intellectual Property Rights (IPR), in order to ensure precision and comprehension. IPR management encompasses the process of recognizing, safeguarding, and capitalizing on intellectual property assets [4].

Intellectual property (IP): IP is a legal concept that covers the ownership rights to intangible creations of the human intellect. These creations encompass a wide range of valuable assets, such as inventions, artistic works, trade secrets, brand names, and other intangible properties. Intellectual Property Rights (IPR) are crucial in the context of an EU funded project. IPR refers to the ownership and control of technology assets within the project. These technology assets include the innovations, inventions, research, and other intellectual property contributions that each project partner brings to the collaboration. IPR management within such projects focuses on the protection, sharing, and exploitation of these assets.

In an EU-funded project, the IP assets are usually categorized into four distinct groups:

Background IP (BG): This category encompasses the pre-existing intellectual property that the project partners possess prior to their engagement in the project. It could include patents, copyrights, trademarks, or any other type of intellectual property that the partners possessed before starting the project. The original owner retains ownership of the background IP, and the project's agreements usually specify how it can be used or shared.

Foreground IP (FG): Foreground IP refers to the intellectual property that is created, developed, or improved as a direct outcome of the collaborative work within the EU-funded project. There may be opportunities to incorporate new technologies, processes, or innovations that arise throughout the project. Partners involved in the project may have shared rights or interests in the foreground IP, depending on the agreements and contributions made. The allocation, sharing, and exploitation of this IP is frequently a topic of negotiation and agreement among the project partners.

Exploitable Result (ER): A foreground asset that the owner or consortium member identifies to have potential of further exploitation relative or irrelative to the project's outcomes.

Key Exploitable Result (KER): KER is a crucial technological outcome of a project that has significant potential for exploitation or commercialization. It plays a central role in enhancing the overall impact and long-term sustainability of the project. The KERs derive directly from the technological advancement and innovations of the project.

3.2 Methodology

In order to effectively identify and gather all pertinent Intellectual Properties (IPs), a comprehensive questionnaire was given to all project partners at the beginning of the project. The purpose of this questionnaire was to document their IP assets, helping them to identify all relevant Background (BG), Foreground (FG), and Exploitable Results (ER), as well as the corresponding types of protection connected with each. Partners were periodically asked to disclose any recently acquired assets and verify the assets they had previously registered.

As a consortium, we collectively established the Key Exploitable Results (KERs), which represent the most innovative intellectual properties (IPs) that have been recognized. During the project, the consortium carefully observed and revised all relevant information regarding the maturity and protection status of these assets. During the last phase, we successfully concluded the thorough identification procedure by determining the type of protection and evaluating the maturity level of each KER.

Finally, in compliance with the conditions outlined in the Grant Agreement and the Consortium Agreement, the participating partners have come to an agreement respecting the shared ownership of certain Intellectual Property (IP). This agreement delineates the collective rights and obligations of the partners with regard to the collectively possessed intellectual property, guaranteeing that their individual interests are sufficiently advocated for and safeguarded. The existing framework clearly defines the circumstances in which each partner's ownership is acknowledged and preserved, fostering fair administration and utilization of the collective creative resources.

3.3 KERS

This is a crucial and impactful undertaking within the project, involving two fundamental aspects. Firstly, it requires a careful analysis to identify the project's key Exploitable Results, which are valuable assets that can be utilized for different purposes. Following that, it is necessary to develop individual exploitation plans for each project partner. These plans will outline detailed strategies and timelines for leveraging their identified strengths, in order to accomplish their specific objectives.

In Table 1: Identified Key Exploitable Results the identified KERs are presented alongside the protection type and the maturity level that they achieved at the end of the project. Additionally, the ownership of each KER that has been agreed among the partners can be found in the same table.

Table 1: Identified Key Exploitable Results.

KER Number	Exploitable Result (ER)	Main Partner(s)	Type of Protection	Ownership	TRL M0	TRL M42
kER1	NAO	UBITECH	Copyright	100%	3	6
kER2	OSS	CNIT INFO	Open source (except MetalCL)	70% CNIT 30% INFO	4	6
kER3	UC1 NetworkApps	ABB-UBU	Copyright	50%-50%	3	7
kER4	UC2 NetworkApps	FIVECOMM-UBU	Copyright	50%-50%	3	7
kER5	UC3 NetworkApps	YBVR	Copyright	100%	3	6
kER6	UC4 NetworkApps	Suite5	Copyright	100%	3	6
kER7	UC5 NetworkApps	UWS	Copyright	100%	3	6
kER8	UC6 NetworkApps	Oculavis	Copyright	100%	3	6
kER09	UC7 NetworkApps	iLink	Copyright	100%	0	7
kER10	UC8 NetworkApps	Internet Institute	Copyright	100%	5	7
kER11	PNI-NPN 5G System	Ericsson España	Copyright	100%	4	7

3.4 Individual Exploitation Plans

Within a research project, Individual Exploitation Plans outline the specific strategies that each participant will use to maximize the project's outputs and effectively use the research results in practical ways. Developing Individualized Exploitation Plans for all participants is crucial because it enhances the impact of research by creating customized tactics that correspond with each participant's specific goals and expertise. This approach promotes a diverse and innovative exploitation landscape [5].

Below are presented the updated individual Exploitation plans for each partner.

3.4.1 Research Institutes

CNIT: As a research institution, the main goal of CNIT is to exploit the results achieved during the project activity in future research projects and in the advancement of its research infrastructure, in terms of Laboratory equipment and software. In this respect, two items that will – and, to some extent, already did – significantly contribute to this advancement are the OSS (Operation Support System) and the DevOps testbed.

The flexibility of the OSS, which is organized in a suite of five main software services, grouped into two main modules – the North-Bound OSS (NB-OSS) and the South-Bound OSS (SB-OSS) – has already allowed to face the different programmability levels exposed by the heterogeneous administrative domains of the 5G-INDUCE ExFas. This flexibility has been enabled by the design of the SB-OSS as a chain of software services that can be selectively activated to gain access to various programmability levels, passing from a simple catalogue of available resources in case of no programmability, up to the complete terraforming of the physical infrastructure in case of full programmability. All the functionalities involved and developed or reinforced in the project are based on open-source software that can be reused and made available internally to other CNIT Research Units or to external institutions. The only exception to this is the MetalCL, as the service dedicated to managing and terraforming bare-metal resources (i.e., physical servers and hardware network equipment) to create Infrastructure-as-a-Service/Platform-as-a-Service (IaaS/PaaS) environments compliant with the 5G-platform needs. This service, which allows the dynamic Day-0 to -N lifecycle management of operating systems in the servers, of configurations in network equipment, and of complex distributed applications like OpenStack and Kubernetes, will be considered for possible future exploitation, not excluding business-oriented ones.

The DevOps testbed is part of a multi-layered hardware and software facility for the advanced experimentation and demonstration of 5/6G, Edge and Cloud Computing technologies. As such, it has been specifically conceived to host multiple isolated tenant spaces, or “islands” (e.g., project environments) that can emulate complete 5/6G network environments, as well as to manage and configure their respective physical/virtual resources through a Metal-as-a-Service (MaaS) approach and the software elements through Red Hat Ansible. Two already significant exploitation results, achieved during the 5G-INDUCE lifetime, have been: i) the use of part of these functionalities with the Horizon Europe 6Green project (coordinated by the CNIT S2N National Lab); ii) the inclusion of the testbed as part of the Scientific Large-Scale Infrastructure for Computing/Communication Experimental Studies (SLICES) project, which has been selected to be part of the 2021 roadmap of the European Strategy Forum on Research Infrastructures (ESFRI).

3.4.2 Industry

OTE: In recent years, the innovative technologies gradually introduced promise to improve working conditions, safety and generally facilitate every aspect of our lives. Increased user demands are driving the continuous development and improvement of 5G networks, including many innovations in network architecture and features, such as slicing and edge computing. Understanding how important these are, OTE

systematically invests in telecommunications infrastructure and new technologies in Greece and supports the country's journey towards its digital transformation.

Through 5G-INDUCE OTE, as a telecommunication provider, had the opportunity to identify the network requirements and design and implement a network that could support services offered to Industry 4.0. At the same time, OTE tested the network's operation in real case scenarios in an industrial environment.

In the project, OTE cooperated with partners integrating a fully operational testbed which was used in three use cases: Predictive maintenance for Power Generator, UAV inspection and surveillance, AR assistance for maintenance procedures. OTE had the chance to communicate the outcomes of this work in several business forums and related events, at national and European level. Additionally, OTE diffused these results within the 'wider' OTE Group of Companies where the company is Leader, as well as to the DT Group of Companies where OTE is an active member.

WIND3: Based on the progress WIND3 has achieved in the deployment of MEC platform in order to guarantee low latency and performance of the 5G network, WIND3 has considered the potential exploitation approach and activities performed during the project. Potential commercialization and other exploitation activities have been identified; WIND3 has deployed this solution in other similar funded projects; furthermore, it has implemented a similar platform for existing Business Customers. The after-project exploitation plan must include the analysis of platforms considering 5G core StandAlone when it will be available. WIND3 has improved its internal know-how related to 5G and MEC in the innovative field. The exploitation activities will mainly concern following vertical markets: smartgrid, Industry4.0, automotive, smart city, etc.

ERC: As stated in the 5G-INDUCE GA, Ericsson España (ERC) expects to exploit the results of this project in two complementary dimensions:

i. Improvement of our competence readiness as supplier of added-value services to 5G Communications and Digital Service Providers, in our national and European markets;
ii. Crafting new business solutions/offerings for addressing control, orchestration and management needs in the scoped vertical industries scenarios, for pursuing opportunities at national, European and global levels.

ERC is already exploiting project outcomes related to novel common architectures and solutions for supporting the integration, validation and enhancement of vertical applications developed by SMEs, especially in the topics of a) flexible edge computing demanding flexible applications' deployment and dynamic adaptation and b) smart and effective integration of non-public network environments with public networks powered by 5G. As a matter of fact, ERC is engaged, in 2024, in the execution of 5+ ongoing customer projects pivoting around the 5G PNI-NPN solution concept conceived in 5Growth and then further specified, developed and validated in 5G-INDUCE.

The knowledge build and solution outcomes from the project are expected to help Ericsson España to improve its positioning in this new market of value-added services, in order to serve our customers at global levels. The exploitation approach adopted has considered the following aspects, for which an update by the end of the project is provided:

i. the Knowledge build in the specific subjects addressed by the project through collaboration with the academic and SME partners. This has been largely achieved already, with special intensity in the collaboration with UBU, 5COMM and YBVR for crafting and validating the Use Cases of 5G-INDUCE in the Spanish Cluster, hosted at Ford factory.
ii. the Joint exploration and assessment, primarily with the Communication and Digital Service Providers, of new challenges and potential breakthrough solutions addressing control, orchestration

and management needs in the scoped vertical industries scenarios. This has been achieved through the organization of specific workshops with involvement of key actors in the value chain of 5G-based I4.0 services, and also reflected in the broader research work performed within 5G-PPP for the I4.0-5G whitepaper published in October 2023.

iii. the pursuit of new partnerships with high-tech SMEs participating in the consortium, for mutually supporting our business offerings in the mid-term, and for jointly tackling further technology challenges identified along the project (through further R&D collaborations). This has been articulated through forging, or participating in, new research consortia proposals at Spanish and European level, pending evaluation at the time of writing this report.

UNIS: 5G-INDUCE presents a significant opportunity for UniSystems, as a leading system integrator and multinational technical solutions provider, to expand its services offerings in the industrial sector and beyond. The project's results provide valuable insights and expertise that can be applied to reinforce UniSystems' current services portfolio in various related vertical sectors, such as transportation logistics and fleet management, both within the national and international market. Moreover, 5G-INDUCE offers an opportunity for UniSystems to investigate new advanced topics, like drone fleet control and VR control of Automated Guided Vehicles (AGVs), which align with future plans of the company.

UniSystems recognizes the importance and value of the 5G-INDUCE platform and intends to further enhance its interface towards a more user-friendly, intelligent and efficient version that could potentially include improved handling of high-level requests and translation into deployment and policy requests, ensuring a seamless experience for clients.

UniSystems plans to collaborate directly with Ubitech as a technology partner. Leveraging their extensive network of Mobile Network Operators (MNOs) contacts and industrial partnerships, the two companies will work together to promote the 5G-INDUCE platform as a holistic application management solution for large industries and companies from related vertical sectors. Additionally, UniSystems plans to involve a diverse group of SMEs (with priority to the project's SMEs) in the development efforts at a later stage to further enrich the range of services available on the platform.

As a system integrator with strong in-house business development services and management capabilities, Unisystems is well positioned to leverage the project results and collaborate with project's partners to offer a wholistic market approach for managing end user large industries or other companies from related vertical industries, towards MNOs and service providers.

BEKO (WHR/WHMAN): Beko Europe (formerly Whirlpool EMEA) will support the exploitation plan of 5G-INDUCE extending the 4 UCs, developed for Cassinetta refrigeration Factory, to the other EMEA factories, in compliance with BEKO Europe purchasing policy and Digital transformation roadmap. The company will evaluate the solution of 5G local industrial infrastructure at factory level with orchestrator capability embedded into the new IT organization. Whirlpool/BEKO Europe will also support 5G-INDUCE dissemination participating as industrial testimonial, invited as speaker in public events and in internal workshops held with EMEA factories network.

FORD: Ford Almussafes has contributed to the 5G-INDUCE project by providing the necessary facilities to successfully carry out use cases UC1, UC2, and UC3. The company will internally evaluate the 5G solution within the current IT infrastructure and recommend other company plants to undertake similar innovative projects using 5G solutions for various new technologies. The combination of 5G and cutting-edge technologies promises to enhance safety, efficiency, and productivity in Ford's manufacturing processes, making it a significant step toward the future of smart factories.

PPC: Through its participation in the 5G-INDUCE project, PPC has further advanced its know–how on 5G communication systems and acquired new knowledge and insights on how they could improve the business

activities of PPC. Moving forward, PPC will showcase the findings of the project and the results of the use cases to internal stakeholders (e.g., maintenance administrators, directors of power plants, etc.) and will initiate discussions with them on how the developed NetworkApps can be incorporated in relevant operations. Based on the feedback received by the internal stakeholders, and the current needs of the company, PPC plans to initiate discussions with the technology providers of UC4 to investigate the adoption of the relevant NetworkApps for predictive maintenance and fault prediction. Furthermore, PPC will examine via its Robotics Lab the commercial exploitation of the solution produced in UC 5 for using drones to detect corrosion in near shore power plants and infrastructure, as well as offshore wind farms. Finally, PPC through its relevant Inspection units will explore the wider exploitation and deployment of the tools developed in UC 6 to facilitate remote inspection and maintenance of critical infrastructure.

3.4.3 Universities

UOP: University of Patras is developing know-how for methodologies pertaining to 5G networking, testing and application-oriented management. In 5G-INDUCE, Up as WP7 leader and with its supportive role has strengthened its expertise of its Networks & Optical Communication (NOC) research group regarding technologies and solutions for 5G infrastructures and access points, while also reinforced the collaborations with the industry sector and standardization bodies. Following the end of the Project, University of Patras aims to exploit the Network Application development for the promotion of knowledge for educational purposes and the expansion of research activities as a common exploitable target for all academic partners. As WP7 leader Up has established communication channels with other ICT-41 projects, standardization bodies and Network Application Developers. These connections will be further exploited even after the end of the project towards the 6G projects. A key target underway at UOP is the establishment of a startup company focusing on remote 5G access terminals and dedicated customer tailored on premises processing. UOP aspires to exploit the scientific know-how and UOP will also contribute to the emerging standards developments proposed by 3GPP.

UWS: UWS through its Research & Enterprise Services department has investigated the potential commercialisation opportunities partially based on the use case (UC5) led by the UWS team. The involved partner PPC has been approached for this initiative, and a UWS spin-out has been created recently and is expected to be officially launched in March 2024. Moreover, UWS has conducted relevant standardisation activities in ITU-T and contributed to the creation of a new ITU standard: ITU-T Recommendation Y.Sup71 (2022), "Use cases for autonomous networks"[1]. In addition, UWS plans to utilise the R&D outcomes especially the demos from the trials to enhance the teaching materials in related modules for UWS students at the honours degree and postgraduate/research levels, thereby improving teaching quality and increasing students' satisfaction.

3.4.4 SMEs

UBITECH: As a leading SME in the creation of innovative software solutions, UBITECH has managed to significantly enhance its service management and orchestration framework with the innovative developments incorporated in NAO (Network Application Orchestrator) framework. Furthermore, standardized interfaces have been established and successfully tested with OSS, while also innovative addons have been provided for the service update, monitoring and policy engine mechanisms that enable the runtime management of applications. Significant insight has been brought also with respect to the application and services for industrial environments.

A key benefit for the 5G-INDUCE platform is the enablement of unique application solutions tailored to end user needs, utilising the companies' expertise in the fields of analytics, data processing and interfacing. UBITECH plans to exploit the project findings to its collaborating system integrators and/or directly to vertical

[1] https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15041&lang=en and https://www.itu.int/rec/T-REC-Y.Sup71-202207-P/en

sectors (primarily in Industry 4.0, health, and smart city verticals) in the form of services and consultancy. Furthermore, with the 5G-INDUCE innovative platform as a driver and in combination to its vertical orchestration solution, UBITECH plans to start having a core contributing role in related open initiatives, primarily in the field of edge computing and private 5G/6G networks, with the goal to widen its market visibility and establish key collaborations with major innovators in the field.

UBITECH, as leading contributor and technical manager in 5G-INDUCE, invests further on the innovative extensions to its vertical service orchestration platform both as integral part of a newly developed multi-domain e2e orchestrator and the interfacing of the edge domain orchestrators to diverse vertical sectors. The long-term goal is to extend the vertical end user interface with service-oriented policies and features in support of automation, while also significant investment is promoted in the adoption of smart telemetry and ZTP in combination with the establishment of a secure deployment framework.

ININ: Based on the progress ININ has achieved in development and productization of its qMON test and monitoring automation solution and through the exploitation approach and activities performed during the project lifetime (cooperation with other partners in the field, market research, dissemination and demonstration activities, validation activities in Industry 4.0 use cases), potential commercialisation and other exploitation activities have been identified and realized. Advanced features of qMON have been recognized as suitable to be utilized in two SNS-JU projects already in progress (6Green, Exigence), as well as the solution has been included into a couple of other R&D project proposals. Further, existing commercial customers are already benefiting from new features and with another large-enterprise industrial customer the solution is in the delivery phase. However, not all features developed during within 5G-INDUCE have been productized yet; therefore, the after-project exploitation plan includes productization of them and searching for further commercial and R&D opportunities, also by continuing dissemination, demonstration, validation, and other similar activities, primarily focusing to specific markets and customers.

5COMM: We aim to offer our product and service as both a licensed solution and a consultancy service to mobile robotics companies. This strategic approach will support future research projects focused on 5G and 6G technologies. Our NetworkApp will be disseminated among mobile robotics companies to gather valuable feedback and ensure its seamless adaptation to clients' systems. By offering a consultancy service, we can tailor the solution to meet specific customer needs and provide ongoing support. Alternatively, licensing the NetworkApp allows us to reach a broader market, enabling companies to integrate our innovative technology into their operations independently. This dual approach not only fosters strong partnerships within the industry but also accelerates the adoption and refinement of our NetworkApp. Engaging with leading mobile robotics companies through direct consultation or licensing agreements ensures our technology remains at the forefront of advancements in 5G and 6G applications.

YBVR: YBVR's participation in the 5G-INDUCE project, with the development of Use Case 3 (VR immersion and AGV control), was used to explore the possibility of commercializing this solution with 5G support for industrial environments. This experience has helped the YBVR innovation team to propose a new service within the company to monitor industrial processes in dangerous or inaccessible environments.

The key points of this service will be the 5G network capacity for uploading immersive videos, the flexible edge computing resources to process the video and compile and overlay the real-time data of the environment on the video, and the player APP developed for immersive (VR headset) and non-immersive (smartphone or tablet) devices to monitor the data and images.

The next step in the exploitation plan is to explore the potential market by showing the demo recorded in this project to get customer feedback to analyze the commercial opportunity.

ASTI/ABB: The outcomes are going to expand the range of functionalities of the AMRs platform and will allow to improve the technical quality of all the ABB products. This is going to contribute to a significant increase in the sales figure of the company and the opening of new target markets and geographic sectors. The execution of the project has been fundamental to achieve the fulfilment of the 2025 objectives, in which it is estimated to reach an annual sales figure of 50M €.

ABB has identified a list of clients that could need AMRs in their installation with a significant added value for their production system and the consequent competitive advantage. They are grouped in 2 categories:

- Returning clients: clients that had automated their factories, by introducing AMRs in their production processes, that need to improve their systems by installing AMRs with improved functionalities.
- New clients: clients that want to automate their logistics and production processes and need some specifications that we can provide with the improvements achieved with this project.

The ABB's AMRs already have been deployed in a huge list of different market sectors and applications; among others: food sector, automotive industry, pharmacy, aeronautics, cosmetic industry, batteries, etc., distributed all over the world but mostly in Europe.

The developments generated in the project are going to be included within the range of ABB products and may be implemented in any of the facilities that are offered. This will multiply the possibilities of commercialization of the new offered solutions.

INFO: INFO is already exploiting the competencies it gained through the participation in the 5G-INDUCE project, and, especially, in the design, development and integration of the 5G-INDUCE Platform carried out in the scope of WP3, WP5 and WP6. In fact, INFO is applying such competencies in two new innovation projects, started in 2024 and funded by the Liguria Region (Italy) from the European Regional Development Fund' (ERDF) 2021-2027 budget. These two projects pertain the development and large-scale tests in real environments (TRL 6/7) of, in one case, a massive IoT (Internet of Thing) system for the monitoring of critical road infrastructures for the prevention of disasters, and, in the second case, a reliable, low latency machine to machine system for the command and control of marine USVs (Unmanned Surface Vehicles) provided with sensors for monitoring the quality of water and air in ports and near-shore areas. Both systems are based on multi-technology telecommunication infrastructures (which, specifically for the USV project, largely relies on a private 5G network) and on edge/cloud solutions for the deployment of vertical applications; hence, the opportunity for INFO to apply and bring to a further level of maturity the solutions about the orchestrated deployment of vertical application and network services co-developed in the scope of 5G-INDUCE.

In the above-mentioned new projects, INFO is collaborating with a set of SMEs and large enterprises that operate in the environmental and infrastructure monitoring markets. Furthermore, the demonstrations of the two systems will involve potential customers such as local port and land authorities. Hence, the new activities, founded on the experience made in 5G-INDUCE, will allow INFO to enter new markets (environmental security and critical infrastructure security) as a provider of smart ICT solutions, by building a solid collaborative network with actors already established in those fields and effectively linking with final customers.

8BELLS: Eight Bells is actively participating in the 5G-INDUCEProject, where they are building an Intrusion Detection System (IDS) that may provide incident warnings. We have also successfully tested predictive algorithms within UC4. Based on the knowledge gained from this initiative, Eight Bells has already taken action to maximize the benefits by combining the IDS with a mitigation mechanism, thus advancing research in this field. In addition, our skill in Artificial Intelligence and Machine Learning has greatly improved, achieving a higher level of knowledge through the utilization of the considerable experience acquired from the implementation of the 5G-INDUCEproject. Our goal is to persist in our study and produce a thorough product, making use of the knowledge and insights gained during the project.

SUITE5: Suite5 through its participation in the 5G-INDUCE project and the development of the UC#4 NetworkApp further advances its technological and innovation know-how related to 5G in manufacturing systems and succeeded to introduce new AI/ML services to its current services portfolio of data-driven intelligence.

Following the end of the project, Suite5 aims to exploit the developed NetworkApp in various domains, that require the provision of real-time predictive maintenance decision, while the overall application that has been delivered is capable of leveraging 5G capabilities to solve other problems as well, as it provides the ability to design various AI pipelines that can be customised to the needs of different domains/end users.

Exploitation activities will target primarily Manufacturing Enterprises and Big Industries that are in need of more flexible, dynamic and scalable analytics based on large streams of data in the specific ICT domains that handle business critical systems. These stakeholders will be reached through personalised contacts with existing or potential clients and through the participation in fairs or through online communication channels.

K3Y: K3Y will exploit the results and solutions of 5G-INDUCE by utilising its capacity in creating, maintaining and optimising the usage of big data, visualised IDPS and Fog / IoT-enabled simulation environment.

K3Y will further advance the use of visual-based anomaly detection to deliver more reliable NetworkApps and services. Additionally, K3Y will expand the IoT tools within the simulation environment by incorporating more Fog devices, nodes, and protocols, including trusted UAVs, to support large-scale applications.

K3Y will mainly investigate the exploitation of the NetworkApp Orchestrator (NAO), the exploitation of UC4 NetworkApps for predictive maintenance and fault prediction and the exploitation of UC6 NetworkApps to facilitate remote inspection and maintenance of critical infrastructure. Specifically, K3Y will explore the internal utilisation of these results for further development and the potential to offer consultancy services.

Exploitation activities will focus on targeting private sector companies in Bulgaria, showcasing the benefits and capabilities of 5G-INDUCE solutions. K3Y will reach the target audience through personalized contacts with existing and potential clients, participation in industry fairs, and online communication channels.

OCULAVIS: The goal is to further develop 5G-INDUCE mobile applications to optimize their use in 5G environments, aiming for a final product that provides quality on demand. Furthermore, the system setup will be evaluated and enhanced to be optimized for public and private 5G network scenarios, specifically targeting large manufacturing industries and SMEs, with a focus on the Automotive, Energy, Life Sciences, Machine Tool Makers, and Plant Manufacturers sectors requirements.

Our monetization strategy includes introducing premium subscription licenses for newly developed features such as adaptive bandwidth on demand and on-premise hybrid media server deployment. The software will remain closed-source, and we will retain all IP rights to the processes and software codes.

Ongoing research and development will continue through follow-up projects to evolve features (e.g., with efforts to reduce the carbon footprint and minimize server usage and costs).

3.4.5 ICT

ILINK: In the strategic rollout of ILINK's indoor positioning application, developed under the 5G-INDUCE HORIZON Project, our aim is to leverage the high TRL of the application to enter and expand within the market as a fully-fledged product. The application, which utilizes ultra-wideband sensors for precise indoor tracking, has been rigorously tested in extensive industrial environments, enabling real-time monitoring of workers and forklifts. A standout feature of our application is the innovative collision avoidance algorithm that proactively sends alerts to prevent accidents, enhancing operational safety. As we transition from project completion to commercialization, our exploitation strategy will focus on enhancing product visibility through targeted marketing campaigns and direct engagements at industry-specific conferences and exhibitions.

These efforts will underline the application's benefits, particularly its potential to significantly increase safety and efficiency in industrial settings.

Furthermore, the successful implementation and positive reception of our application within large industrial facilities underscore its readiness and potential for broader application. ILINK plans to capitalize on this by initiating pilot programs with potential clients in the logistics and supply chain sectors, where the demand for such innovative solutions is rapidly growing. These pilot programs will serve as a platform to demonstrate the application's effectiveness and to refine its features based on real-world feedback. By aligning our development strategies with the evolving needs of these industries, ILINK aims to not only solidify its foothold in the market but also to explore opportunities for scaling the application internationally, thereby maximizing the exploitation of our technological advancements and contributing to safer, more efficient industrial operations.

3.5 KER Exploitation

Table 2 shows the intention of every partners to exploit the KERs. They have to choose between **M**: Making a product and selling it, **U:** Using the project result internally for further development, **L:** Licensing the project result to third parties. **S:** Providing a Service, such as consultancy, etc.

Note here that the ER11 has been identified in the last month of the project by ERC.

Table 2: Individual Exploitation Paths.

ER / Partner	ER1	ER2	ER3	ER4	ER5	ER6	ER7	ER8	ER9	ER10	ER11
CNIT	-	U/S	-	-	-	-	-	-	-	-	-
OTE	-	-	-	-	-	-	-	-	-	-	-
WIND3	-	-	-	U	-	U	U	U	-	-	
ERC	-	-	U/S	U/S	U/S	-	-	-	-	-	M/U/S
UNIS	-	-	-	-	-	-	-	-	-		-
WHR/WHMAN	-	-	-	-	-	-	-	-	-	-	-
FORD	-	-	U	U	U	-	-	-	-	-	
PPC	-	-	-		-	-	-	-	-	-	-
UOP	-	-	-	-	-	-	-	-	-	-	-
UWS	-	-	-	-	-	-	M/U/L/S	-	-	-	-
UBITECH	M/U/S	U/S	-	-	-	-	-	-	-	-	
ININ	-	-	-	-	-	-	-	-	-	M/U/S	-
5COMM	-	-	-	M/U/L	-	-	-	-	-	-	-
YBVR	-	-	-	-	M/U	-	-	-	-	-	-
ABB /ASTI	-	-	U	-	-	-	-	-	-	-	-
ILINK	-	-	-	-	-	-	-	-	M/U/S	-	-
INFOCOM	-	U/S	-	-	-	-	-	-	-	-	-
8BELLS	U/S	-	-	-	-	U/S	-	U/S	-	-	-
SUITE5						M/S					
K3Y	U/S	-	-	-	-	U/S	-	U/S	-	-	-
OCULAVIS	-	-	-	-	-	-	-	U	-	-	-

The data analysis, visualized in Figure 6: Individual Exploitation Preferences per Partner, indicates that out of the total number of partners, 28 opted to utilize the project findings internally for additional advancement, which emerged as the most favoured alternative among the available choices. This indicates a clear inclination to utilize the results of the project to improve their own talents and even create new products or services internally. Chosen by 18 partners, the second most favoured option is offering a service, such as consultancy. This demonstrates a significant desire to utilize the outcomes of the project to provide expertise and specialized services to others, which could potentially generate new business prospects in the service industry. Only a limited number of partners, precisely 8, are interested in developing and marketing a product. This indicates a more conventional approach to commercialization, where the outcomes of the research are transformed into marketable items. Only 2 partners have chosen the option of licensing the project result to outside parties, showing a minimal interest for allowing external parties to monetize the project outcomes through licensing agreements. In summary, the data indicates that partners primarily prefer to use the project outcomes for internal development and providing services, rather than focusing on creating direct products or showing minor interest in licensing. This tendency emphasizes a deliberate preference for innovative and service-oriented business strategies among the partnering group.

Figure 6: Individual Exploitation Preferences per Partner.

3.6 Joint Exploitation Plans

A Joint Exploitation Plan in a research project details the collective intentions of all participants to effectively utilize the project's results and outcomes [5]. This plan ensures a coordinated and synergistic approach to converting research findings into practical applications. The importance of having a Joint Exploitation Plan resides in its capacity to optimize the combined effect by promoting collaboration and utilizing the strengths of each member, resulting in stronger and more complete methods for exploitation. A Joint Exploitation Plan ensures that all participants in a project are aligned with its broader aims. This helps to establish a clear direction and facilitates coordinated exploitation operations, which in turn prevents disagreements and redundancies. It facilitates the effective distribution of shared resources, aiding in the prioritization of actions and investments that are crucial for the collective utilization of outcomes. Joint contingency plans are developed by Joint Exploitation Plans to identify and overcome potential barriers, hence improving risk management within the collaboration. They facilitate stakeholder participation by motivating participants to establish connections and jointly strategize dissemination actions, thus increasing the visibility and adoption of the research findings. Monitoring and assessment are made more efficient by establishing common,

quantifiable objectives and benchmarks, enabling coordinated modifications and enhancements. In addition, Joint Exploitation Plans guarantee the durability and expandability of research findings by strategically preparing for their prolonged utilization and wider implementation in a cohesive manner.

The consortium has received multiple strategic proposals outlining how they may effectively utilize and benefit from the 5G-INDUCE project once it is finished. The plans have been classified into three primary domains:

Product (Commercialization): The consortium partners have numerous prospects to develop and market goods generated from the entire project or its separate components.

- Complete Product Ownership: A consortium entity has the authority to possess the entire platform but has the option to delegate certain network applications (NetworkApps) or other components to guarantee complete functionality.
- Stakeholder Engagement: Partners have the ability to include stakeholders and potential clients in order to showcase the worth and usefulness of their offers, whether it is a whole product or certain components.
- Licensing: Partners have the ability to offer licenses for products that are built on the platform and NetworkApps, which allows for a continuous and ongoing source of revenue.
- New Ventures: They have the ability to create spin-offs, start-ups, or other related enterprises in order to market and monetize their valuable components or the platform itself.

Services: The second category pertains to the potential of providing services derived from the discoveries and advancements of the 5G-induce project.

- Consulting Services: Offering advisory services that utilize the knowledge and skills acquired during the project.
- Policy and Procedure Development: Formulating or strengthening organizational policies and processes using the project's findings.
- Standardization Contributions: Making valuable contributions to standardization procedures, in order to influence industry standards and guarantee compatibility and interoperability.

Further Development: If the consortium deems their solutions insufficiently developed for market launch, they can pursue other avenues for further advancement.

- Consortium members have the option to independently finance their outcomes, in order to progress the Technology Readiness Level (TRL) of their discoveries.
- External funds: If self-financing is not possible, they can pursue outside funds to support further development. This might be accomplished by reapplying for Horizon Europe programs or by obtaining funding from external sources.

The partner's preferences can been seen in Table 3; their choice is between:

- **Product**: 1) Stakeholder Engagement, 2) Licensing, 3) Subcontracting, 4) Spin off or Startup.
- **Service**: 1) Consulting, 2) Policies, 3) Standardization.
- **Research**: 1) European or National Research Programs, 2) Self-Funded, 3) External Funded.

When partners collaborate to develop a product using their resources, they often select from two primary strategic approaches to enter the market and maximize the product's value. One such approach is to directly include stakeholders, such as customers, industry influencers, regulatory agencies, and other important individuals, in the promotion and distribution of their product. This method enables partners to cultivate robust relationships, collect useful input, and establish a community centred around their offering, so augmenting and mutually reinforcing their overall solution. An alternative approach is to grant a license for their solution to other companies, allowing them to generate income through licensing fees and royalties. This approach enables partners to generate revenue from their intellectual property without requiring major marketing and

distribution endeavours. It has the ability to create a consistent income flow, while allowing them to concentrate on more invention and development. None chose to subcontract or create an alternative company.

When it comes to offering a service, most partners opt to provide consulting services, a strategic choice that can pave the way for collaborative partnerships aimed at delivering comprehensive solutions. This approach leverages the combined expertise and resources of multiple stakeholders to address complex challenges, creating a holistic service offering. A key asset in this scenario is the 5G-INDUCE technology, which has the potential to foster partnerships through engagement with standardization bodies. By aligning with these bodies, partners can ensure their solutions meet industry standards, enhancing interoperability and credibility, ultimately driving widespread adoption and innovation within the 5G ecosystem.

In order to advance their research, most partners will seek external financing by collaborating with stakeholders and participating in research initiatives like Horizon Europe. This approach not only ensures the required financial means but also promotes cooperation among various entities. By obtaining finance through these channels, partners can commence new collaborative projects, harnessing the combined experience and potential for innovation of all parties involved. Collaborations of this nature expand the range and influence of research efforts, facilitating the creation of sophisticated solutions and technology. The collaborative endeavour in these projects not only expedites advancement but also establishes a robust groundwork for enduring alliances and continuous innovation throughout the sector.

Table 3: Exploitation Paths Towards Commercialization.

KER Number	Exploitable Result (ER)	Main Partner(s)	Product	Service	Research
ER1	NAO	UBITECH	1	1, 3	1, 3
ER2	OSS	CNIT/INFO	1	1, 3	1, 3
ER3	UC1 NetworkApps	ABB	1	1	1, 2
ER4	UC2 NetworkApps	5COMM	2	1	1, 3
ER5	UC3 NetworkApps	YBVR	2	1	1, 3
ER6	UC4 NetworkApps	SUITE5	2	1	1,2
ER7	UC5 NetworkApps	UWS	-	1	1
ER8	UC6 NetworkApps	OCULAVIS	2	1	1
ER09	UC7 NetworkApps	ILINK	1,2	1	1
ER10	UC8 NetworkApps	ININ	2	1	1,2
ER11	PNI-NPN 5G System	ERC	2	1	-

4 Business Modelling & Analysis

4.1 Objectives

The purpose of business modelling and analysis [6] for the 5G-INDUCE platform is to provide a comprehensive description of our strategy plan for entering the market, with a particular emphasis on clarifying project use cases in order to evaluate all elements that affect the platform's long-term viability [7]. This entails guaranteeing the practicality and financial feasibility of the platform in both existing 5G and beyond 5G. Emphasizing the platform's technological developments and advancements is essential. This entails providing a comprehensive explanation of how the platform promotes operational efficiency, minimizes expenses, enhances user experiences, or creates new avenues for corporate growth, so presenting a clear and persuasive value proposition to attract attention and investment. The 5G-INDUCE platform is strategically positioned in the telecommunications sector to take advantage of the potential given by 5G and future advancements. By addressing these factors, it is considered a feasible and innovative solution.

4.2 Methodology

SWOT analysis [8] is an acronym derived from the words: **S**trengths, **W**eaknesses, **O**pportunities, and **T**hreats. Furthermore, SWOT analysis is a strategic framework utilized to assess the strengths, weaknesses, opportunities, and threats present in an organization or project, with the aim of informing strategy analysis and development. The SWOT analysis was used in the deliverable D7.6 to examine the internal and external factors that may positively or negatively impact the outcomes of the project. Therefore, considering these attributes, it is important to identify the potential opportunities that can be utilized to make the 5G-INDUCE platform adaptable and feasible. The analysis results demonstrate that both the selected use cases and the NAO/OSS technologies have the ability to effortlessly integrate into the existing market offers. They provide comprehensive assistance throughout the entire process of deploying and managing diverse i4.0 NetworkApps, which include easy-to-use plug-and-play capabilities. This flexibility guarantees that these advancements can be efficiently integrated into other platforms and systems within the sector.

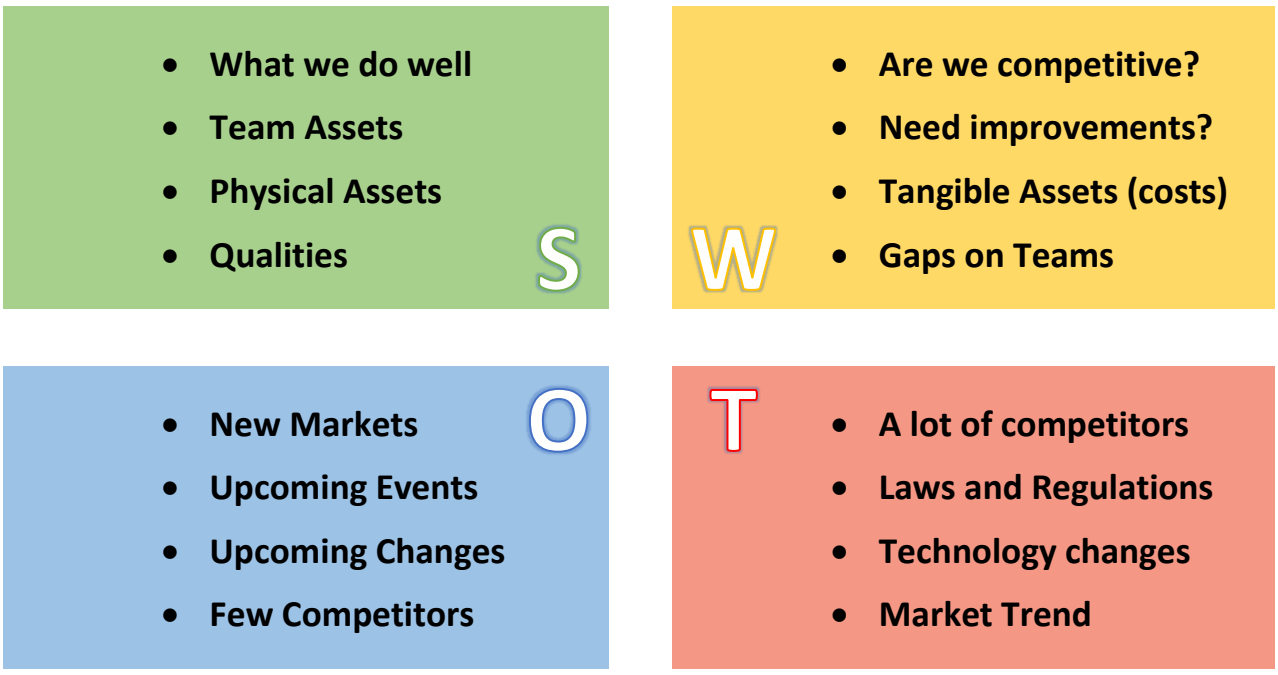

Figure 7: SWOT Analysis Template.

Lean Canvas: The Lean Canvas [9] is a concise business plan template tailored for startups that adhere to the Lean Startup methodology. It simplifies traditional business plans into a concise one-page format, with a strong emphasis on the fundamental assumptions and ensuring their validity prior to making significant investments. Essentially, it offers a concise and practical framework to break down your business idea and its fundamental assumptions, replacing the need for lengthy documents. Testing your ideas through customer feedback before allocating significant resources is highly encouraged. The Lean Canvas encourages a flexible approach, enabling you to adjust your business model based on insights gained from validation. The single-page format promotes effective communication and alignment among team members and potential investors. Similar to a financial analyst, the Lean Canvas is designed specifically for startups, with a focus on problem validation and customer segments.

The LEAN canvas consists of the following elements:

Problem: This section focuses on clearly defining the top three issues that your product or service aims to address. Having a deep understanding of your customer's pain points is essential for creating a thriving business.

Solution: In this section, you will outline how your product or service effectively tackles the issues identified earlier. This is essentially the value proposition, a brief explanation of how the customer's problem is solved and value is provided.

Unique Value Proposition: This section extends beyond your solution. Here, you will find an explanation of why our solution sets itself apart and what distinguishes it from competitors. What sets you apart from other options in the market?

Customer Segments: Determine who your ideal customers are. Who is your target audience for your product or service? This can be a wide-ranging category or broken down into more specific user groups.

Unfair Advantage: This section is completely optional, yet incredibly powerful. Do you possess a distinctive edge that is difficult for competitors to replicate? These factors could include unique technological advancements, a well-established brand image, or privileged access to valuable resources.

Channels: How do you plan to effectively reach your target customer? This section outlines the various channels that will be utilized to deliver your product or service and effectively communicate the unique value it offers. This could be achieved through various channels, such as online platforms, brick-and-mortar stores, strategic alliances, or a blend of these options.

Revenue Streams: In this section, you will detail the ways in which your business will generate income. There are various ways to generate revenue, such as product sales, subscriptions, advertising, or other methods.

Cost Structure: Identify the key costs associated with running your business, just like a financial analyst would do. These expenses encompass various aspects of the business, such as production, marketing, salaries, and rent. Gaining a thorough grasp of your cost structure is crucial for achieving profitability.

Key Metrics: Establish the essential performance indicators (KPIs) that will enable you to monitor and evaluate your business's progress. These metrics can be used to evaluate the effectiveness of your strategies and pinpoint areas that could be enhanced.

Table 4: LEAN Canvas Template.

<table>
<tr><th>Problem</th><th>Solution</th><th>Unique value Proposition</th><th>Unfair Advantage</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">List the top 3 Problems

Existing Alternative
How these problems are solved today</td><td>Outline a possible solution for each problem</td><td rowspan="3">Single, clear, compelling message that states why you are different and worth paying attention</td><td>Something that can’t
be easily copied or bought</td><td rowspan="3">Target customers
All target customers and users

Early Adopters
List of ideal customers</td></tr>
<tr><td>Key Metrics</td><td>Channels</td></tr>
<tr><td>List the key numbers that tells you how your innovation is doing</td><td>Path to customers</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Customer Acquisition Costs, Distribution Costs, Hosting People, etc.</td><td colspan="3">Revenue Model, Lifetime Value, Revenue, Gross Margin</td></tr>
</table>

4.3 5G-INDUCE Innovations Business Analysis

4.3.1 NAO

The primary objective of the NAO (Network Application Orchestrator) is to promptly deploy and oversee NetworkApps, guaranteeing adaptability and adherence to top-level regulations. It operates as a platform for industry professionals and application developers to oversee deployable apps without disrupting the network operations controlled by telecom providers. The NAO improves application awareness in network slice creation and maintenance by separating application layer management from network layer management. It is interoperable with different orchestration solutions. Created for contemporary distributed architectures with edge processing, it is compatible with cloud-native components and has telco-interplay capabilities such as bi-directional interaction with OSS, resource-constrained slices, application profiling, and policy enforcement. By utilizing the developments in the 5G-INDUCE OSS, the NAO offers improved slicing capabilities, virtualizes resources for NetworkApp components, and enables the dynamic management of NetworkApp capabilities based on relevant events.

LEAN Canvas Analysis

Problem: The main problems noted are the absence of a cohesive, user-focused framework for deploying applications, leading to time-consuming setup and adjustment of applications, as well as restricted ability to repeat the process. This is a significant challenge in industrial applications, as they require tailoring to suit the specific needs of each industrial site, resulting in inefficiencies and inconsistencies.

Existing alternatives: At present, there are no dedicated frameworks to tackle these problems. Industrial applications are commonly established and arranged using manual processes, which require a significant amount of labor and are susceptible to mistakes. This highlights the necessity for an automated solution.

Solution: The NAO presents a cutting-edge framework for onboarding, deployment, and management that is seamlessly connected with an OSS resource manager. This solution streamlines the process of creating applications and implements runtime management processes based on policies. Applications are defined as graphs of interconnected components, which may be easily upgraded and reused, hence resolving the inefficiencies of existing manual processes.

Key measurements: The efficacy of the NAO framework is assessed using two key metrics: service deployment time and service reconfiguration time. These metrics are crucial for assessing the effectiveness and influence of the framework on operational processes.

Unique Value Proposition: The NAO provides a service orchestration framework that is constantly updated, ensuring its relevance in the future. The system prioritizes comprehensive infrastructure monitoring, automatic optimization features, and flexibility to manage a large volume of deployment events across different and geographically dispersed infrastructures. This includes numerous connectivity options like private or public 5G.

Unfair Advantage: The NAO possesses a significant advantage due to its extensive knowledge and experience in NBI (Northbound Interface) and SBI (Southbound Interface), its utilization of a clearly defined automation framework that links monitoring data with policies, and its commitment to establishing new standards in the post-5G era. These aspects together create a strong basis for NAO's enhanced capabilities.

Channels: The NAO engages its target audience through the implementation of workshops, clustering events, associations, and expos. These channels effectively engage potential consumers and stakeholders by offering forums for demonstration and collaboration.

Customer Segments: The intended clientele include Mobile Network Operators (MNOs), prominent industrial clients, and enterprises from diverse vertical industries, such as application developers and infrastructure consultants. Early adopters refer to private entities that hold significant vertical infrastructure, indicating a specific emphasis on industries that require extensive infrastructure.

Cost Structure: The main expenses related to the NAO framework consist of the personnel needed for development, marketing, legal proceedings, and the costs of testing infrastructure, such as servers, databases, and cloud services.

Revenue Streams: NAO revenue will come from platform licensing or the acquisition of intellectual property rights (IPR) by vendors. They also earn money from support services such as installation, maintenance, and upgrades, as well as consultancy, training, and the development of specific application solutions.

Verdict: The NAO framework efficiently resolves substantial inefficiencies in the implementation and administration of industrial applications by utilizing its automated, forward-looking solution. NAO is strategically positioned to revolutionize application deployment procedures in the industrial sector by utilizing its distinct value proposition and competitive advantages. This will enable NAO to serve a wide range of customers and generate several sources of revenue, resulting in substantial value creation.

Table 5: NAO Lean Canvas.

<table>
<tr><th>Problem</th><th>Solution</th><th>Unique value Proposition</th><th>Unfair Advantage</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Lack of a unified application-oriented framework for end user driven application deployments.
Time-consuming application instantiation and reconfiguration.
Limited repeatability. Industrial applications and services are customized to the needs of each industrial site.

Existing Alternative
No specific framework available. Industrial applications are manually set-up and configured.</td><td>NAO application onboarding-deployment-management framework, integrated with OSS resource manager
Automated application instantiation and policy-based runtime manage-ment processes.
Applications and services defined as graphs of linked application components that are easily upgradable and reusable in diverse infrastructures</td><td rowspan="3">NAO is designed developed and continuously evolved with the scope to provide a future-proof service orchestration framework built upon iterative deep infrastructure visibility, self-tuning zero-touch capabilities, and adaptability to a massive number of application deployment events over diverse and geo-distributed infrastructures, addressing demanding industrial environments and different connectivity models (e.g. private or public 5G connectivity, 5G SA, O-RAN deployments etc.).</td><td>The developed framework relies
a) on significant expertise w.r.t the NBI with end-users and the SBI with diverse types of OSS-based resource management schemes
b) on the implementation of a well-defined automation framework connecting monitoring information and policies
c) on efforts that are promoted towards new standards within an emerging new area beyond 5G</td><td rowspan="3">Target customers
MNOs addressing in turn large industry customers or customers from other vertical sectors
Vertical sector business owners/ companies serving either as application developers or infrastructure consultants.

Early Adopters
Private large vertical infrastructure owners</td></tr>
<tr><td>Key Metrics</td><td>Channels</td></tr>
<tr><td>Service deployment time
Service reconfiguration time</td><td>Workshops, clustering events, associations, and EXPOs</td></tr>
<tr><td colspan="3">Cost Structure</td><td colspan="2">Revenue Streams</td></tr>
<tr><td colspan="3">Costs related to required human resources for Development-Update-Marketisation-Legal actions
Testing infrastructure costs including servers, databases, cloud services</td><td colspan="2">Platform licensing revenues OR IPR acquisition by vendor (for licensed approach)
Support services revenues (installation, maintenance updates) (for open approach)
Consultancy and training to targeted customers
Development of targeted application solutions</td></tr>
</table>

Updated SWOT analysis

Strength: The updated SWOT analysis focuses on a modular design that allows for the efficient deployment and management of applications across various infrastructures. The text discusses the comprehensive design and execution of the framework, as described in deliverables D3.4 and D3.5. It also mentions the successful integration and validation of the NAO with OSS, specifically for use cases at all three ExFa sites.

The updated strengths indicate a change in emphasis from solely highlighting distinctive characteristics and technical incorporation to presenting a verified, adaptable, and comprehensive structure. This evolution represents an improvement in the level of development and usefulness of the platform.

Weakness: The updated SWOT analysis offers a more comprehensive assessment of shortcomings, including highlighting the absence of a defined framework for end-user application request forms, integration with the underlay network resource orchestration framework, and the incorporation of lifecycle management extensions. Although there are still certain gaps, it recognizes the continuous endeavors to adhere to specific defined interfaces, such as the TMF framework and ETSI OSL, and to tackle various infrastructure connectivity while considering security. Furthermore, there is a current effort to actively seek additional collaboration and expand the framework with open-source software (OSS) and the network orchestration layer. This is being done through project activities such as 6GREEN FIDAL.

The newly identified vulnerabilities provide a more comprehensive awareness of the areas that need improvement, as well as suggesting proactive steps to address these concerns. This demonstrates a more strategic approach to managing and minimizing shortcomings.

Opportunities: The updated SWOT analysis introduces more ambitious prospects, such as developing the initial comprehensive framework for application onboarding, deployment, and administration. This framework enables direct interaction between mobile network operators (MNOs), service providers, and end-users in a unified manner. This framework has undergone validation in the DevOps testbed for the purpose of dynamic and automated deployment, while also ensuring resource reserve across distributed infrastructures. It has also shown its ability to adjust and thrive in situations where operators are directly in charge, as well as in situations where operators handle the deployment. The new framework enables the smooth deployment of services with application-aware policies in different contexts.

The emerging potential signify a more ambitious and practical vision, with the goal of revolutionizing the interaction among Mobile Network Operators (MNOs), service providers, and end-users, and streamlining the implementation of apps.

Threats: The updated SWOT analysis offers a more sophisticated perspective on threats, recognizing the potential danger presented by effective proprietary solutions offered by major manufacturers that cater to specific end-user requirements and thereby bypass existing deficiencies in industry standards. Additionally, it highlights substantial endeavors in creating standardized solutions and launching open framework versions to expedite the adoption of the suggested framework. Additionally, it highlights the deliberate promotion of the solution to prominent telecom service providers and manufacturers to encourage active partnerships within the European Commission's Horizon Europe framework.

The new dangers are more comprehensive, as they acknowledge external concerns and provide detailed strategic measures to manage them. This technique demonstrates a stronger and more proactive strategy for managing risks.

Verdict: The updated SWOT analysis demonstrates a significant advancement compared to the previous analysis. The new analysis emphasizes a shift towards a more comprehensive, verified, and strategic framework, with explicit measures to tackle shortcomings and exploit potential. The transition from a singular platform to a modular, integrated, and proven framework represents significant progress, showcasing improved preparedness for market challenges and possibilities.

Table 6: NAO Updated SWOT Analysis.

Internal Factors	
Strengths	**Weakness**
Modular design enabling the deployment and runtime management of applications over diverse type of infrastructures, while also providing an application-oriented approach in the management of network resources (achieved through the integrated OSS part). Complete framework design and implementation as described initially within D3.4 and the final version in D3.5. Integration and successful validation and demonstration of the NAO integration with OSS over specific use case examples in all 3 ExFa sites.	Lack of a specific standardised framework for a) end-user application request format, b) interfacing with underlay network resource orchestration framework, c) adding life-cycle management extensions (policy, monitoring, analytics engine). Latest updates follow specific standardised interfaces (e.g., TMF framework, ETSI OSL) as well as extensions addressing diverse infrastructure connectivity taking security into consideration. Seeking further collaboration and framework extensions primarily with OSS and network orchestration layer through project activities such as 6GREEN, FIDAL
External Factors	
Opportunities	**Threats**
Create the first complete application onboarding, deployment and management framework that allows MNOs and service providers to interact directly with end-users in a unified manner, thus enabling new business opportunities for actual distributed services that make use of the end-user infrastructure capabilities and the 5G connectivity provided by infrastructure owners. The joined NAO-OSS framework has been implemented and validated within the DevOps testbed in its full potential, considering dynamic and automated deployment with resource reservation over distributed infrastructures (e.g., the private 5G infrastructure model). The framework has been successfully adapted and applied to scenarios where the connectivity is managed directly by the operator as well as scenarios in which the application deployment is provided by the operator. The deployment over all typical service provisioning models showcased the adaptability of the NAO-OSS framework assisted primarily by the SB interface of the OSS (NFVCL) and the end-user capability to seamlessly deploy services with app-aware policies in any scenario.	Creation of successful closed solutions by large vendors, targeting specific end-user needs (primarily large industrial customers) thus avoiding the existing gap in standards. Significant efforts towards standardised solutions as well as release of open framework versions, in order to faster promote the proposed framework. Promotion of solutions towards major telecom service providers and vendors, seeking active collaborations within the EC Horizon Europe framework with the scope to raise awareness.

4.3.2 OSS

The 5G-INDUCE Operations Support System (OSS) is responsible for supervising the placement of Network apps on edge computing facilities and establishing their connection to configured network slices. It also handles the management of data related to deployed apps, services, and infrastructure resources. The system has a modular structure that utilizes cutting-edge cloud-native technologies. It employs MongoDB and Prometheus for maintaining its state. The OSS is partitioned into two sections: the North-Bound OSS (NB-OSS) and the South-Bound OSS (SB-OSS). NB-OSS manages the process of negotiating and exchanging information about slices and metadata for numerous SB-OSS modules. On the other side, SB-OSS is designed to be flexible and adaptable to diverse administrative domains, providing different levels of programmability for edge and network resources. NB-OSS comprises the Slicing-Interface, which is used for creating APIs, and the North-Bound Core, which is responsible for managing SB-OSS instances and processing slice requests. SB-OSS is composed of the South-Bound Core, NFV Convergence Layer (NFVCL), and Metal Convergence Layer (MetalCL). These components work together to process slice requests, oversee NFV services, and transform bare-metal resources into IaaS/PaaS environments that meet the necessary standards.

LEAN Canvas Analysis

Problem: the absence of a distinct division of responsibilities between the application and networking fields, and the difficulties encountered by small Telco operators in handling OSS platforms due to limited adaptability and absence of fully automated processes. Several platforms necessitate NetworkApp developers to possess a comprehensive understanding of the intricate workings of Virtual Infrastructure Managers (VIMs), which impedes their capacity to completely harness the promise of network slicing. Additionally, small telecommunications operators confront difficulties with OSS platforms that lack the necessary flexibility to connect with diverse hardware and do not possess automatic configuration capabilities.

Solution: The proposed solution is a very flexible open-source software (OSS) architecture that utilizes cutting-edge cloud-native, stateless services. The design has two primary modules: the North-Bound Operations Support System (NB-OSS) and the South-Bound Operations Support System (SB-OSS). The NB-OSS is responsible for overseeing the process of negotiating slices for NetworkApps and keeping track of the metadata of onboarded SB-OSS modules. On the other hand, the SB-OSS is specifically built to manage various administrative network and computing resource domains. This modular architecture enables the selective activation of services to meet different levels of programmability, ranging from a basic catalog of resources to comprehensive administration of physical infrastructure.

Value Proposition: The 5G-INDUCE OSS presents a distinctive value proposition by offering a comprehensive solution for the dynamic creation of networks on behalf of cloud services provided by third parties, ensuring a guaranteed quality of service and quality of experience. The system guarantees the protection of secret data, cost-effectiveness, efficient management with decreased implementation time for interfaces, energy efficiency, commercial feasibility, and seamless interaction with Service Providers. This combination renders it a compelling choice for Telecom Operators and Service Providers.

Unfair Advantage: The 5G-INDUCE OSS has an unfair advantage due to its early acceptance and testing as one of the initial mobile edge computing prototypes in real-life situations. This has led to the creation of collaborative solutions and collective expertise through innovative initiatives and pilot projects involving system integrators, telecommunications carriers, and small and medium-sized enterprises. The OSS gains a competitive advantage by utilizing practical knowledge and established collaborations.

Customer Segment: The 5G-INDUCE OSS primarily focuses on European Telecom Operators, specifically small Telcos aiming to broaden their market presence through the provision of personal cloud services and enhanced hosting capabilities to third-party Service Providers. In addition, the OSS focuses on targeting system integrators and telecom corporate solution providers who are part of the provider portfolio of Telecom Operators. The goal is to utilize these alliances to achieve market penetration. Additionally, embraced by pioneering companies in the cloud and softwarized network sectors (specifically UBITECH). These companies offer advanced solutions to Telecom Operators. These small and medium-sized enterprises (SMEs) are expected to gain advantages from the advanced features and flexible structure of the open-source software (OSS), enabling them to provide improved services to their clients.

Key Metrics: The success of the 5G-INDUCE OSS can be measured through key metrics such as the quantity of pilots and demonstrations utilizing the OSS, the amount of requests and emails received through the 5G-INDUCE website, the launch and acceptance of an enterprise edition, and the number of Telecom Operators, system integrators, and SMEs that adopt the enterprise edition. These indicators will aid in monitoring the platform's acceptance and efficacy in the market.

Channels: Potential customers and partners can be reached through various channels, such as participating in innovation actions with system integrators and telecom corporate solution providers, engaging in industrial forums and standardization bodies, conducting live demonstrations at Telecom R&D events, and establishing direct contact with operators and system integrators to carry out pilots. These channels are specifically created to optimize visibility and promote collaboration.

Cost Structure: The cost structure of the 5G-INDUCE OSS encompasses the creation of novel functionalities that cater to the requirements of operators, service providers, and end-users. It also includes the upkeep and assistance for the software, as well as a proficient team dedicated to research and development, legal matters, sales, and technical support. The size of this team will vary from 5 to 20 individuals, depending on the level of market penetration. These expenses are crucial for maintaining a consistent level of enhancement and assistance for the platform.

Revenue Streams: The 5G-INDUCE OSS can generate revenue through the sale of the platform to Telecom Operators and partnership clients. Additionally, revenue can be generated from maintenance, support, training, and consultancy services. Furthermore, the platform will earn cash through the sales of new features, establishing a financially viable paradigm. This technique of generating revenue from multiple sources provides the long-term sustainability and opportunity for expansion.

Verdict: The 5G-INDUCE OSS LEAN canvas presents a well-rounded and compelling business model for addressing the current shortcomings in network slicing and OSS flexibility. The modular, cloud-native design offers significant benefits in terms of scalability, manageability, and integration ease, which are crucial for modern telecom operations. The unique value proposition and unfair advantage highlight the OSS's potential to drive innovation and efficiency in the telecom sector. The clear identification of customer segments and early adopters ensures a focused market entry strategy. Furthermore, the well-defined channels and key metrics will facilitate effective tracking of progress and adoption. The cost structure and revenue streams are aligned with the strategic goals, making the financial model viable and sustainable. Overall, the 5G-INDUCE OSS has a strong potential to revolutionize network management for Telecom Operators, particularly smaller ones, by simplifying operations, reducing costs, and enhancing service offerings.

Table 7: OSS LEAN Canvas.

Problem	Solution	Unique value Proposition	Unfair Advantage	Customer Segments
Many platforms that were developed for 5G and network slicing lack a clear separation of concerns between the Application and Networking domains. This reflects into difficulties for NetworkApp developers – used to operate in a cloud-native environment – to fully exploit the potentiality offered by network slicing, as they need to understand the internal details of Virtual Infrastructure Managers (VIMs), rather than concentrating to the real communication needs of their vertical applications. The 5G-INDUCE NAO provides them with a familiar environment, leaving to the OSS the burden of network configuration and slice creation on the basis of a clearly defined slice intent. On the other hand, small Telco operators might also find the burden of managing and maintaining an OSS	The OSS is designed according to a highly modular architecture: all the software services are state-of-the-art cloud-native software, i.e., stateless services (or more precisely services with a state maintained in an external database; namely, MongoDB and Prometheus), inherently parallelizable. The 5G-INDUCE OSS architecture is organized in a suite of five main software services, grouped into two main modules: the North-Bound OSS (NB-OSS) and the South-Bound OSS (SB-OSS). The former module is meant to front-facing the NAO by managing slice negotiations for NetworkApps, and to maintain metadata (e.g., coverage area served, operational capabilities, etc.) of one or multiple onboarded SB-OSS modules. The SB-OSS is meant once per each different administrative network/computing	The 5G-INDUCE OSS is a holistic solution enabling the dynamic network instantiation on behalf of highly demanding personal cloud services by third-parties to end-users with guaranteed QoS/QoE, anywhere, anytime, while ensuring: - confidentiality of sensible information (end-users, Telecom Operators and Service Providers), - cost efficiency - high manageability and low complexity interfaces (interface implementation time reduced by 20-30% with respect to legacy technologies), - energy efficiency, - business viability (considerable traffic/revenues increase, competitive advantage, etc.), - easy integration with Service Providers.	The 5G-INDUCE OSS, in combination with the NAO, has been among the first mobile edge computing prototype tested in real-life scenarios, allowing the support of networked cloud-native virtual applications. Common know-how and shared solutions with system integrators/telecom operators/corporate solution providers/SMEs, which have been participating in innovation actions and pilots involving the OSS.	**Final customers** Telecom Operators (mostly European, with special reference to small Telcos) –upon availability of a commercial release- which could expand their role in the market value chain by offering: 1. Personal cloud services to individuals (and increase their Average Revenue Per User) 2. New advanced hosting capabilities to third-party Service Providers. **Partnership/intermediated customers** System integrators and telecom corporate solution providers (mostly European) in the provider portfolio of Telecom Operators. **Additional benefits** - Offering innovative services with short time-to-market - Energy savings - Network Softwarization - Future proofness (business sustainability) - Competitiveness

platform which lacks flexibility in interfacing with heterogeneous hardware and does not offer zero-touch and fully automatic configuration capabilities to the maximum possible extent.	resource domain onboarded onto the OSS. To reflect the different programmability levels exposed by such administrative domains (e.g., the various ExFa testbeds), the SB-OSS has been designed as a chain of software services that can be selectively activated to gain access to various programmability levels, passing from a simple catalogue of available resources in case of no programmability, up to the complete terraforming of the physical infrastructure in case of full programmability.			**Early adopters** High-tech SMEs in the cloud and softwarized network field (e.g., UBITECH, HOPU Ubiquitous, etc.) providing corporate solutions to Telecom Operators.
	Key Metrics		**Channels**	
	(to be measured in 2 years after the 5G-INDUCE project end) - Number of pilots/demos using the OSS. - Number of requests/emails in the 5G-INDUCE website. - Release of an enterprise edition. Number of Telecom Operators/system integrators/SMEs adopting the OSS enterprise edition		Participation in innovation action with system integrators and telecom corporate solution providers. Participation in Industrial forums and Standardization bodies. Live demonstration of the OSS platform at Telecom R&D events. Contact Operators/system integrators to conduct pilots.	

Cost Structure	Revenue Streams
Development of new features in the OSS addressing Operator, Service Provider and end-user needs. OSS software maintenance and support. Strong R&D, legal, sales and technical support team depending on the market penetration during the commercialization of the enterprise edition (from 5 to 20 persons).	Sales of the OSS platform to Telecom Operators and Partnership/Intermediated customers. Maintenance, support, training and consulting services. Sales of new features

SWOT Analysis

Regarding the updated SWOT analysis CNIT has identified some new strengths:

- Provision of a single interface for receiving requests for various cloud-native and monolithic applications, from various customers; in case of a small Telco Service Provider (TSP – e.g., Mobile Virtual Network Operator - MVNO) such applications may be the services provided by the TSP.
- Automated Life-cycle management of network services (composed of physical, virtual or Kubernetes network functions) and 5G-ready application deployment over an application-aware network slice.

Verdict: The updated strengths of the 5G-INDUCE OSS significantly bolster its competitive position, offering enhanced flexibility and efficiency in network management. By addressing its weaknesses and leveraging opportunities while mitigating threats, the platform is well-positioned to achieve sustained growth and market leadership in the evolving telecom landscape.

4.3.3 UC1: Autonomous indoor fleet management

5G communication will facilitate an automated logistic procedure that utilizes both indoor and outdoor AGVs. The responsibility for coordinating the AGVs will be assigned to the fleet manager, who will be determined by NetworkApps and operated as a MEC application. Furthermore, the outdoor AGV will be furnished with a camera to enhance the existing navigation system included into the AGV. The camera's data will be analyzed in the MEC using vSLAM algorithms, which will also function as a NetworkApp. The chosen indoor AGV for this specific use case is an EBOT manufactured by ASTI Mobile Robotics. This Automated Guided Vehicle (AGV) is part of the platform line range and offers exceptional maneuverability. This platform AGV is equipped with a small design and advanced omnidirectional and turn on spot technology, allowing it to easily travel both longitudinally and transversally. As a result, it significantly enhances agility and efficiency in intralogistics operations for moving items. Conversely, the outdoor AGV manufactured by ASTI Mobile Robotics is a durable tractor AGV that offers a reliable, convenient, secure, and adaptable option for logistics trains. These Automated Guided Vehicles (AGVs) have the capability to simultaneously convey multiple trolleys, resulting in increased productivity and reduced operational expenses in intralogistics operations.

LEAN Canvas Analysis

Problem: The 5G-INDUCE project focuses on tackling three crucial issues: the exorbitant expenses associated with infrastructure, the looming dangers of cybercrime, and the imperative need for network dependability. The cost associated with establishing 5G infrastructure, which includes network gear and installation, presents a substantial financial obstacle. The proliferation of 5G networks heightens the susceptibility to cyber assaults, making cybersecurity a significant issue. Consequently, it is imperative to implement strong security measures to safeguard data and operations. Moreover, it is imperative to guarantee a steady and

dependable 5G connection, especially for tasks involving automated guided vehicles (AGVs), since any interruption might result in operational inefficiencies and jeopardize safety.

Solution: In order to address these issues, the 5G-INDUCE project suggests three novel approaches: cost-sharing models, security threat analysis, and private 5G networks. By implementing cost-sharing mechanisms among sectors in close proximity, the financial responsibility of infrastructure development can be divided, resulting in increased affordability. The project also involves comprehensive evaluations of potential security threats and attack surfaces to effectively reduce cybersecurity risks. In addition, the implementation of private 5G networks improves the level of control, security, and dependability, specifically for industrial purposes, guaranteeing that the network fulfils the special requirements of its users.

Unique Value Proposition: The distinctive value proposition of the 5G-INDUCE project resides in its capacity to utilize 5G technology to synchronize indoor-outdoor AGVs and incorporate sophisticated control algorithms. The synchronization facilitated by 5G provides smooth coordination among AGVs, leading to a substantial enhancement in operating efficiency and a reduction in downtime. Embedded control algorithms fully leverage the capabilities of 5G connectivity to optimize the performance and automation of AGVs. The project distinguishes itself from current solutions by utilizing modern technology and implementing a strategic approach, resulting in enhanced efficiency and productivity for businesses that depend on AGVs.

Unfair Advantage: The 5G-INDUCE initiative possesses a substantial unfair advantage due to its focused strategy for entering the market and segmenting it. By targeting early adopters in the automotive industry and clients with regular logistic flows, the project can promptly showcase its feasibility and appeal to additional sectors. This strategic emphasis enables quick entry into the market and establishment, utilizing first achievements to gain credibility and encourage wider acceptance. The project's capacity to offer customized solutions for particular industries strengthens its competitive advantage, establishing it as a frontrunner in 5G-powered AGV technology.

Customer Segments: The initiative categorizes many customer segments, such as the automobile, industry, logistics, e-commerce, and food industries. These industries are ideal candidates to reap the advantages of 5G-powered AGVs, including heightened efficiency, decreased operational expenses, and better automation. The project aims to specifically target early adopters in the automotive sector in order to demonstrate the potential of the project and establish a precedent for other industries. The 5G-INDUCE project intends to build a strong position and increase its market share in diverse sectors by specifically addressing the unique requirements and difficulties faced by these segments.

Key Metrics: The primary metrics for the 5G-INDUCE project revolve around the quantity of 5G-connected AGVs and the number of projects that make use of 5G technology. These measures are essential for evaluating the extent to which the market has embraced the project and its potential for growth, serving as reliable indicators of its overall success. Utilizing 5G technology to monitor the implementation and connectivity of AGVs aids in assessing the efficiency of the solutions and pinpointing areas that need enhancement. In addition, tracking the quantity of 5G initiatives offers valuable information about the extent to which the technology is being used and the overall influence it has on industry operations.

Channels: The distribution plan for the 5G-INDUCE project comprises three main channels: robot distributors, direct sales, and robot integrators. The project can efficiently reach potential clients by leveraging established distribution channels that are specifically tailored for robots. Direct selling offers a customized and regulated sales approach, directly interacting with customers to guarantee effective execution. Engaging in partnerships with experts in robot integration facilitates the integration of Automated Guided Vehicles (AGVs) into larger automated systems in client operations, hence improving the entire value proposition and guaranteeing smooth integration.

Cost Structure: The cost structure of the 5G-INDUCE project encompasses expenditures associated with 5G licensing, network equipment, infrastructure, and edge computing resources. Obtaining 5G licenses incurs a substantial cost that is essential for network operation. Acquiring and implementing the necessary network devices and infrastructure can add to the total expenses. Furthermore, allocating resources to edge computing facilitates the immediate processing of data and the smooth operation of AGVs, guaranteeing the highest level of performance and responsiveness. Efficiently controlling these expenses is vital for the project's long-term financial viability and achievement.

Revenue Streams: The 5G-INDUCE project generates revenue from various sources, including licensing fees per AGV, licensing fees each logistic project, increasing sales of AGVs, and new projects and market sectors. Implementing a licensing charge for every AGV that utilizes the 5G network results in a consistent stream of income. In the same vein, license fees associated with particular logistical initiatives serve as an extra source of revenue. With the incorporation of 5G technology, the capabilities of AGVs are being improved, leading to a projected rise in AGV sales. Moreover, the project seeks to diversify into untapped market areas and initiatives, propelled by the benefits of 5G technology, thereby generating supplementary revenue prospects.

Verdict: The Lean Canvas for the 5G-INDUCE project efficiently delineates a strategy methodology for harnessing 5G technology in AGVs, effectively tackling significant market obstacles through inventive resolutions. The initiative proposes a complete strategy to improve efficiency and productivity by implementing cost-sharing, conducting security threat studies, and constructing private 5G networks. The emphasis on particular client segments and early adopters, combined with explicit KPIs and revenue objectives, highlights a comprehensive approach that is positioned for future success. The project's feasibility and market adoption are supported by the thorough identification of challenges, solutions, and market segments. However, the success of the project relies on good execution and adaption to industry needs.

Table 8: UC1 LEAN Canvas.

<table>
<tr><th>Problem</th><th>Solution</th><th>Unique value Proposition</th><th>Unfair Advantage</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Cost of infrastructure
Cybersecurity problems
Network reliability</td><td>Cost sharing between industries in the same area
Analysis of security threats and attack surfaces. Private 5G networks</td><td rowspan="3">5G-driven synchronization of Indoor-outdoor AGVs</td><td>Control algorithms embedded in the AGVs</td><td rowspan="3">Target customers
Automotive
Industry
Logistic
Ecommerce
Food

Early Adopters
Automotive
List of ideal customers: Clients with recurrent logistic flows</td></tr>
<tr><td>Key Metrics</td><td>Channels</td></tr>
<tr><td>Number of 5G connected AGVs.
Number of projects with 5G</td><td>Robot distributor
Direct selling
Robot integrator</td></tr>
</table>

Cost Structure	Revenue Streams
5G license, 5G network devices, 5G network infrastructure, Edge use	Including a licence cost per AGV, including a licence cost per logistic project, increase in AGVs sales, new projects, new market sectors.

Updated SWOT Analysis

Strength: The previous SWOT analysis identified the primary advantages of fast speed, minimal delay, increased efficiency, and reduced operational expenses. These strengths were fundamental, with a primary focus on performance indicators and cost-effectiveness. In the updated SWOT analysis, the focus has shifted towards highlighting the tangible benefits of strengths, such as improved remote control of AGVs (Automated Guided Vehicles) through greater data extraction and increased reliability. In addition, the enhanced capabilities now encompass a heightened proficiency in communication network infrastructures, facilitating the expedited deployment of AGVs in diverse sectors. The transition from fundamental technical characteristics to practical advantages and the cultivation of knowledge demonstrates the project's growth in capabilities and strategic orientation.

Weakness: The previous SWOT analysis highlighted only one weakness: the exorbitant infrastructure expense associated with 5G. The expanded analysis encompasses not only the financial aspect, but also the technical complexities involved in implementing the infrastructure (such as modems and base stations) and guaranteeing a high level of dependability for logistics applications that rely on the network. Furthermore, it states that 4G devices cannot be upgraded to 5G, hence requiring entire replacements. This expanded viewpoint demonstrates a more profound comprehension of the intricate technical and financial intricacies associated with the implementation of 5G technology.

Opportunities: The previous SWOT study mostly emphasized the potential for collaboration between enterprises and NetworkApp developers. Conversely, the new research identifies a wider spectrum of prospects. These factors encompass advancements in telecommunications infrastructure, decreased costs in equipment, increased automation, the emergence of Industry 4.0, and the growing trend of mobile robotics-as-a-service. Moreover, the recent analysis emphasizes the emergence of a novel indoor-outdoor logistical solution facilitated by 5G technology, hence creating opportunities for other market applications. This enlarged perspective showcases a methodical and market-savvy approach to utilizing evolving trends and technologies.

Threats: Previously, the main concerns revolved around obstacles in the robotics market and the presence of comparable solutions. The updated SWOT analysis highlights specific and urgent risks, including challenges in securing 5G licenses due to bureaucratic obstacles, cybersecurity concerns, and the possibility of communication device shortages. These risks are more precise and demonstrate an understanding of the potential impact of regulatory, security, and supply chain difficulties on the project's performance. This signifies a more thorough and all-encompassing approach to assessing risks.

Verdict: The comparison of the previous and current SWOT analysis demonstrates a substantial transformation in the project's strategic perspective. The initial research primarily examined the core technological capabilities and identified cost-related limitations. However, the current analysis offers a more advanced and comprehensive understanding of the strengths, weaknesses, opportunities, and threats. The project's emphasis has transitioned from primarily focusing on technical performance and cost efficiency to a more comprehensive evaluation of practical applications, market trends, and strategic implementation obstacles. This sequence indicates a more developed and all-encompassing strategic planning procedure,

which enhances the project's ability to take advantage of upcoming possibilities while efficiently handling possible dangers.

Table 9: UC1 Updated SWOT Analysis.

Internal Factors	
Strengths	**Weakness**
The project results allow to exploit the 5G communication advantages enabling a better remote control of the AGVs with a larger bandwidth, with less delay and a more reliable transmission. Thanks to this, we can extract and exploit more valuable data from the AGVs, the remote-controlled logistic processes have less errors and are more reliable and can react faster to face changing production demands. We have also improved our expertise in communications, network infrastructures, and commissioning to accelerate the implantation of the AGVs in new industries.	The main problem is the infrastructure needed to enable the 5G communication between the AGVs and the MEC, such as the modems, the base station, etc. Other related weaknesses are the cost of equipment and deployment, and the high reliability needed to guarantee the logistic application, as it is a network-dependent solution. 4G communication devices cannot be updated to 5G, they must be replaced.
External Factors	
Opportunities	**Threats**
Trend towards improved telecommunications infrastructure Cost reduction of equipment Growth of the automation Industry 4.0 Mobile robotics as a service trend A new indoor-outdoor logistic solution has been implemented thanks to the 5G-based orchestration. This indoor-outdoor solution will enable new applications and open new markets.	Excess of bureaucracy to get the license to emit on 5G Cybersecurity problems Unavailability of supply of communications devices

4.3.4 UC2: Smart operation based on human gesture recognition

Use case 2 entails the manipulation of industrial AGVs by human gestures, without the need for specialized equipment such as haptic gloves or VR/AR glasses. AGVs may be operated by workers using hand gestures. The robots receive RGB/depth information from any camera and transmit this data to the 5G network through a modular 5G modem. The NetworkApp system located at the edge of the network analyzes the video and gesture data, and subsequently transmits instructions to the Automated Guided Vehicles (AGVs). The AGVs then respond by either moving, stopping, or altering their course in accordance with the motions made by the worker. The system's configuration entails the decoding of the video stream, the processing of gestures using an algorithm, and the transmission of commands to the AGVs for execution.

LEAN Canvas Analysis

Problems: Rigidity, complexity, and reliance on specialized technology characterize the current state of industrial Automated Guided Vehicle (AGV) control, leading to operational inefficiencies and higher expenses. AGV control usually requires the employment of specialist hardware and technology, which adds to the control process' complexity. This reliance prevents AGVs from being seamlessly integrated into current industrial workflows by limiting the scalability and interoperability of AGV control systems. Furthermore, the rigidity and complexity of the existing industrial AGV control approaches make their implementation difficult and ineffective. These systems often lack the flexibility and agility needed to react quickly to shifting environmental circumstances and dynamic operational requirements. Finally, the use of conventional AGV control methods results in notable extra expenses related to the acquisition and upkeep of specialist machinery and accessories. These additional costs raise the overall cost of putting AGV systems into place, decreasing their cost-effectiveness and preventing their widespread adoption.

Solutions: Fivecomm's approach, which prioritizes cost-effectiveness, minimal equipment needs, and ease of use, delivers a paradigm shift in AGV control. The utilization of gestures, which give users a natural and simple way to operate AGVs, is essential to the solution. Users may easily control and guide AGVs with ease and precision by using hand gestures and other familiar motions. This user-friendly design reduces learning curves and improves user experience, which raises productivity and operational efficiency. Fivecomm's AGV control system requires less hardware infrastructure than typical AGV control systems, which rely on specialized equipment and intricate interfaces. Users may access and interact with the AGV control interface using just a tablet and a camera, doing away with the need for expensive and bulky equipment. The solution's simplicity not only lowers the initial investment expenses but also simplifies deployment and maintenance, making it affordable and accessible for businesses of any size. Moreover, the gesture-based method provides a more affordable option than haptic methods, which sometimes require complex hardware components and high implementation costs. Fivecomm maximizes functionality and usefulness while minimizing capital investment by utilizing pre-existing hardware resources and user-friendly interfaces. Because of its affordability, its solution is a desirable choice for businesses looking to improve AGV control capabilities without going over budget.

Key Metrics: Key metrics act as vital reference points for assessing the effectiveness and performance of UC2 network applications. The amount of time it takes for data packets to go from their source to their destination and back is measured by end-to-end latency. Ensuring that the end-to-end latency in the UC2 network application remains below 150 milliseconds is crucial for preserving real-time responsiveness and guaranteeing smooth user experiences. Reaching this low latency level reduces delays and allows for quick data transfer, promoting seamless and continuous communication between systems and devices. The pace at which data can be sent from a user's device to the network is known as uplink (UL) throughput. Achieving a maximum throughput (UL) of 15 megabits per second (Mbps) in Fivecomm's technology guarantees effective data transfer from user devices to the network infrastructure. This robust UL throughput capability easily supports applications like file uploads, real-time data sharing, and video streaming, meeting the increasing demand for upstream data transmission. Moreover, 5G technology, the next-generation wireless communication standard, offers extremely low latency to enable a variety of applications, such as augmented reality, autonomous vehicles, and the Internet of Things. For real-time interactions and engaging user experiences in this network application, it is critical to maintain a 5G latency below 20 milliseconds. By enabling nearly immediate responsiveness and facilitating seamless communication and job execution, this low latency threshold unlocks the full potential of 5G technology.

Unique value proposition: Employees can operate AGVs inside the facility without having to come into direct touch due to the UC2 solution. Using simple hand gestures and movements, users can easily and precisely

command and control AGVs. Because AGVs may be accurately directed by workers using intuitive gestures, workers can do jobs more quickly and effectively. This hands-free control mechanism improves workplace safety and decreases downtime by making it easier to operate AGVs while lowering the risk of accidents and injuries linked to traditional manual control methods.

Unfair advantage: The incorporation of advanced AI algorithms which are carefully crafted for image processing tasks specific to our use case is the fundamental component of UC2's unfair advantage. By utilizing state-of-the-art machine learning techniques, these algorithms can precisely interpret and recognize hand gestures and movements with unmatched efficiency and precision, all due to the analysis of visual data acquired by cameras. Fivecomm's use of artificial intelligence (AI) has allowed them to process images with greater sophistication and accuracy than they could have with more conventional techniques. This has opened up new possibilities for intuitive control and interaction in industrial settings.

Channels: Fivecomm's channels strategy encompasses a combination of online and offline channels, each designed to provide customers with convenient access to information, resources, and support. Its website serves as a central hub for disseminating information about the system, facilitating communication with potential customers, and providing resources for interested parties. Through the website, visitors can access detailed information about offerings, view case studies and testimonials, and engage with interactive content such as demos and tutorials. Moreover, the website features contact forms and chat support options, enabling prospective customers to initiate direct communication with company and consortium members. In addition to UC2 online presence, Fivecomm prioritizes direct communication channels to foster personalized interactions and build relationships with customers and stakeholders. Through direct contact with our company or consortium members, customers can access tailored assistance, receive customized solutions, and address specific inquiries or concerns.

Customer segment: The customer segments comprise a diverse range of industrial stakeholders, all of whom aim to gain from the innovative features and customized solutions offered by UC2 solution. Partnerships with businesses looking for creative ways to streamline processes and improve productivity. UC2's customized solutions are designed to meet the specific needs of their industrial customers, enabling them to increase efficiency, accomplish their goals, and streamline operations. Additionally, Fivecomm helps factory shopfloors to improve material handling procedures, streamline production workflows, and guarantee flawless coordination between automated systems and human operators, by providing sophisticated control and monitoring capabilities. Furthermore, UC2 offers flexible and scalable solutions which are designed to meet the requirements of industrial parks. These solutions enable effective resource management, collaboration, and communication among various tenants and facilities. Moreover, Fivecomm's system integration enables AGV suppliers to offer cutting-edge control, navigation, and safety capabilities, differentiating their goods in a competitive marketplace and meeting changing consumer needs. The sophisticated control and monitoring features of the UC2 system, which are designed to satisfy the demanding specifications of automotive manufacturing settings, can be advantageous to automakers. With the support of Fivecomm, manufacturers can streamline assembly lines, enhance logistical operations, and guarantee the smooth incorporation of autonomous AGVs into their production procedures. In conclusion, businesses in a variety of sectors that are introducing autonomous AGVs into their operations will consider the UC2 system to be suitable. Businesses using autonomous AGVs in manufacturing, shipping, warehousing, and other industries take advantage of the UC2 solution to increase productivity, flexibility, and operational efficiency.

Cost structure: A substantial amount of UC2 expenses belongs to the creation of customized software solutions designed to satisfy the various demands and specifications of clients. These solutions are meticulously developed to meet the unique needs of Fivecomm's consumers, utilizing cutting-edge technologies and creative thinking to provide the best possible functionality and performance. Investing in

software development includes coding, testing, debugging, and quality assurance, among other tasks, to guarantee that the system satisfies the highest requirements in terms of usability, scalability, and dependability. The technical deployment required to successfully execute Fivecomm's software solutions into the operational settings of UC2 customers is another important component of the company's cost structure. This involves activities like setting up, integrating, installing, and customizing software components to match the workflows of clients and the current infrastructure. In order to maximize the customers' return on investment, technical deployment costs also include training and support services that are designed to facilitate end users' acceptance and utilization of the solution.

Revenue streams: Use Case 2's revenue streams include both licensing and services for technical support and maintenance. A subscription-based business strategy is used to generate revenue from licensing, giving customers the flexibility to select between monthly and yearly payment schedules. This strategy takes into account the various financial limitations and consumer preferences while guaranteeing a steady and predictable income. Comprehensive technical support and maintenance services are another source of income; these are billed annually. To guarantee the AGV gesture recognition system operates at peak efficiency and dependability, these services comprise regular system updates, troubleshooting, and on-site or remote assistance.

Verdict: The network application of UC2 offers a transformative solution for industrial automation, specifically addressing challenges in Automated Guided Vehicle (AGV) control. By leveraging advanced AI algorithms for image processing and intuitive gesture-based controls, UC2 solution enables hands-free and seamless interaction with AGVs, enhancing operational efficiency and workplace safety. With a focus on serving diverse customer segments such as industrial partners, factory shopfloors, and AGV providers, Fivecomm's solution caters to a broad range of industrial stakeholders, delivering tailored solutions to meet their unique needs and objectives. The cost structure is primarily centered around specific software ad-hoc development and technical deployment, ensuring that the system is finely tuned to address the specific challenges faced by clients while maximizing value and driving success in the industrial landscape.

Table 10: UC2 LEAN Canvas.

<table>
<tr><th>Problem</th><th>Solution</th><th>Unique value Proposition</th><th>Unfair Advantage</th><th>Customer Segments</th></tr>
<tr><td rowspan="4">Industrial AGV control is currently rigid and difficult to execute.
Special equipment is usually needed for control.
Additional costs on extra equipment and peripherals.
Existing Alternative
Haptics, XR, joystick controllers</td><td>Gestures are easy and intuitive.
No major equipment is needed, just a camera and a tablet.
Minor costs compared to haptic solutions.</td><td rowspan="4">Workers on the facility will be able to control AGVs without establishing direct contact with them. By performing different hand gestures and movements, they will control the robot in an easy manner.</td><td rowspan="2">Advanced AI algorithms (image processing) specifically integrated for this use case.</td><td rowspan="4">Target customers
Industrial partners
Factory shopfloors
Industrial parks
AGV providers
Any company integrating autonomous AGVs in their processes

Early Adopters
Automotive manufacturers
AGV providers</td></tr>
<tr><td>Key Metrics</td></tr>
<tr><td>End to end latency < 150 ms
UL throughput of 15 Mbps
5G latency < 20 ms</td><td>Channels</td></tr>
<tr><td>Through the website.
Direct contact with our company / consortium.</td></tr>
</table>

Cost Structure	Revenue Streams
Mainly related to specific software ad-hoc development and technical deployment.	Licensing (monthly/annual). Technical support and maintenance (per year).

Updated SWOT analysis

Strength: The updated SWOT analysis maintains most of the existing strengths while placing greater emphasis on the significance of the INDUCE platform and 5G infrastructure in attaining minimal delay for real-time AGV control. Additionally, it emphasizes the reduction of danger through gesture control and showcases the intuitive UI. Furthermore, it brings the advantage of instantaneous network monitoring through the utilization of 5G infrastructure and orchestration platforms.

Weakness: The updated SWOT analysis recognizes the existing problem of gesture detection accuracy while identifying two additional weaknesses: heightened intricacy resulting from the utilization of an orchestration platform and elevated investment expenses linked to the implementation of 5G infrastructure and gadgets.

Opportunity: The updated SWOT analysis acknowledges the increasing need for 5G and AI-driven applications. These technologies provide increased cooperation options across various industries, which enhances the creation of network applications and the exploration of novel use cases.

Threat: The updated SWOT analysis reaffirms these risks and introduces an additional one: a possible skepticism towards emerging technologies among certain corporations in other industries, potentially impeding the adoption of these technologies in the market.

Verdict: The updated SWOT analysis integrates the latest developments in 5G infrastructure and orchestration platforms, hence improving real-time monitoring and control functionalities. It recognizes more vulnerabilities associated with intricacy and expense, demonstrating a more thorough comprehension of the present technical environment. The increased potential is in line with the growing need for 5G and AI, indicating a wider range for collaboration and implementation. Nevertheless, the latest report also presents a fresh concern regarding the use of novel technologies, highlighting the necessity of resolving trust-related challenges within the sector. In general, the updated SWOT analysis offers a more comprehensive and up-to-date viewpoint, encompassing both the advancements achieved and the obstacles that still exist.

Table 11: UC2 Updated SWOT Analysis.

Internal Factors	
Strengths	**Weakness**
Reduced latency: the use of the INDUCE platform and 5G infrastructure allows for video processing at the edge in real time with very low operating latencies. This is essential when controlling an industrial AGV in real time. *Risks mitigation:* The use of gesture control network applications in the platform avoids any type of direct contact with the machine. This is important	*Increased complexity*: the use of an orchestration platform sometimes entails an additional step compared to manual deployment of a network application. *Investment costs*: the deployment of a 5G infrastructure and devices entails an additional cost.

to prevent accidents and increase safety as well as trust in Industry 4.0 applications. *Intuitive controls:* The application implements a user-friendly interface with easy access, which allows for intuitive control of AGVs. No advanced knowledge, studies or manuals are needed to provide different instructions to the AGV. *Network information:* The use of a 5G infrastructure with an orchestration platform, as well as 5G devices permits the user to monitor network information in real-time.	*Gesture detection accuracy*. Gesture detection is based on an artificial intelligence algorithm. This means that it is not 100% accurate, and often depends on the light and the environment.
External Factors	
Opportunities	**Threats**
The demand of 5G as well as AI-based applications is increasing nowadays. They offer the possibility to tech wireless companies of collaborating with different verticals in the industry. This benefits the development of the Network Application and allows to exploit new use cases.	The applications may not reach the market due to the stringent requirements set by the industry, in terms of reliability or latency. Artificial intelligence algorithms may not be sufficient for the security market demands. High competition in the industrial market. Lack of trust in new technologies from some vertical companies.

4.3.1 UC3: VR immersion and AGV control

UC3 provides factory operators with an immersive experience that allows them to acquire a high-quality interactive view of the activities taking place in each ASTI-AGV (auto-guided vehicle). A 360 video offers a comprehensive and panoramic perspective of the ASTI-AGV, enabling the detection of any objects or abnormal situations in the surrounding area. In addition, the video displays real-time data to enhance the information provided, including details such as the strength of the 5G connection, speed, location on the route, display code, and active laser field.

The YBVR's software utilizes NetworkApp to process the video streams and generate a 360-degree image in virtual reality (VR). Simultaneously, it collects real-time status data from the AGV to provide an augmented reality (AR) information layer. The feeds are transmitted to a specified instance of the NetworkApp via a Fivecomm 5G modem, which is positioned closer to the video source. The objective is to minimize latency and maximize availability. The YBVR software within the VR headset plays the video and superimposes data onto the video display.

LEAN Canvas Analysis

Problem: The restricted visibility of regions that are either neglected or considered unsafe for human presence is one of the main issues encountered in industrial operations. Critical regions may remain unmonitored or unreachable, posing serious dangers to both worker safety and operational effectiveness. Furthermore, it is crucial to maintain uninterrupted operations and minimize disruptions by guaranteeing thorough monitoring of facility conditions. However, real-time insights into dynamic operational circumstances are often not provided by standard monitoring systems, which causes inefficiencies and delays

in responding to important situations. Moreover, the capacity to observe locations remotely is necessary to provide effective management and supervision of industrial facilities, particularly in situations when physical presence is unfeasible or prohibited. With the ability to examine visual data in real time from a variety of locations, remote viewing capabilities enable stakeholders to make well-informed decisions, respond quickly to incidents, and work seamlessly with on-site and off-site staff.

The installation of video surveillance systems throughout industrial buildings is a popular solution to the problem of visibility in unattended or dangerous locations. In order to collect visual data across the property, these systems usually entail putting cameras in various corners and locations strategically. Although this solution offers certain visibility, in order to guarantee complete coverage and dependability, it frequently necessitates a large investment in physical infrastructure and continuous maintenance. A different approach used to keep an eye on facility conditions is designating staff members to supervise several screens showing real-time feeds from the mounted cameras. This method looks for possible problems or hazards inside the facility through human observation and involvement. However, because staff members might find it difficult to efficiently monitor and respond to occurrences across numerous displays at once, it can be resource-intensive and prone to human error. Additionally, employees may occasionally have access to nearby monitors on the property, which enables them to watch live camera feeds near the locations they are watching. Although this offers a certain degree of accessibility and convenience, it still necessitates staff members to be physically present on the premises and restricts their capacity to view visual data from several locations at once or remotely monitor conditions.

Solution: The initial solution offered by UC3 is the installation of 360-degree cameras connected by the fast 5G network infrastructure. Real-time, full vision of every area is provided by these cameras, which record immersive video footage of industrial facilities. With the use of VR headsets or mobile devices, stakeholders can access and see this immersive video from any location with network connectivity, providing them with a dynamic and interactive viewpoint of the facility. The solution enables seamless remote monitoring and improved situational awareness by utilizing immersive technologies and 5G connectivity. This gives stakeholders the ability to make well-informed decisions and react quickly to changing operational conditions. The solution not only records immersive video but also adds contextual environmental data, like date, time, 5G signal quality, AGV status, speed, direction, and more, to the visual data. By giving stakeholders vital information about the facility's conditions and operational status in real time, this integration of environmental data raises the value of the immersive video stream. Through the integration of pertinent environmental data onto an immersive video interface, the system enables stakeholders to make informed decisions and improve operations while identifying trends and mitigating hazards. Lastly, UC3 offers clients unmatched flexibility and accessibility by letting them watch the facility from any location with an IP network connection. Clients can engage with augmented environmental data, watch the immersive video stream remotely, and track the real-time status of AGVs and other operational parameters through a simple and secure interface. Regardless of their physical location, stakeholders are empowered to maintain situational awareness, manage emerging difficulties, and coordinate actions efficiently thanks to this remote monitoring feature.

Key Metrics: Glass-to-glass latency is the total amount of time, including processing, transmission, and rendering delays, that elapses between the moment a video frame is taken by a camera (a glass) and the time it is presented on the viewing device (another glass). This metric is essential for evaluating the immersive video feed's responsiveness and real-time features. Achieving low glass-to-glass latency guarantees that there is as little delay as possible between the time the image data is captured and when it is displayed on the viewing device. This improves the user experience in general and makes quick decisions possible in dynamic industrial contexts. Additionally, the amount of data transferred per second while streaming video material is measured by streaming video bandwidth. It illustrates how well the network infrastructure can

sustain continuous, high-quality video streaming. The smooth and continuous delivery of immersive video feeds is ensured by optimal streaming video bandwidth, which also helps to avoid buffering, stuttering, or deterioration in video quality. UC3 guarantees a smooth and engaging viewing experience for stakeholders who are watching the video feed remotely by tracking and optimizing streaming video bandwidth. A crucial piece of information is the addition of more real-time environmental data to the immersive visual interface. Examples of this data include date, time, 5G signal quality, AGV status, speed, direction, and other pertinent characteristics. Stakeholders are better able to analyze the visual information offered and take appropriate action based on the operating conditions in situ due to the availability and accuracy of this additional data. The addition of further real-time data enhances the value and usefulness of the immersive video feed by offering thorough insights into the operation and condition of the facility. Finally, the clarity, sharpness, and detail of the live video feed recorded by the 360-degree cameras and shared to viewing devices are referred to as high-resolution real-time video quality. This metric evaluates the precision and accuracy of the visual information displayed, guaranteeing that stakeholders can clearly and precisely identify important elements and details within the video feed. To maximize the usability and efficacy of the immersive video solution, maintaining high-resolution real-time video quality is crucial for supporting efficient decision-making, situational awareness, and analysis of operations within industrial facilities.

Unique value proposition: Use Case 3, "VR Immersion and AGV Control," offers a distinctive value proposition since it can improve operating efficiency and safety in industrial settings. This solution removes the need for humans to physically enter dangerous, remote, or complex regions for monitoring reasons by utilizing cutting-edge VR and AR technologies. Alternatively, from a secure location, operators can get a detailed and dynamic 360-degree image of the ASTI-AGVs and their surroundings. In addition to guaranteeing quick detection of objects and anomalous circumstances, this immersive experience offers vital real-time data overlays, including 5G connection strength, speed, route position, display codes, and active laser fields.

Unfair Advantage: UC3 partners use cutting-edge technologies and methods to create smooth, high-quality visual experiences. They have a wealth of experience and expertise in the field of immersive video streaming. The unique characteristics of recording, processing, and sending immersive video content are all part of their immersive video streaming expertise, which guarantees top performance and dependability in a variety of settings. The use of edge computing capabilities and the 5G network further increases this unfair advantage. Through the utilization of the 5G network's unmatched speed, capacity, and low latency, they provide the real-time transmission of immersive video feeds with a minimum of delay and highest level of efficiency. Furthermore, by maximizing resource utilization and lowering latency, the integration of edge computing capabilities improves video data processing and analysis at the network edge, resulting in improved surveillance capabilities.

Channels: The UC3 consortium develops cooperative alliances with top suppliers of industrial robotics and security products. The surveillance capabilities of these systems can be improved by combining UC3's immersive video streaming technology with their robotic platforms. This allows for real-time visual monitoring and analysis of facilities in various industrial situations. These partnerships take advantage of each other's advantages to provide comprehensive and cutting-edge surveillance solutions which meet the changing demands of industrial stakeholders. Furthermore, the consortium establishes collaborations with either public or private 5G network providers to capitalize on their infrastructure and expertise in providing fast, low-latency connectivity. Through these partnerships, they can make use of 5G networks' enhanced capabilities, which guarantees top performance and dependability for their immersive video streaming service. Through collaboration with 5G network providers, the consortium increases our solution's accessibility and reaches a wider audience, opening new possibilities for deployment and acceptance in a range of sectors and regions.

Customer Segments: Manufacturers, mining companies and industrial plants can profit from the UC3 solution's potential to improve security, track equipment performance, and reduce operational hazards. They can efficiently monitor important regions, identify errors, reduce worker dangers, and react quickly to problems by implementing our immersive video streaming solution, protecting resources, and ensuring business continuity.

Cost Structure: Expenditures related to marketing, sales, and customer acquisition initiatives that are intended to increase the client base and bring in new customers are included in customer acquisition costs. These expenses include services like commissions and salary for marketers as well as advertising campaigns and promotional activities. The costs associated with distributing and deploying the immersive video streaming solution to clients are included in the distribution charges. This covers the logistical costs related to providing software installations, on-site deployment services, and hardware component deliveries. To ensure a seamless implementation and uptake of UC3 service, distribution charges may include cover expenditures for customer onboarding, technical support, and training sessions. Furthermore, the costs related to hosting UC3 solution on cloud infrastructure, as well as salary, hardware and benefits for staff members working on solution development, maintenance, and support, are included in the hosting and people costs. This covers the costs of data storage, software updates, server and hardware maintenance, and cloud hosting services. Salaries for software developers, technical support representatives, and other employees in charge of keeping the support and maintaining clients are also included in personnel costs.

Revenue streams: The consortium makes revenue by licensing its software, which comprises containerized software packages and specialized technical solutions made to fit the unique demands of its clients. Customers can access and use the technology to improve their operations and meet their business goals by paying license costs that are determined by the usage, functionality, and scope of the program that is given. In addition to meeting the various needs of our clientele, UC3 creates recurring revenue streams that support the long-term viability and expansion of our company.

Summary: By supporting real-time data exchange, quick communication, and streamlined workflows, the network application in UC3 improves operations efficiency. It also strengthens connectivity among stakeholders, encouraging collaboration and synergy across various teams, departments, and locations. By using its potential, resource allocation improves accuracy and efficiency, making sure that resources are distributed where they are most required and, as a result, increasing total production. Furthermore, by virtue of its execution, users are empowered with seamless access to critical information and resources, irrespective of their physical location. Through improved surveillance and monitoring features, the application helps to reinforce safety measures, ensuring proactive identification and mitigation of risks within industrial environments. Real-time insights provided by the application also give stakeholders valuable data-driven decision-making capabilities, enabling prompt actions and informed strategic decisions. Lastly, the application improves the overall customer experience through the provision of smooth and effective services, which increases user happiness and loyalty.

Table 12: UC3 LEAN Canvas.

<table>
<tr><th>Problem</th><th>Solution</th><th>Unique value Proposition</th><th>Unfair Advantage</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Visibility of areas that are unattended or are unsafe for human
Monitor the situation of the facility
View the premises remotely

Existing Alternative
Install video surveillance in each corner of the facilities
To have personnel to monitor multiple screens from various installed cameras

The personnel can view the monitors adjacent to the facility, but within the premises</td><td>To use 360 degrees cameras connected by the 5G network with immersive video that can be viewed through VR headsets or mobile devices.

The immersive video is enriched with environmental data such as date, time, 5G signal quality, AGV status, speed, direction, etc.
The client can monitor the facility from whichever place connected to the IP network.</td><td rowspan="3">No need to put personnel in unsafe, remote and/or complex spaces to monitor what is happening around.
Having a quick view of what is happening.</td><td rowspan="2">The expertise in immersive video streaming using the 5G network, and edge capabilities, makes it ideal for facility surveillance over complex environments</td><td rowspan="3">Target customers
Manufacturing companies
Industrial factories
Industrial areas with unsafe spaces for human (e.g., oil refinery, machineries)
Mines
Chemical industrial areas</td></tr>
<tr><td>Key Metrics</td><td>Channels</td></tr>
<tr><td>Glass-to-glass latency
Streaming video bandwidth
Additional real-time data included in the view
High-resolution real-time video quality</td><td>Collaboration with security and industrial robots.
Collaboration with public or private 5G networks providers.</td></tr>
<tr><td colspan="3">Cost Structure</td><td colspan="2">Revenue streams</td></tr>
<tr><td colspan="3">Customer Acquisition Costs. Distribution Costs, Hosting People etc. Commercialization costs for integrator (network provider, security provider, robots' provider…)
+ Hardware cost of cameras, modems, etc.
+ Infrastructure cost of Edge/Cloud resources.</td><td colspan="2">Licensing for software part of the product (Engineering, containers…)</td></tr>
</table>

Updated SWOT analysis

Strength: When comparing the strengths of the old and new SWOT analysis, the emphasis changes from specific technological capabilities to broader network benefits. The previous SWOT analysis identifies high-quality, 360-degree video and lower bitrate as significant strengths, underscoring the significance of precise resolution and effective bandwidth utilization. Augmented reality (AR) overlays boost operational effectiveness to a greater extent. In contrast, the updated SWOT analysis highlights the advantages of 5G connectivity, little delay, and ample bandwidth, which are essential for instantaneous applications such as VR headset connections. The additional capabilities encompass network slicing and enhanced video processing, enhancing both flexibility and efficiency. Furthermore, real-time data may be displayed on virtual reality or mobile screens, providing a thorough overview of the AGV's status.

Weakness: The limitations of the previous SWOT analysis mostly pertain to the restrictions imposed by the current 5G-upload bandwidth in managing 8K video resolution, which surpasses the present capabilities. Moreover, it highlights the inadequacy of existing 360-degree cameras in industrial environments, as they require manual adjustments by humans and lack durability. These shortcomings suggest a need for more robust and superior hardware solutions that are suitable for industrial applications. The revised SWOT analysis acknowledges similar issues, notably emphasizing the limitation on uplink bandwidth in 5G networks as a notable weakness that affects the streaming quality of 360-degree cameras. Furthermore, it asserts that current 360-degree cameras are primarily designed for the prosumer market and do not sufficiently meet the requirements of industrial applications. The persistent occurrence of these imperfections in both assessments indicates an ongoing inadequacy in the readiness of hardware and network systems for industrial applications.

Opportunities: The opportunities mentioned in the previous SWOT analysis revolve around new possibilities for immersive video in high-risk or unattended settings, utilizing the installation of 5G and MEC. This emphasizes the possibility of creative uses in difficult environments. The enhanced SWOT analysis explores the possibility for commercializing virtual reality immersion in the monitoring of industrial processes. This immersive monitoring technology has the potential to benefit several industries, including manufacturing and chemical mining. The expanded perspective in the updated SWOT analysis indicates a growing acknowledgement of the wide range of commercial and industrial uses for immersive video technology.

Threats: The threats identified in the previous SWOT analysis encompass challenges related to the identification of suitable commercial channels. Telecommunication businesses possess the required infrastructure but lack specialized industrial services, whereas engineering organizations have a good understanding of client needs but have not yet ventured into these technologies. There is a lack of communication between companies that offer infrastructure and the potential industrial users. The updated SWOT analysis emphasizes the wider obstacles encountered in the invention process for immersive video and VR headsets. The statement acknowledges that the future progress and advancement of these technologies are not under the influence of specific industries or developers of application networks. It implies that there is a reliance on external technological breakthroughs and the readiness of the market. The transition from specific business obstacles to more general technological difficulties demonstrates the changing nature of immersive video technology.

Verdict: Both SWOT assessments acknowledge the technological strengths and possible uses of 360-degree video and immersive monitoring. However, the current SWOT study places a greater emphasis on the capabilities provided by 5G technology. It also highlights the ongoing deficiencies associated with limited bandwidth and insufficient high-quality gear. The range of business applications has increased, while the potential risks now include reliance on the continuous development of immersive technologies. The transition from the traditional to the updated SWOT analysis demonstrates a move towards utilizing sophisticated networking, while also emphasizing the necessity for ongoing technology and market advancement.

Table 13: UC3 Updated SWOT Analysis.

Internal Factors	
Strengths	**Weakness**
Connectivity and Low latency – it was the highest priority to deliver high quality radio transmission to be able to connect the viewers to the AGV in real-time via VR headsets. High Bandwidth – while connected to 5G network, it significantly offers higher data transfer rates compared to standard 4G network. Network slicing and video processing – enhances overall agility and optimized the processing of 360-degree videos. Real-time information viewed on the VR or mobile screen. This tells the actual location, status, and battery life of the AGV while remotely viewing the vehicle surroundings.	Uplink bandwidth limitation in 5G network can commit the quality of the 360-degree camera streaming. Existing 360-degree cameras are designed for prosumer segment, they are not well adapted for industrial applications.
External Factors	
Opportunities	**Threats**
VR Immersion for industrial process monitoring has commercial potential. Industrial factories, manufacturing companies, miner or chemicals activities can take advantage of this model of immersive monitoring.	Immersive video and VR headsets are in a challenging process of innovation. The future development and evolution of these technologies are out of the control of verticals and of application networks developers.

4.3.2 UC4: ML-Supported Edge Analytics for Predictive Maintenance

Use case 4 involves implementing data-driven analytics to predict maintenance needs in an industrial environment. The NetworkApp, developed specifically for this use case, provides separate Virtual Network Functions (VNFs) that include data collection, analytics, and visualization capabilities. These VNFs cater to the specific requirements of the shop floor and factory levels, by taking into account their respective technical capabilities and any limitations that may be in place. Edge analytics are conducted at the shop floor level, enabled by the deployment of three essential components: the Edge Data Collector, Edge Analytics, and Edge Data Store. The data collected at the edge level can be merged with data from other internal or external sources and then analyzed by the On-Prem Analytics Engine using sophisticated analytical algorithms. An interface for visualization is supplied to end-users, enabling them to construct graphs and boards that effectively communicate the results of analytics.

LEAN Canvas Analysis

Problems: Real-time data integration into predictive maintenance methods' analysis is frequently a weakness. As maintenance predictions aren't based on the most recent data regarding the performance and condition of the equipment, this limitation reduces their accuracy and efficiency. Furthermore, it is frequently necessary to make maintenance decisions quickly to resolve new problems or stop possible equipment

failures. Nevertheless, current predictive maintenance methods might not offer prompt insights or suggestions, delaying decision-making and raising the possibility of costly repairs or downtime.

Pre-defined schedules are frequently used in current maintenance procedures to direct maintenance operations. There are several drawbacks to these schedules, which are usually created in accordance with manufacturer recommendations, past maintenance records, or legal obligations. Firstly, this method frequently results in reactive maintenance procedures, which increase downtime, production losses, and maintenance expenses by delaying repair until after equipment failure or deterioration is noticed. Furthermore, there's a chance that defined timetables won't always coincide with the real state or functionality of the machinery, which could result in ineffective maintenance procedures and poor resource allocation. Finally, there are missed maintenance opportunities and weakened equipment reliability because of these schedules' inability to adjust to changing operational conditions or unanticipated changes in equipment performance.

Solution: The UC4 solution consists of an application which utilizes machine learning (ML) and artificial intelligence (AI) to enable real-time decision-making for predictive maintenance of machinery. This program continually analyzes real-time data streams from machinery and equipment sensors by utilizing cutting-edge AI and ML algorithms, in order to precisely identify future failures or performance issues before they arise. This proactive strategy reduces the likelihood of unscheduled downtime and expensive repairs by enabling prompt intervention and maintenance activities. To identify patterns, abnormalities, and trends in the streaming data, the AI/ML based application uses advanced data analytics techniques. This enables the early detection of potential equipment failures or degradation. The UC4 system gives stakeholders the ability to prioritize maintenance jobs according to the criticality and state of the equipment, allowing them to make well-informed decisions. This is achieved by directly integrating predictive maintenance capabilities into operational processes. Moreover, the application is made to offer practical insights and suggestions in real-time, enabling maintenance teams to plan maintenance tasks effectively, allocate resources optimally, and increase the lifespan of machinery and equipment. In conclusion, proactive maintenance improves overall productivity and profitability for industrial organizations by minimizing operating disruptions, increasing equipment performance and dependability, and lowering maintenance costs.

Key metrics: The degree of accuracy and time granularity of forecasting are the two main metrics used to assess the performance of the UC4 predictive maintenance solution. The degree of accuracy measures the match between expected results and actual equipment conditions, evaluating the precision and dependability of predictive maintenance forecasts. When AI/ML algorithms predict possible equipment failures or performance issues with a high degree of accuracy, it allows for proactive maintenance interventions while avoiding false alarms. Furthermore, forecasting's time granularity gauges how accurate and detailed it is at estimating when maintenance will be required. More accurate forecasting is made possible by a greater time granularity, which helps maintenance teams organize and carry out tasks more effectively. Suite5 makes sure that their predictive maintenance solution provides precise, timely, and actionable insights by consistently tracking and optimizing key parameters. This helps to improve equipment reliability, reduce downtime, and streamline maintenance procedures in industrial settings.

Unique value proposition: The core of the UC4 value proposition is the use of 5G technology to implement edge AI/ML predictive maintenance solutions, which have several strong advantages. Suite5 makes it possible to identify predictive maintenance algorithms right at the network edge, enabling quicker prediction results, less operating expenses, and more accuracy by utilizing the capabilities of 5G networks. Firstly, real-time data transfer with extremely low latency is made possible using 5G networks, which enables predictive maintenance algorithms to handle data quickly at the edge. This increased processing speed translates into quicker forecast outcomes, allowing for preventive maintenance and prompt intervention to avoid

equipment breakdowns or downtime. Secondly, by reducing the requirement for centralized data processing and storage infrastructure, AI/ML predictive maintenance at the edge lowers operating expenses. Through the utilization of edge computing resources and reducing data transfer to centralized servers, companies can attain substantial cost reductions without compromising high-performance predictive maintenance capabilities. Lastly, by lowering data latency and guaranteeing that insights are drawn from the most recent data, putting predictive maintenance algorithms at the edge improves accuracy. With the ability to interpret data in real-time, predictive maintenance projections become more accurate and reliable, allowing organizations to maximize maintenance efforts and extend the life of vital assets.

Unfair advantage: Suite5's ability to quickly build no-code AI pipelines for processing incoming data streams gives UC4 an unfair advantage. Their capacity to quickly implement and modify AI solutions to deal with the constantly changing industrial data streams, without requiring lengthy development cycles or coding knowledge, is what makes them unique. UC4 accelerates the development process by utilizing no-code AI pipelines, which facilitates the rapid prototyping and deployment of AI models for the purpose of evaluating and extracting insights from real-time data streams. Because of its agility, the system can quickly respond to changing requirements and modify its solutions to meet shifting business needs, which promotes innovation and continual improvement. Additionally, Suite5's expertise in creating no-code AI pipelines improves scalability and flexibility, making it possible to effectively manage massive data volumes and support a variety of use cases in industrial settings. Due to their capacity to quickly deploy and develop AI-driven solutions that are customized to meet unique customer requirements, their agility and scalability provide them a competitive edge.

Channels: Face-to-face interactions are given top priority in the UC4 channels strategy as the primary method of engaging with stakeholders and prospective customers. By use of these face-to-face communications, the consortium builds relationships with decision-makers and enables them to efficiently convey the benefits of predictive maintenance solutions and promptly resolve any questions or issues. Meetings in person help create rapport, foster trust, and provide a thorough grasp of each client's particular requirements and difficulties. They may customize their solution offerings to meet the needs of individual clients due to this individualized approach, which increases the possibility of fruitful partnerships and collaborations. Additionally, in-person meetings offer a chance to highlight the features and advantages of the solution through interactive talks, presentations and live demos, giving clients a firsthand look at the functionality and helping them make decisions.

Customer segments: The planned customer segments for UC4 consist of a wide variety of industrial organizations. Firstly, large enterprises should be a primary focus. They run vast production facilities equipped with sophisticated machinery. To proactively monitor equipment health and optimize maintenance schedules to improve operational efficiency and profitability, they have to face major risks related to unexpected breakdowns and expensive maintenance issues. This is the reason why predictive maintenance is so important for them. Small and medium-sized businesses (SMEs) in the manufacturing industry can also profit from the UC4 system's scalable and affordable predictive maintenance solution. Small and medium-sized enterprises (SMEs) face similar difficulties in preserving equipment dependability and reducing downtime, thus the solution is crucial for enhancing productivity and competitiveness. Additionally, another significant customer sector consists of businesses that run machinery-intensive operations in a variety of industries, including construction, energy production, logistics, and transportation. These businesses may increase operational efficiency, save maintenance costs, and maximize asset performance by utilizing the predictive maintenance solution, which will boost their competitiveness and sustainability in their markets.

Small manufacturers who are proactive in accepting cutting-edge solutions to address maintenance difficulties inside their operations represent the majority of UC4 early adopters. Despite their limited

resources and size of operations, these manufacturers understand the value of predictive maintenance in maximizing equipment performance and avoiding downtime. These creative manufacturers hope to gain a competitive edge by utilizing cutting-edge technologies to improve operational efficiency and dependability by implementing predictive maintenance early on. Additionally, by being early adopters and influencers in their respective sectors, these small manufacturers are essential in verifying the efficacy and value proposition of the UC4 solution.

Cost structure: The UC4 cost structure includes a number of essential elements that are vital to the creation, management, and marketing of the predictive maintenance system. Initially, the dedicated data science team covers the cost of analytics development, which includes research, development, and optimization of AI/ML algorithms necessary for predictive maintenance models. Secondly, expenses for data storage, cloud computing services, and security measures to guarantee the reliability, scalability, and security of the solution's infrastructure are included in platform hosting and operation charges. In addition, maintenance expenses—which also include AI/ML model costs—go toward continuing support, control, and updates to maintain the system's performance and accuracy over time. Lastly, marketing expenses include a range of activities like digital marketing, industry events, and advertising that are aimed at disseminating information about the solution and increasing awareness among stakeholders and target customers.

Revenue streams: There are two main sources of revenue for UC4. Firstly, users pay a monthly membership fee to access the predictive maintenance platform. They can choose from multiple subscription packages according to CPU hours and data volume. With these subscriptions, users may access all the services on the platform, such as maintenance insights, AI/ML predictive models, and real-time data analytics. With its tiered subscription model, customers may get a cost-effective solution that is customized to meet their needs while also ensuring scalability and flexibility to fit a range of consumption levels and requirements. In addition, UC4 gets money by charging one-time fees for creating personalized analytics pipelines. The development, modification, and use of AI/ML algorithms suited to the requirements and goals of each client are included in these prices. Suite5 enables its clients to take advantage of sophisticated predictive maintenance features that optimize the efficiency and worth of our platform by offering customized analytics solutions.

Verdict: UC4's network application has numerous beneficial effects in a variety of industrial contexts. The application transforms maintenance procedures by solving important issues like the lack of real-time data integration and the requirement for quick maintenance options. The system uses 5G technology to enable AI/ML algorithms at the edge, which leads to faster prediction results, reduced costs, and increased predictive maintenance accuracy. By proactively monitoring equipment condition, optimizing maintenance schedules, and minimizing downtime, it enables enterprises to improve operational efficiency and profitability. Furthermore, the application guarantees wide market acceptability and adoption by facilitating in-person meetings and focusing on a variety of customer sectors, such as large manufacturers, manufacturing SMEs, and businesses with machinery-intensive operations. The network application of UC4 enables industry-wide transformation, boosting equipment dependability, operational efficiency, and competitiveness across industrial sectors with its creative approach and customized solutions.

Table 14: UC4 LEAN Canvas.

<table>
<tr><th>Problem</th><th>Solution</th><th>Unique value Proposition</th><th>Unfair Advantage</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Predictive Maintenance often is not considering real-time data
Maintenance Decisions in many cases need to be taken instantly.

Existing Alternative
Maintenance is based on pre-defined schedules</td><td>AI/ML based application for real-time decisions for machinery predictive maintenance</td><td rowspan="3">Using 5G to place AI/ML predictive maintenance at the edge, for faster prediction results, lower costs and improved accuracy</td><td>Ability to rapidly design no-code AI pipelines for the incoming data streams</td><td rowspan="3">Target customers
Big Manufacturers
Manufacturing SMEs
Companies operating machineries requiring maintenance

Early Adopters
Small manufacturers</td></tr>
<tr><td>Key Metrics</td><td>Channels</td></tr>
<tr><td>Degree of Accuracy
Time granularity of forecasting</td><td>Face-to-Face Meetings</td></tr>
<tr><th colspan="3">Cost Structure</th><th colspan="2">Revenue Streams</th></tr>
<tr><td colspan="3">Analytics Development Costs (Data Science Team)
Platform Hosting and Operation
Maintenance Costs (also of AI/ML models)
Marketing Costs</td><td colspan="2">Monthly Subscription to the Platform (tiers based on data volume and CPU hours)
One-Off fees for the development of analytics pipelines</td></tr>
</table>

Updated SWOT analysis

Strength: The previous analysis emphasized the advantages of the architecture in terms of scalability and edge computing. It specifically focused on how the architecture enables efficient management of resource requirements for data ingestion and analysis, while also taking advantage of the high-speed data transfer capabilities of 5G to facilitate communication between edge computing/data collection sites and the centralized cloud architecture. The emphasis on scalability and the efficiency of data transfer laid a solid groundwork. On the other hand, the current analysis enhances these advantages by focusing on the fast and reliable implementation capabilities of 5G-INDUCE, which allows for the dependable deployment of UC#4 NetworkApp. This newfound strength showcases not only the strong and high-performing characteristics of the application, but also its capability to reduce the delay in getting AI outputs, hence improving the overall efficiency and effectiveness of the system.

Weakness: The previous investigation highlighted the main drawback as the exorbitant expenses associated with acquiring 5G infrastructure, which placed a substantial financial load on clients. The issue of cost was a significant obstacle in the acceptance and execution of the technology. The new analysis redirects attention from financial to technological obstacles, particularly the possible intricacies that may arise from extensive and personalized Kubernetes (K8s) implementations. These deployments may involve issues with the NetworkApp Operator (NAO), necessitating additional effort to rectify. The shift in weakness indicates a more

sophisticated comprehension of the technical obstacles that could affect the implementation and incorporation of the technology.

Opportunities: The previous investigation indicated potential advantages in the increasing need for edge computing and data sovereignty inside manufacturing settings. This request has established a favorable environment for implementing analytics in closer proximity to the production shop floor, hence improving operational efficiency. The new report further explores the possibilities for market expansion in different areas by merging 5G technology with AI/ML algorithms for maintenance. This expanded viewpoint on opportunities suggests a strategic change towards utilizing technical advancements to enter new industries and applications, therefore enhancing the potential for growth and influence.

Threats: Previously, the primary concern was the possibility of facing competition from major suppliers who provide comparable IT solutions for the industrial shop floor. This competitive threat emphasized the danger of being surpassed by well-established competitors with more extensive solutions. The revised report redirects attention to the financial obstacles encountered by small and medium-sized enterprises (SMEs), particularly the exorbitant expenses involved in procuring 5G equipment. This issue highlights the possible obstacle to widespread adoption caused by financial limitations, especially for smaller businesses. This enhanced risk evaluation offers a more focused comprehension of the market forces and the particular obstacles that may hinder the acceptance and achievement of the technology.

Verdict: The updated SWOT analysis provides a comprehensive and proactive viewpoint, specifically focusing on harnessing cutting-edge technology and tackling precise technical and financial obstacles. This demonstrates a developed comprehension and deliberate placement inside the market

Table 15: UC4 Updated SWOT Analysis.

Internal Factors	
Strengths	**Weakness**
5G-INDUCE offers the ability to rapidly and securely deploy the NetworkApp of UC#4 in a trustworthy manner, enabling data flow, as well as computational resources to take advantage of 5G capabilities, making thus the application more robust and performant, while minimizing the time required for receiving the AI outputs	Technical Complexity in case large and customised K8s deployments are already developed might arise, as these might include some incompatibilities with the NAO, which require some effort to be resolved.
External Factors	
Opportunities	**Threats**
Expansion in various markets is possible, as the novelty of the approach to combine 5G technologies and AI/ML algorithms for maintenance can gain ground in various critical domain operations. Algorithms for maintenance can gain ground in various critical domain operations.	Investment costs of manufacturing SMEs for acquiring 5G equipment might negatively impact the overall adoption.

4.3.3 UC5: Inspection and surveillance services for critical infrastructures

Use-case 5 aims to utilize AI-powered inspection and surveillance using UAVs to promptly identify early signs of corrosion on vital infrastructures, such as storage tanks or pipelines, as well as to detect and identify unauthorized intrusions, including humans and animals. This use-case comprises four primary Virtual Network Functions (VNFs). The Video Proxy VNF efficiently transmits video content to other VNFs by utilizing an NGINX server to minimize transmission delay and ensure optimal performance. The Intruder VNF performs automated area surveillance using UAVs to detect intruders. It consists of three pipelines: picture pre-processing using OpenCV, an intruder detection model based on artificial intelligence, and sending the results in JSON format to the Message Bus VNF. The Corrosion VNF utilizes unmanned aerial vehicles (UAVs) to conduct automated inspections for the early detection of corrosion. This process has three main stages: pre-processing, an artificial intelligence (AI)-based corrosion detection model, and post-processing. The Message Bus VNF receives detection results in JSON format and transmits them to the Android UAV control application and other web-based applications over Rabbit MQ.

LEAN Canvas analysis

Problem: Several urgent issues in the field of critical infrastructure management are addressed by the Inspection and Surveillance Services for Critical Infrastructures network application. First, it reduces the possibility that unauthorized people may enter these facilities, protecting against possible security lapses and guaranteeing the integrity of vital assets. Second, the application addresses corrosion and deterioration in infrastructure, a common issue that causes errors, breakdowns, and ensuing losses of money. It allows for the early detection of deterioration and rapid interventions to preserve infrastructure integrity and safeguard capital expenditures by putting proactive inspection and monitoring methods into place. Furthermore, the program addresses latency and reliability issues in response and surveillance operations, guaranteeing efficient and trustworthy tracking of vital infrastructure components to reduce possible hazards and improve overall operational resilience. By utilizing a thorough inspection and surveillance process, the network application successfully resolves significant vulnerabilities, strengthens infrastructure resilience, and protects vital assets across several industries.

Alternatives currently in use usually involve manual inspection techniques carried out while controlling drones. Nevertheless, there are a number of disadvantages to this strategy, such as the possibility of the pilot becoming less focused and fatigued. Long-term monitoring can impair the accuracy and speed of detection because it causes the pilot, who manually controls the drone to inspect infrastructure, to become less focused and more tired. Furthermore, using human labor to perform manual inspection chores is quite expensive, especially since it takes a lot of time and money to complete and calls for trained workers. As a result, the shortcomings of human inspection techniques make it more difficult to conduct efficient surveillance and put vital infrastructures at risk of both structural failure and security concerns.

Solutions: The network application suggests deploying AI-equipped Unmanned Aerial Vehicles (UAVs) with 5G capabilities as a solution. These UAVs are used for real-time video streaming and analysis, which helps with the early identification of corrosion on vital infrastructure and intrusions. The UAVs can transmit real-time, high-quality video data by utilizing 5G connectivity. This enables prompt analysis and detection of potential threats or structural damage. The use of artificial intelligence models improves the efficacy and precision of monitoring endeavors, permitting the more accurate identification of anomalies and possible dangers. In addition, the system provides people on-site with instant warnings in cases that infrastructure problems or security breaches are discovered, allowing for quick maintenance and reaction times. By promptly detecting and mitigating potential risks, this proactive approach to surveillance and response improves the overall security and resilience of critical infrastructures.

Key Metrics: The UC5 network application's core metrics cover significant aspects of surveillance and response efficiency. Firstly, the application's real-time detection capabilities is a crucial statistic that shows whether it can quickly detect anomalies or possible threats within critical infrastructures. This indicator shows how well the system responds to new hazards by identifying them and notifying the appropriate parties in a timely manner, allowing for mitigation and action. Second, detection accuracy—which measures how precisely an application can recognize and categorize infrastructure problems or security threats—is crucial. The possibility of false alarms or missed detections is reduced with a high detection accuracy rate, improving the overall effectiveness of surveillance. Network app deployment time is another important measure that evaluates the way the surveillance application is deployed into network infrastructure. A quicker deployment period is indicative of more efficient implementation procedures, which facilitates the quick integration of surveillance capabilities and the quick reinforcement of security measures. Finally, latency in video streaming is important because it affects the real-time transfer of video data for analysis. Reducing latency makes it possible for surveillance staff to react quickly to threats or situations by ensuring that they receive timely and useful insights.

Unique value proposition: This network application's value proposition is centered on providing proactive, accurate, and real-time threat detection using cutting-edge technologies. The application provides unmatched surveillance capabilities by utilizing 5G-enabled UAVs and sophisticated AI algorithms, allowing for the precise and quick identification of infrastructure problems or security concerns. Organizations are able to take actions quickly to mitigate risks and ensure the security and integrity of vital facilities by utilizing this proactive approach to threat detection. Moreover, the application's real-time corrosion and intruder detection capabilities enable crucial insights to be made, decreasing the risk of infrastructure breakdowns, security breaches, and following financial losses.

Unfair advantage: The UC5 network application has an unfair advantage because of its proprietary AI algorithms, which have been carefully created and optimized for the surveillance of vital infrastructure. These artificial intelligence systems have been meticulously developed to address the particular difficulties and complexities involved in maintaining and protecting vital infrastructure assets. The inspection system surpasses generic surveillance solutions with high levels of accuracy and responsiveness due to the use of proprietary algorithms. As these algorithms are customized, the system can identify small abnormalities and possible dangers with noteworthy accuracy, which makes early identification and proactive risk mitigation easier. This benefit not only increases the effectiveness of surveillance operations but also gives stakeholders additional trust in the inspection system's reliability and ability to protect vital infrastructures from new threats and weaknesses.

Channels: Aiming to maximize market penetration and engagement, the network application's channels strategy consists of multiple critical methods. First, the strategy aims to build direct relationships with target consumers through direct sales efforts, providing customized solutions to meet their unique surveillance needs. Furthermore, consultation services offer the chance for in-depth discussions and evaluations, allowing for a customized strategy to address the needs and issues of clients. Secondly, industry collaboration plays a crucial role in expanding the application's reach and impact. In order to accelerate adoption and implementation efforts, the consortium can collaborate with stakeholders such as infrastructure operators, security companies, and regulatory agencies. Finally, events and demonstrations are excellent opportunities to show off the features and advantages of the program to a larger audience. The application seeks to create interest, establish reputation, and cultivate relationships with potential partners and clients through live demonstrations and participation in industry events.

Customer Segments: The network application's target client groups comprise a wide range of stakeholders from the public and private domains. A key focus is on public infrastructure stakeholders, which include

owners, operators, maintenance agents, and regulatory bodies. These organizations oversee the maintenance and management of vital infrastructure assets, including government buildings, utilities, and transportation networks. The UC5 consortium also targets stakeholders in the commercial sector that have vital infrastructure and depend on reliable surveillance systems to protect their operations and assets. Another group of customers are surveillance companies that focus on offering solutions and services for surveillance to different industries and sectors. Finally, since they are essential in identifying and reducing risks related to major infrastructure assets, insurance companies and risk management organizations are recognized as significant stakeholders.

Among the early users of the network application are partners in the EU Project who are currently doing collaborative studies. These partners are organizations that are actively involved in R&D projects aimed at improving security and surveillance protocols for vital infrastructure assets. These early adopters have shown a strong interest in utilizing cutting-edge technology and solutions to address new issues within the critical infrastructure sector through their continued participation within EU-funded initiatives. Being among the first users, they are essential in confirming the viability and effectiveness of the application's monitoring features. They also offer insightful feedback that helps with future improvement and optimization.

Cost structure: The costs linked to this network application comprise a range of fundamental elements necessary for both its functionality and maintenance. Firstly, human expenses include the costs of hiring qualified staff to manage daily operations, maintain security systems, and react to anomalies or threats. These staff members are essential to maintaining the responsiveness and efficient operation of the surveillance system. Second, costs associated with complying with aviation and data security and insurance requirements are included in regulatory compliance costs. Maintaining ethical and legal standards during surveillance operations involves adherence to these requirements. Finally, costs associated with using AI models, using the 5G network (which includes Multi-Access Edge Computing), purchasing and maintaining UAV equipment, and continuous software and hardware upgrades are all included in the category of technology infrastructure costs. The application's sophisticated features, such as real-time video streaming, AI-based analysis, and remote monitoring, depend on these infrastructure expenses. The application guarantees the reliability, effectiveness, and security of its surveillance activities by investing in these crucial components, thus assisting in the preservation and integrity of vital infrastructure assets.

Revenue streams: The network application's revenue streams are a multifaceted strategy designed to maximize revenue production and maintain long-term profitability. First of all, companies can obtain continuous benefit and assistance via subscription-based services, which provide constant monitoring and maintenance packages customized to their unique needs. Secondly, custom solutions and consulting services that provide knowledge and specially designed solutions to meet certain infrastructure needs bring in revenue. Furthermore, by selling processed data and actionable insights to relevant companies or authorities and utilizing the valuable information obtained from surveillance activities, the program monetizes data analytics and insights. Maintenance of clients and continuous provision of updated AI models and surveillance services guarantees continued value delivery and client satisfaction, which in turn increases the possibility for recurring revenue. Monthly Recurring Revenue (MRR) and Annual Recurring Revenue (ARR), which are dependent on the coverage area and client subscriptions, further aid in revenue creation by offering a steady revenue stream which is in line with the application's attempts to retain customers and reach new markets.

Verdict: In general, network application is a key component in improving operational effectiveness, security, and resilience in critical infrastructure domains, which eventually supports public safety, economic stability, and societal well-being. More specifically, the application provides real-time, accurate, and proactive identification of possible threats to critical infrastructure assets by utilizing state-of-the-art technology like

AI algorithms and 5G-enabled UAVs. By taking a proactive approach, companies may quickly detect and address problems, protecting the security and integrity of vital infrastructure. The application also makes it easier to take quick action to resolve problems that are found, minimizing downtime, costs, and potential safety risks. Furthermore, the program encourages continued protection and resilience of vital infrastructure assets by offering maintenance and continuous surveillance services through subscription-based packages. Furthermore, the revenue generated by data analytics and insights provides authorities and related industries with useful information that helps with risk management and well-informed decision-making.

Table 16: UC5 LEAN Canvas.

<table>
<tr><th>Problem</th><th>Solution</th><th>Unique value Proposition</th><th>Unfair Advantage</th><th>Customer Segments</th></tr>
<tr><td rowspan="4">Critical vulnerability in critical infrastructures: Intruders gaining access to these facilities.

Infrastructure corrosion and deterioration: Leading to infrastructure faults and failure, loss of capital investment and business revenue, etc.

Latency and Reliability in Surveillance and Response.

Existing Alternative

Manually inspecting infrastructures while flying the drone, causing downgrading attention and fatigue of the pilot, leading to reduced detection accuracy and speed at an excessive cost due to human labor.</td><td>Utilizing 5G-enabled UAVs equipped with AI models to conduct real-time video streaming and analysis for prompt detection of intruders and corrosion on crucial infrastructure. Offering immediate notifications to on-site personnel for rapid response and maintenance.</td><td rowspan="4">Providing real-time, accurate, and proactive detection of potential threats to critical infrastructure using cutting-edge technologies. Enabling immediate action to mitigate risks, ensuring the security and integrity of essential facilities.</td><td>Proprietary AI Algorithms: Developed and fine-tuned specifically for critical infrastructure surveillance, making the inspection system more accurate and responsive.</td><td rowspan="4">Target customers

Public Infrastructure stakeholders such as Owners, Operators, Maintenance Agents, Authorities, etc.

Private Sector Industries with Critical Infrastructure, and their stakeholders.

Surveillance Companies.

Insurance Companies and Risk Management Agencies.

Early Adopters

EU Project partners with current research collaborations.</td></tr>
<tr><td>Key Metrics</td><td>Channels</td></tr>
<tr><td>Real-time detection.

Detection accuracy.

Network App Deployment time.

Video streaming latency.</td><td>Direct sales once commercialised and consultation.

Industry collaboration.

Demonstrations and events.</td></tr>
</table>

Cost Structure	Revenue Streams
Personnel: Expenses associated with skilled personnel managing operations and responding to detections. Regulatory Compliance: Costs for adhering to aviation and data privacy regulations, and insurance. Technology Infrastructure: Costs related to AI model execution, 5G network (including MEC) usage, UAV equipment investment and maintenance, and software/hardware upgrading.	Revenue Stream: Subscription-based Services: Offering service packages to businesses for continuous surveillance and maintenance. Revenue Stream: Custom Solutions and Consultation: Providing tailored solutions and expertise for specific infrastructure needs. Data Analytics and Insights: Selling processed data and insights to relevant industries or authorities. LTV: Potential for recurring revenue by retaining customers and offering continual value through updated AI models and surveillance services. Revenue: MRR/ARR based on coverage area/customer.

Updated SWOT analysis

There have been no additional factors that have come to light since our last investigation. Therefore, the current SWOT analysis stays unaltered.

Verdict: The 24/7 availability with 0% downtime, coupled with easy deployment and seamless interconnection between different VNFs, presents a promising solution for the surveillance of critical infrastructure using UAVs and AI. This innovative solution not only broadens opportunities for new business models and collaborations but also poses challenges to NetworkApp's feasibility and development due to current hardware limitations, cost constraints, and EASA regulations.

4.3.4 UC6: AR-based remote maintenance, repairing and upgrade

Application Scenario The "AR-based Remote Maintenance, Repair and Upgrade" system enhances remote support video sessions by integrating high-quality video and audio feeds with collaboration tools such as augmented reality annotation features and documentation capabilities. This application facilitates the remote implementation of maintenance, inspection, and repair assignments, hence minimizing the need for service experts to travel and saving associated expenses. Additionally, it enhances the availability of machines. Additionally, it facilitates the generation of two-way sequential guidelines connected to asset hierarchies and the presentation of 3D models superimposed as augmented reality models on actual machines. The media server component, known as a Selective Forwarding Unit (SFU), functions as the media plane for the UC6 Oculavis SHARE NetworkApp. It is responsible for facilitating the transmission of video, audio, and data streams between client applications. The purpose of this component is to utilize the high bandwidth and low latency capabilities of the 5G infrastructure, in order to enhance video quality and user experience. Meanwhile, the Oculavis SHARE Backend component is deployed in the conventional MS Azure environment, creating a hybrid 5G arrangement.

LEAN Canvas Analysis

Problem: The main issues identified are bandwidth constraints and unstable network conditions that negatively impact the quality of video communication. There is also significant latency during live video collaborations, which disrupts real-time interactions. Additionally, there are challenges related to the complexity and time required for manual adjustments of video parameters. Lastly, traditional video

communication platforms have high operational costs and consume excessive energy, making them unsustainable.

Solution: The suggested solutions for these issues are inventive and characterized by cutting-edge technology. These methods utilize the capabilities of 5G and edge media server gateways to enable the management of resolution and framerate up to 4K. This is especially useful for remotely troubleshooting and maintaining machinery. In addition, the deployment of latency-critical media components at the edge aims to guarantee low-latency video communication. Adaptive operational policies are implemented to maintain a sustainable balance in NetworkApp's energy consumption and reduce platform hosting costs, while also ensuring stable performance.

Unique Value Proposition: The distinctive value proposition focuses on providing the optimal user experience in live video collaboration by utilizing adaptive technology to regulate video resolution and framerate, ensuring good quality. This is further improved by supplying real-time video statistics overlays, allowing users to optimize video settings. Additionally, it provides a cost-effective and sustainable video communication platform that balances energy usage and performance through adaptive operational policies.

Unfair Advantage: The project possesses a distinct edge that is particularly convincing, based on its exclusive collaborations with network application developers and telecom providers, as well as the skills and experience gained from operating applications in 5G networks and performing research initiatives. These factors add to a distinct advantage that is difficult for rivals to imitate.

Customer Segments: The UC6 system's customer segments primarily consist of the machine and plant engineering, automotive, and Industry 4.0 manufacturing sectors. The system's capabilities, which combine superior video and audio feeds with cutting-edge augmented reality features and collaborative tools, greatly enhance both parts. Firstly, the solution reduces the need for expert travel and downtime by enabling precise and efficient maintenance and inspection operations in machine and plant engineering. Secondly, the improved capacity to conduct remote diagnostics and repairs benefits the automobile sector by guaranteeing continuous production and lowering servicing costs. Finally, the solution leverages 5G infrastructure to deliver high-bandwidth, low-latency connectivity, and it supports smooth remote upgrades and troubleshooting in the larger Industry 4.0 and manufacturing landscape.

Key Metrics: In order to evaluate the effectiveness of these solutions, specific metrics have been defined. These metrics cover user engagement, including the number of active users, average session duration, and frequency of video sessions. Additionally, video quality metrics such as average resolution and framerate, as well as user satisfaction, are taken into account. Lastly, operational efficiency metrics are considered, which focus on cost savings achieved through the use of adaptive operational policies.

Channels: The methods for consumer outreach are carefully selected, which include conducting Proof of Concepts (PoCs) and testing at customer locations, as well as promoting the product at trade shows and industry events. These channels are efficient in showcasing the solution's capabilities and establishing client confidence, especially in the specific market areas of machine and plant engineering, the automotive industry, and Industry 4.0 and manufacturing industries.

Cost Structure: The cost structure is inclusive, encompassing all significant expenditures related to the development and upkeep of the solution. The costs encompass research and development expenses, hardware expenses for user equipment, expenses for service deployment and integration, expenses for after-sales support, and expenses for operating cloud infrastructure. These expenses are crucial for providing a strong and dependable service.

Revenue Streams: The revenue streams are clearly defined and consist of fees for the initial implementation and integration of the solution, as well as ongoing payments for service usage or licensing. This structure provides a well-balanced strategy to earning revenue by combining immediate income with consistent financial inflows over an extended period.

Verdict: The analysis offers a strong and organized business plan. The issues are well outlined, the solutions are inventive and technically viable, and the distinctive value proposition is robust and sets it apart. The measurements are suitable, the cost structure is well planned, and the income sources are rational. Given its effective implementation, this plan exhibits a considerable likelihood of achieving success.

Table 17: UC6 LEAN Canvas.

Problem	Solution	Unique value Proposition	Unfair Advantage	Customer Segments
High-quality video communication often suffers from bandwidth limitations and fluctuating network conditions. Users experience significant latency during live video collaborations, which disrupts real-time communication. Manual adjustment of video parameters can be complex and time-consuming for users who want to optimize their video experience. High operational costs and energy consumption of traditional video communication platforms are unsustainable for many organizations.	Utilize 5G upload/download capabilities and edge media server gateways to provide adaptive resolution and framerate control up to 4K to conduct remote troubleshooting and maintenance of machinery. Deploy latency-critical media server components on the edge to ensure low latency video communication. Use adaptive operational policies via the NAO to maintain a sustainable NetworkApp energy consumption balance and reduce platform hosting costs while ensuring stable performance.	Deliver the best possible user experience in video live collaboration through adaptive, high-quality video resolution and framerate control. Provide real-time video statistics overlay for user-managed optimization of video settings. Offer a cost-effective and sustainable video communication platform with adaptive operational policies to balance energy consumption and performance.	Exclusive partnerships between network application developers, NAO and telecom providers. Expertise and experience of running application in 5G networks by conducting research projects.	**Target customers** Machine and plant engineering Automotive Industry 4.0 & Manufacturing

	Key Metrics		Channels	
	User engagement (number of active users, average session duration, frequency of video sessions) Video quality metrics (average resolution and framerate used, user satisfaction) Operational efficiency metrics (cost savings from operational policies)		PoCs and trials at customers' premises Dissemination at fairs and other industry events	

Cost Structure	Revenue Streams
- R&D costs - HW costs (UEs) - Service deployment and integration costs - After-sales support costs - Cloud infrastructure operation costs	- initial solution deployment and integration fee - service usage fees and/or licensing fees

Updated SWOT analysis

The SWOT analysis has been revised and no new factors that can affect the use case are found in this iteration as it was precisely defined in the previous version. The highlighted aspects, encompassing strengths, weaknesses, opportunities, and threats, have remained unchanged from the previous examination. Considering the comprehensive nature of the last release, there have been no notable alterations or fresh advancements that would require an upgrade at this moment. Hence, the current SWOT analysis remains an accurate reflection of the present circumstances.

Verdict: UC6 NetworkAppS have the capability to provide high-quality services for high-resolution and low-latency video feeds, which can reduce maintenance costs and increase machine availability. This capability paves the way for synergies with video processing algorithm owners. However, challenges such as high energy consumption, overheating, and potential data transparency issues from the end user's perspective threaten the development.

4.3.5 UC7: Crossroad control for safety for forklifts & humans

Use Case 7 offers a secure method for both forklifts and humans to navigate within interior facilities, such as factories or warehouses, while preventing collisions at blind spots and intersections. The project's architecture relies on the use of UWB anchors, which are positioning aware devices, to locate moving entities. A custom mobile phone application is used to determine the entity's location based on the RSSI values of nearby UWB tags. Additionally, a set of developed VNFs are employed to provide various functionalities, including location awareness (Location VNF at the Edge), communication channels (Message VNF at the core), collision detection (Collision VNF at the Core), storage space (Storage VNF at the Core), and digital map visualization (Mapping VNF at the Core).

LEAN Canvas analysis

Problem: The Lean Canvas highlights several critical challenges encountered by major industrial facilities, including workplace hazards resulting from forklifts, absence of real-time spatial awareness, and data deficiencies in operations management. These issues lead to higher levels of danger, inefficiencies in operations, and psychological stress among workers, because of using manual observation systems and indoor positioning systems with inadequate accuracy. It is crucial to tackle these problems to improve workplace safety and operational efficiency.

Solution: Use Case 7's solution is based on a multimodal strategy that combines sophisticated collision avoidance algorithms, a UWB positioning system, and strong big data storage capabilities for data modeling and insights. By examining real-time position data, the collision avoidance algorithm is intended to anticipate and avoid potential collisions. Based on RSSI readings from neighboring UWB tags, the UWB positioning system uses mobile phone applications and UWB anchors to precisely locate moving objects. In factories and warehouses, this exact placement is essential for keeping an eye on and traversing blind spots and junctions. Furthermore, the big data storage infrastructure makes it easier to gather and analyze large amounts of data, which leads to the creation of insightful models and insights that improve operational efficiency and safety even further.

Unique Value Proposition: The distinctive value proposition is around the exceptional precision and substantial enhancement in intelligent safety standards and worker psychological well-being. The solution's incorporation of both hardware and software components, along with the implementation of customized safety algorithms and advanced positioning systems, provides a clear and unique advantage. By adopting this holistic approach, consumers can be certain of receiving a safety solution that is both stable and scalable, while also being extremely effective. This sets the product apart from other systems that have lower accuracy.

Unfair Advantage: The UC 7 solution possesses various key advantages, such as the exclusive integration of hardware and software components and tailored safety algorithms. These components confer a distinctive technological advantage that is arduous for competitors to duplicate. In addition, the advanced design of the internal positioning system improves the overall dependability and efficiency, providing UC7 with a notable competitive edge in the market.

Customer Segments: The main target audience consists of expansive industrial establishments that own mobile machinery and employees, where safety and up-to-the-minute operational observations are of utmost importance. Whirlpool Italy's recognition as an early adopter exemplifies a focused strategy for entering the market. These facilities necessitate strong safety protocols and precise up-to-the-minute data, making them excellent candidates for the UC7 solution.

Key Metrics: The primary metrics include minimal delay and data analysis for event monitoring, which are essential indicators of the solution's effectiveness. These metrics aid in quantifying the app's efficacy in improving safety and operational efficiency. By monitoring these Key Performance Indicators (KPIs), UC7 can guarantee that the solution fulfils its performance objectives and provides concrete advantages to its clients.

Channels: The main avenues for engaging with clients consist of corporate network workshops, clustering events, organizations, and EXPOs. The selection of these channels is based on strategic considerations to successfully engage with large industrial facilities and market the product. Through the utilization of industry-specific events and networks, UC7 may establish connections with potential customers and showcase the practical benefits of the solution.

Cost Structure: The cost structure encompasses expenses related to client acquisition, distribution and hosting, equipment (including IoT hardware, network, and cabling), setup and configuration, software customisation, and training. The expenses mentioned are a result of the extensive scope of the solution and the financial commitment needed to provide a product of superior quality. Ensuring financial sustainability requires careful management of these costs in relation to revenue streams.

Revenue Streams: The income streams comprise of sales of equipment, which generate gross margins, and a Software-as-a-Service (SaaS) model, which involves licensing payments. This strategy of generating revenue from two sources simultaneously guarantees a consistent and uninterrupted cash flow, while also accommodating the diverse tastes of customers. The sale of equipment generates immediate cash, whereas the SaaS model ensures long-term financial stability and client engagement by providing recurring income through subscriptions.

Verdict: The Lean Canvas for 5G-INDUCE UC7 offers a comprehensive and strategic method for tackling safety and operational obstacles in sizable industrial establishments. UC7 is strategically positioned to have a substantial influence in the industrial sector by prioritizing high-precision solutions, utilizing cutting-edge technology, and targeting specific market niches. The comprehensive examination of each aspect emphasizes the advantages, potential obstacles, and possibilities for expansion, guaranteeing that the company model is strong and flexible to meet market demands.

Table 18: UC7 LEAN Canvas.

Problem	Solution	Unique value Proposition	Unfair Advantage	Customer Segments
Working accidents caused by forklifts Real-time location awareness of moving entities Data shortage in operations management Manual observation systems and lower-	Collision avoidance algorithm Ultra wideband positioning system Big data storage for data modelling and insights	The proposed solution offers a high level of accuracy and a significant proliferation of smart safety and working psychological standards.	The combination of hardware and software components. Custom algorithms for smart safety alongside the configuration of the internal positioning system	**Target customers** The target and ideal customers are large industrial facilities that include machinery, moving vehicles, and workers **Early Adopters** Beko (previously Whirlpool) Italy

accuracy indoor positioning systems Workers need to pay attention and, in many cases, develop tension and fear within their working environment.	**Key Metrics** The key numbers indicating the progress of our solution revolve around the KPIs of the App. Very low latency combined with data insights on incident monitoring are the major points.		**Channels** The customer target group consists of large industrial facilities. Existing corporate network, workshops, clustering events, associations, and EXPOs are the main paths to be followed for product promotion	
Cost Structure			**Revenue Streams**	
Equipment (IoT Hardware, Network and Cabling) Set up and configuration Software – Platform and Application Customization Training			Equipment selling – Equipment Gross Margin SaaS model – Licensing	

Updated SWOT analysis

Strength: The latest analysis reaffirms the enhancements in network coverage and speed offered by 5G, emphasizing its superiority over Wi-Fi and 4G specifically for asset monitoring purposes. Both the old and new strengths highlight similar aspects, however the new analysis marginally improves the emphasis on enhancement compared to earlier technologies.

Weakness: Both the old and new strengths highlight similar aspects, however the new analysis marginally improves the emphasis on enhancement compared to earlier technologies.

Opportunities: The opportunities are the same in both analyses. Both emphasize the urgent necessity for enhancing safety measures in industrial settings and the possibility of a standardized solution to tackle these concerns.

Threats: The new threats section excludes the discussion of privacy concerns and compliance with GDPR that were mentioned in the previous analysis. Excluding this information is a notable oversight since it fails to consider possible legal and ethical difficulties.

Verdict: The updated SWOT analysis offers a more precise examination of the practical elements involved in implementing and sustaining the tracking system. This includes a thorough consideration of the logistical difficulties and the importance of worker adherence to tag usage. Nevertheless, it fails to address the crucial privacy and GDPR concerns emphasized in the previous research. To guarantee a full awareness of potential threats, it is important to integrate the privacy and GDPR issues from the previous SWOT analysis into the new study. This would offer a more equitable and comprehensive assessment. In general, the new approach enhances clarity and precision, but it should be extended to encompass all pertinent facets, particularly those pertaining to legal and ethical considerations.

Table 19: UC7 Updated SWOT Analysis.

Internal Factors	
Strengths	**Weakness**
Significantly improved coverage and latency. Enhanced asset tracking compared to Wi-Fi or 4G technology. Wi-Fi can cover small areas and therefore in the case of large warehouses or industrial areas the limited coverage is a blocking factor. 4G technology, which has been used so far, exposes significantly less speed than 5G leading to less robust models in collision detection. 5G provides a better approach by eliminating these 2 blocking factors.	A minimum setup of 4 anchor devices plus a mobile gateway can cover an area of 200 square meters. Moving entities (forklifts, workers) or assets (containers) need to be equipped with UWB tags (magnetically installed or wearable), to allow the tracking of their position in the covered area. When the control area becomes large enough, the supply of the significantly high required number of UWB devices, as well as their dispersion in the area, can become a risk factor. It needs to be ensured that the workers constantly carry their tags during their shifts.
External Factors	
Opportunities	**Threats**
Safety inside large industrial sectors & warehouses is critical. The number of accidents because of blind points at crossroads involving forklifts and/or humans (workers) increases year-on-year. There is no standard way of monitoring blind spots at industrial crossroads. This sets the basis for a standard product that could be based on the outcome of UseCase7, promote industrial safety and prohibit accidents related to forklifts. Furthermore, the awareness of the locations of moving entities or assets in internal infrastructures can be utilized in a series of applications related to safety, internal asset management, internal routing, etc.	Cost could potentially become a threat in case the supply of UWB equipment becomes too high, when the controlled area is significantly enlarged and/or the number of tracked entities increases a lot. Assets tracking should be strongly analyzed regarding privacy when the assets are humans (workers moving inside the internal area). In that case proper anonymization of the location data should be provided to avoid GDPR violations.

4.3.6 UC 8 - Drone assisted network performance and coverage monitoring for industrial infrastructures

Use Case 8 utilizes continuous and on-demand monitoring modes to supervise the performance of 5G networks and the metrics related to radio coverage. This method combines extensive data analytics and reporting capabilities to offer immediate insights into the circumstances and quality of service (QoS) accessible to user equipment (UEs) linked to the network. As a result, it verifies the key performance indicators (KPIs) outlined in the service level agreement (SLA). In addition, the inclusion of monitoring equipment on a drone introduces a vertical aspect to the parameters being monitored. This allows for video streaming of the monitored facility area, which can be used to optimize the network and conduct root-cause

analysis. For example, it can help identify potential sources of interference or obstacles that may be causing signal scattering. Continuous and on-demand monitoring in industrial contexts guarantees the uninterrupted availability of vital communications and services required for essential processes to operate seamlessly, such as automated forklift operations and video-based remote control.

LEAN Canvas analysis

Problem: Existing techniques for maintaining updated radio coverage and network performance in industrial infrastructures are not able to offer automated, round-the-clock, real-time measurements and assessments on demand. This shortcoming hinders operational efficiency and dependability by making manual interventions necessary and adding time to the identification and resolution of performance problems. Furthermore, the scalability of current solutions is limited, making it difficult for them to adapt to the dynamic growth and development of industrial infrastructures. Organizations are unable to successfully scale their monitoring capabilities in unison with their operational expansion due to the difficulty of integrating new monitoring probes into the current framework. This limits the organizations' ability to respond and adapt. Furthermore, when a centralized management system is lacking, monitoring resources that are spread across several physical sites inside industrial infrastructures are subject to fragmented control. The inefficiencies in resource allocation, monitoring, and decision-making caused by this decentralized model make managing and improving network performance and coverage more difficult. The current solutions are deficient in comprehensive analytical tools, namely in spatial analysis capabilities for radio coverage data. This restriction makes it more difficult for enterprises to obtain useful insights regarding coverage patterns, trends in network performance, and possible areas for improvement. As a result, it makes it more difficult for them to proactively improve operational effectiveness and reduce risks associated with performance. Current network performance and coverage monitoring tools frequently lack orchestration features and are incompatible with cloud-based designs. This weakness prevents businesses from making use of the processing power, scalability, and flexibility that cloud platforms provide, which impedes their capacity to effectively handle, examine, and draw conclusions from real-time monitoring data. Lastly, because traditional methods of network monitoring rely on specialized hardware, they come with a high initial cost, complicated maintenance requirements, and vendor lock-in. This dependence makes it more difficult for enterprises to adopt scalable and affordable monitoring systems that are customized to meet their operational needs. It also restricts their capacity to respond quickly to new technological developments.

Solutions: A distributed network of agents that can independently conduct ongoing performance tests among themselves is used in ININ's solution. This method makes sure that network performance is thoroughly and continuously monitored across different infrastructure segments, which makes it easier to identify and fix possible problems in a timely manner. ININ's main component is a cloud-native architecture that is intended to centralize management and monitoring tasks. Our solution improves operational efficiency and scalability by ensuring the smooth deployment, scaling, and maintenance of monitoring agents across distributed systems by utilizing strong orchestration frameworks like Kubernetes and OSM (Open-Source MANO). Minimal local storage is used on the agents themselves as data gathered by monitoring agents is smoothly routed to a central location. Users have access to a range of analytical tools at the central location, which allows for in-depth real-time study and visualization of network performance parameters. Also, this approach makes use of specific probes that are mounted on drones to enable tests and measurements to be done whenever needed. Because of their sophisticated sensors and communication capabilities, these probes may be quickly deployed and used to carry out focused performance evaluations in response to user requests or operational demands. Finally, the modem capabilities of the probes are used to continuously monitor critical radio parameters. This encompasses elements like interference levels,

channel usage, and signal strength, offering important insights into radio coverage and infrastructure performance optimization potential.

Key metrics: Customers are the primary metric, representing the total number of consumers who interact with the monitoring system during a given reporting period. It offers crucial information for breaking into new markets and growing the clientele. Furthermore, monitoring the yearly development of new customer acquisitions provides priceless information on market growth paths and the effectiveness of long-term customer acquisition campaigns. It helps assess how well client retention and market outreach initiatives are working. Additionally, monitoring the quantity and patterns of customer-initiated support cases offers a thorough grasp of system stability, user happiness, and possible areas that require development. It makes it possible to proactively identify and fix persistent problems to improve the client experience. The average time needed to finish customer support cases acts as a gauge for the effectiveness and responsiveness of the support personnel. It immediately affects customer retention and satisfaction rates, demonstrating the effectiveness of support procedures. Moreover, monitoring customer-submitted requests for new features provides priceless insights into changing user preferences, industry trends, and chances for innovation and product improvement. It guarantees alignment with consumer demands and expectations and directs strategic product development efforts. Moreover, the number of probes indicates the total number of monitoring probes strategically placed throughout various physical places, reflecting the scalability and breadth of the monitoring infrastructure. It clarifies the breadth of monitoring coverage and the ecosystem's resilience. Lastly, a thorough evaluation of both operational and financial performance can be obtained by contrasting the monitoring solution's income with its operational expenditures (OPEX). It makes well-informed decisions about long-term business sustainability, profitability analysis, and resource allocation easier.

Unique value proposition: The ININ solution's unique features and primary benefits are distilled into the value propositions, which are tailored to meet the specific requirements of industrial infrastructures. This solution is an automated platform of the highest caliber, painstakingly designed to satisfy the demanding requirements of industrial settings. Its unmatched dependability and effectiveness in testing and monitoring the radio conditions and network performance of our customers' infrastructures stem from its fundamental automation. A centrally managed architecture, which guarantees continuous and round-the-clock monitoring of network performances and radio conditions, is at the core of the ININ system. By streamlining processes, improving supervision, and facilitating quick action in the case of irregularities or interruptions, this centralized strategy strengthens operational resilience and dependability. Furthermore, this system has strong data analytic capabilities which allow customers to extract meaningful insights from the massive amount of gathered data. Our analytics suite, which includes everything from coverage evaluations to performance trends, delivers unmatched depth and granularity, facilitating proactive network infrastructure optimization and well-informed decision-making. Because ININ offers customers the freedom to perform measurements and inspections on-demand, it enables users to promptly handle unexpected disruptions and emerging concerns. Because of its quick response times, there are less interruptions and downtime, which promotes smooth business continuity and increases customer satisfaction. The solution's scalability and ease of maintenance allow it to effortlessly adjust to our clients' infrastructures' changing needs and growth trajectories. ININ system scales easily, reducing overhead and optimizing operational efficiency, whether adding more locations or meeting growing monitoring requests. Finally, ININ offers its clients an unmatched value proposition by providing a compelling combination of reliable functionality and economic effectiveness. The system yields considerable cost savings and improves performance and reliability by streamlining operational workflows, eliminating downtime, and maximizing resource utilization.

Unfair advantages: To offer its clients unmatched value, ININ has deliberately created a number of unfair advantages that distinguish its solution from the competitors. These benefits strengthen ININ's position as

an industry leader and increase the effectiveness and efficiency of its product. ININ's solution's cloud-native architecture is one of its primary unfair advantages. Their unparalleled scalability, flexibility, and resilience are derived from their utilization of cloud-native principles and technology. The smooth integration of this design with cloud platforms allows for elastic scaling, dynamic resource allocation, and quick update and enhancement deployment. By utilizing a cloud-native approach, clients may fully utilize cloud computing for their testing and monitoring requirements, as the solution stays at the forefront of technical innovation. Furthermore, the exclusive usage of Commercial Off-The-Shelf (COTS) hardware components is another unique advantage of ININ's system. Because ININ uses readily available, standardized components instead of proprietary hardware, it delivers unmatched flexibility, dependability, and cost-effectiveness. This calculated move reduces the need for large upfront investments while reducing vendor lock-in, giving customers more freedom and control, and enabling easy hardware replacements and upgrades as technology advances. Their commitment to provide clients with the most value and flexibility is demonstrated by their use of COTS hardware components. Finally, the centralized control of all components, including field-based probes, is a critical differentiator of the solution. Regardless of their geographic dispersion, ININ's customers can see and handle any part of their monitoring and testing infrastructure with a single unified administration interface. By streamlining processes, increasing productivity, and making maintenance easier, this centralized approach guarantees dependable and consistent performance throughout the ecosystem. ININ provides its customers with the necessary tools to optimize resource usage, streamline workflows, and maximize operational effectiveness through the provision of centralized management capabilities.

Channels: ININ's channel development strategy is based on a wide range of platforms that are specifically designed to connect and interact with the intended audience. To demonstrate the effectiveness and value of their product to potential clients, ININ first organizes organized test and trial programs. Through hands-on experiences in replicated real-world circumstances, these campaigns give stakeholders a firsthand look at the features and advantages of our solution. ININ hopes to create confidence and trust in their solution by utilizing guided experiences and regulated conditions, which will open the door for wider adoption. As a result of the test and trial campaigns' success, ININ works with interested clients to carry out proofs of concept (PoCs) and trials on their property. Through these projects, clients can assess the way the solution fits into their operating settings and how effectively it performs. By means of intensive preparation, implementation, and assistance, ININ endeavors to provide visible advantages and understandings that connect with clients, stimulating conversion and sustained dedication. Furthermore, deliberate attempts to promote oneself on the internet and social media enhance one's online profile. By means of focused digital marketing initiatives, educational materials, and captivating social media exchanges, ININ effectively involves its audience in conversation, sharing pertinent news, announcements, and triumphant tales. They want to build deep relationships with their audience across digital platforms, promote community involvement, and increase brand awareness through engaging narrative and interactive participation. Lastly, ININ actively engages with important stakeholders by showcasing their solution at industry fairs, conferences, and events. These platforms facilitate knowledge exchange, networking, and partnership opportunities by connecting users with thought leaders, industry colleagues, and potential customers. By taking advantage of these industry conferences, ININ expands its audience, enhances its reputation, and positions itself as an innovator and thought leader in the field.

Customer segments: The product from ININ has been meticulously developed to meet the needs of a wide variety of sectors and industries, each with unique operational demands and difficulties. In order to provide customized solutions which, add real value and can establish enduring relationships, ININ strives to match the final product with the particular requirements and objectives of the target client segments. Industry 4.0 and the industrial industry, at the vanguard of digital transformation, are a key market for ININ's technology. These companies look for cutting-edge solutions to streamline production procedures, improve operational visibility, and guarantee smooth integration throughout their manufacturing ecosystems. They prioritize automation,

efficiency, and connection. Port operators work in places that are dynamic and complicated, with large areas, a variety of infrastructure, and strict operational standards. Because ININ's system offers real-time monitoring and testing capabilities specifically designed for the maritime environment, it meets the specific needs of these operators. Furthermore, to guarantee smooth operations and inventory management, warehouse facilities play a crucial role as hubs in the logistics and supply chain ecosystem. For this reason, they need reliable monitoring and testing solutions. ININ's technology provides extensive visibility into network performance and radio conditions within warehouse environments, addressing the unique problems faced by warehousing operators. Warehouse managers may optimize resource allocation, reduce downtime, and improve operational efficiency with the use of the system's real-time insights and actionable data. In addition, the agriculture industry is going through a digital revolution, with technology becoming more and more important in streamlining agricultural procedures, raising output, and guaranteeing sustainable practices. By providing customized monitoring and testing capabilities suited to agricultural environments, ININ's system meets the requirements of agricultural operations. Technology enables farmers and agricultural organizations to make data-driven decisions, maximize productivity, and minimize environmental impact—from monitoring crop health to managing irrigation systems. Finally, to support teaching, learning, and administrative activities, educational institutions—including schools, colleges, and universities—need a strong network infrastructure. The ININ system offers extensive monitoring and testing capabilities that are customized for campus contexts, meeting the unique requirements of educational institutions. The system helps educational institutions to improve the quality of education delivery, increase administrative efficiency, and offer a seamless digital learning experience for both professors and students. It does this by guaranteeing dependable Wi-Fi access and optimizing network performance.

Cost structure: The term "cost structure" refers to a number of components that are necessary for ININ's solution to be developed, implemented, and maintained in order to provide value to consumers and preserve competitiveness in the market. Research and development (R&D) investment is the cornerstone of ININ's innovation-driven strategy. These expenses go toward investigating, designing, and refining new features, functions, and technologies that improve the system's scalability, performance, and reliability. Moreover, a sizeable amount of the cost structure is allocated to the acquisition and implementation of hardware components, such as User Equipment (UEs), monitoring probes, and drones. These expenses cover buying, installing, setup, and maintenance of hardware components needed for data gathering, testing, and monitoring. Costs related to setting up, implementing, and integrating the system into clients' current infrastructure are included in the service deployment and integration costs. These expenses cover labor, consulting fees, and software customization charges necessary to fit ININ's solution to each customer's unique demands and specifications. In addition, the expenses associated with after-sales support include the resources used to provide continuous maintenance, troubleshooting, and customer assistance. These expenses cover the labor, education, and infrastructure needed to respond to client questions, fix problems, and guarantee the solution's continuous operation and performance over the course of its lifetime. Storage, bandwidth, data transfer, and cloud computing resource demands are all included in the operating costs of cloud infrastructure. In order to provide optimal performance, stability, and scalability, these expenses are necessary for hosting, operating, and scaling ININ's solution in cloud environments. The costs associated with administrative overheads, protecting intellectual property rights (IPR), and adhering to legal and regulatory obligations like the General Data Protection Regulation (GDPR) and data confidentiality rules are all included in the category of administrative and legal expenditures. These expenses consist of data security methods which aim to safeguard client data and guarantee compliance to relevant legal and regulatory frameworks, as well as legal fees and regulatory compliance activities. Finally, the resources devoted to system promotion, client acquisition, and market expansion are included in marketing and business development costs. These expenses consist of business development programs, commissions from sales, advertising, and promotional efforts that are meant to create leads, cultivate connections, and increase income.

Revenue streams: The value which ININ provides to its clients is strategically reflected in the variety of its revenue streams and the financial sources that underpin its R&D initiatives. The deployment and integration fee for the solution is one of ININ's main sources of income. Customers must pay this cost in order for our solution to be deployed and integrated into their current infrastructure. It includes labor expenses, consulting fees, and software development costs that are required to customize ININ's technology to each customer's unique demands and specifications. The resale margin obtained from third-party components included in the solution is another source of income for ININ. The difference between the price at which these parts are resold to clients as part of the integrated solution and their acquisition cost is represented by this margin. Furthermore, NIN's licensing and service usage fees are a major source of income, especially for continuous software licensing and service providing. Depending on the type of software or service offered, these costs may be assessed on a subscription or per-use basis. Lastly, the research and development (R&D) funds from the EU and the national government provide ININ with funding for their innovation and R&D projects. The funds are distributed to support their efforts in creating innovative technologies, improving the offerings of solutions, and promoting industry innovation through competitive grants, subsidies, or other financial sources.

Verdict: The Lean Canvas for UC8 presents a well-thought-out business model that addresses critical industry pain points with innovative, scalable solutions. The comprehensive approach to metrics, value propositions, and unfair advantages positions UC8 strongly in the market. The detailed cost structure and diverse revenue streams further enhance its viability and sustainability. Overall, UC8 Lean Canvas demonstrates a strong potential for success in the industrial infrastructure monitoring space.

Table 20: UC8 LEAN Canvas.

Problem	Solution	Unique value Proposition	Unfair Advantage	Customer Segments
To provide automated 24/7 real-time and on-demand measurements of network performance and radio coverage for multiple physical locations To enable scalability in terms of (easily) adding new monitoring probes Central management of the solution To provide analytical tools, including spatial analysis for radio coverage data	Concept of multiple agents performing continuous (performance) tests among themselves Centralized cloud-native solution with orchestration support (Kubernetes, OSM) Data from agents are forwarded to central location (while agents still have limited local storage) where multiple analytical tools are available for the user - using probes installed on drones for on-	Industry-grade automated, centrally managed solution for 24/7 monitoring and testing customer's network performances and radio conditions in the (3D) space. Provides data analytic tools for collected data, on-demand measurements, and inspection of sudden interruptions. Highly scalable, easy to maintain and cost effective.	The solution is designed as a cloud-native COTS HW components used only Central management of all components (incl. probes located in the field)	**Target customers** Industry 4.0 / Manufacturing (Sea) Port operators Warehousing Agriculture Educational institutions

Cloud-compatible and orchestrate-able solution No specialized HW required **Existing Alternative** Up to date solutions are mainly less scalable and don't provide automated on-demand measurements. They usually lack cloud-centric support and are not orchestrate-able.	demand tests and measurements - radio parameters monitored by facilitating probe's modem capabilities **Key Metrics** Number of customers Number of probes deployed Yearly trends of new customers Number/trends of support cases opened Average time of solving support case Number/trends of new feature requests Revenue generated vs. OPEX		**Channels** Test and trials campaigns PoCs and trials at customers' premises web and social media promotion Dissemination at fairs and other industry events	

Cost Structure	Revenue Streams
R&D costs HW costs (UEs, probes, drone) service deployment and integration costs After-sales support costs Cloud infrastructure operation costs Administrative and legal costs (IPR, potential GDPR and related data confidentiality issues) Marketing, business development costs	Solution deployment and integration fee Resale margin for 3rd party components Service usage fees and/or licensing fees EU and national R&D funds

Updated SWOT analysis

Strengths: The updated strengths primarily emphasize the technical and practical aspects of implementing the solution, with a particular focus on the orchestrator's role, cloud-native techniques, and analytical tools. Additionally, there is a deliberate emphasis on market positioning and forming strategic partnerships. Conversely, the previous advantages emphasize the overall advantages and characteristics such as improved potential for use and novel services, without further exploring the exact methods by which they are accomplished.

Weakness: Both the new and old vulnerabilities recognize the significant capital expenditures and the willingness of users to embrace emerging technologies. Nevertheless, the newly identified vulnerabilities provide precise information regarding the intricate nature of maintenance and the restricted accessibility of UEs for Stand-Alone operation. This offers a more distinct understanding of the potential difficulties in adopting the technology.

Opportunities: The new opportunities highlight specific verticals, such as manufacturing, and emphasize collaboration with consortium partners for future projects. This detailed, targeted approach contrasts with the broader and more general opportunities mentioned in the old analysis, which focus on global expansion and brand strengthening.

Threats: The new threats offer additional information regarding the regulatory obstacles, specifically addressing safety and security regulations imposed by potential clients, as well as restrictions on drone flights and the utilization of frequency spectrum. The previous threats are of a broader nature, specifically targeting obstacles in the market and regulatory demands within certain regions.

Verdict: The updated SWOT analysis provides a more comprehensive and subtle perspective on the strengths, weaknesses, opportunities, and threats in comparison to the previous version. It offers more profound understanding of technological elements, market placement, and distinct industry obstacles and possibilities. The focus on cooperation, particular sectors, and regulatory specifics enhances the practicality and strategic nature of the new analysis. The updated SWOT analysis comprehensively encompasses the various dimensions of the NetworkApp solution's market positioning and operational dynamics. The comprehensive analysis of strengths, weaknesses, opportunities, and threats offers a precise plan for utilizing advantages, tackling obstacles, and maximizing growth prospects. This thorough examination places the organization in a favorable position for strategic planning and decision-making, guaranteeing its ability to handle the intricacies of the 5G and industrial infrastructure industries with flexibility and anticipation. The company is well-prepared to stimulate expansion and sustain a competitive advantage in a changing industrial environment by prioritizing technical innovation, market partnership, and regulatory compliance.

Table 21: UC8 Updated SWOT Analysis.

Internal Factors	
Strengths	**Weakness**
Role of the orchestrator and underlying functionalities for organizing network components, enhancing scalability, and reducing instantiation and reconfiguration times. Cloud-native approach supported by the 5G-Induce platform and testbeds for simplified application development and testing. Inclusion of various analytical tools, including spatial analysis of radio coverage data. Cost optimization benefits. Acquisition and deepening of specific know-how, aiding market positioning and new partnerships.	Significant investments required for 5G networks. Technical complexity of network and virtualization infrastructure maintenance, potentially delaying 5G adoption. Learning curve associated with new technologies. Limited availability and functionality of UEs for Stand-Alone operation.

External Factors	
Opportunities	**Threats**
Cost optimization and global standardization of 5G enabling business expansion. Promising potential in the manufacturing vertical with the highest number of deployed NPN networks. Growth opportunities in other verticals with a high compound annual growth rate. Collaboration with consortium partners and dissemination activities to create future R&D and commercial projects.	Specific regulatory requirements in different regions. Safety and security regulations enforced by different companies. Limitations related to drone flights and frequency spectrum usage

5 Market Potentials and opportunities

The business analysis uncovers the crucial functions of two cutting-edge resources within the 5G-INDUCE platform: the NAO and the OSS. These assets are crucial for the development and operation of NetworkApps, which are distinguished by their distinctive traits and innovations that promote the establishment of a stable and forward-looking ecosystem. The NAO and OSS enable this unique ecosystem, which serves as a strong foundation for the growth and long-term viability of 5G-Induce technologies.

Similarly, the market study reveals a substantial demand for these cutting-edge technologies, suggesting promising prospects for their utilization and monetization. The strong demand for these technologies highlights their capacity to efficiently fulfil market requirements and provide significant economic worth.

The partnership, headed by the technical leaders of the 5G-INDUCE project, has been provided with strategic routes and approaches. These strategies aim to utilize their technology developments to support the process of bringing products or services to market, improve the range of services they offer, and encourage additional growth and research. Each member of the consortium possesses customized plans that allow them to optimize the potential of their ideas, whether by entering new markets, expanding their service offerings, or continuously doing research and development to improve and enhance their goods.

A key factor that will determine the business model transformation associated with the exploitation of the developments undertaken by 5G-INDUCE is which market player will assume the role of NetworkApps Orchestrator/OSS. Given this dynamic market environment, will it be the Network Operator? An offering provided by a System Integrator or a specialized NetworkApps Orchestrator provider? Another possibility is that this role can be fulfilled by a collaboration among 5G-INDUCE partners or a spin-off stemming from the consortium.

Another decision to consider is whether the NAO should be commercialized independently or become integrated to existing service offerings. Below there is a table with the pros and cons of integrating a new venture and for keeping independent.

Table 22: Pros and Cons of integrating a new venture and for keeping independent.

Integrating a new venture	Keeping a new venture independent
• Can take advantage of existing mature processes and operator scale (e.g. distribution channels) • Can leverage existing skills either in-house or externally (established vendors and partner agreements) • Access to an existing customer base • Less likely to be considered a parasite or threat by the core business so unlikely to be ignored or killed off - easier to get broad management support	• Enables unique (agile) processes to be developed quickly and for new KPIs to be used to measure success outside the mainstream telco ones. E.g. less reliance on CapEx-based KPIs such as EBITDA margins and less restrictive ROI hurdles • Stronger sense of focus and greater clarity over strategy and performance from management working in the new venture and management outside providing support and funding to it • Perceived independence from core business makes it easier to provide services to other operators

5G presents CSPs with a unique opportunity, but to monetize 5G at scale, CSPs must ensure that their operational and business support systems can meet four main requirements. First, they need to orchestrate and deliver complex solutions that span different types of networks (e.g., 4G, 5G, Fiber) and various sources of services (e.g., Edge, AR, VR), while effectively managing the challenge of dynamic 5G service activation. Second, CSPs must have flexible charging and monetization capabilities that enable them to charge for any event, unit of measurement, or characteristic, and to bundle and price offerings from network slicing and consumer IoT to industrial IoT solutions. Third, the development of partner ecosystems is crucial, enabling CSPs to co-invent and co-create joint 5G solutions with multiple third parties that better fit customer needs. The final requirement is the increased operational agility and speed which can be achieved with cloud-native solutions. Operators/CSPs can utilize the developments of 5G-INDUCE to become B2B2X enablers with quick onboarding of innovative value-added applications for any targeted vertical partner.

6 Conclusion

The 5G-INDUCE project has successfully demonstrated the potential of 5G technology to revolutionize various industrial sectors through the development and deployment of advanced Network Applications (NetworkApps). By leveraging the capabilities of 5G, such as ultra-low latency, high reliability, and scalability, the project has showcased significant advancements in Industry 4.0 applications, including autonomous indoor fleet management, smart AGV operations based on human gesture recognition, VR immersion for AGV control, indoor fleet management, AR remote maintenance and UAV inspection and surveillance.

The project's innovative approach to 5G orchestration and network slicing has enabled seamless integration and management of NetworkApps, providing a flexible and efficient framework for industrial automation. Through collaboration with various stakeholders, including MNOs, industries, system integrators, and SMEs, the 5G-INDUCE project has created a robust ecosystem for the development and commercialization of 5G solutions in various verticals.

In conclusion, the 5G-INDUCE project has made significant strides in advancing 5G technology and its applications in industrial settings. The project's outcomes highlight the transformative potential of 5G in enabling smarter, more efficient, and resilient industrial operations, paving the way for future innovations and market opportunities in the 5G landscape.

Appendix

Table 23: Identified Background Assets.

#	Name	Short Description	Partner	Type of Protection
1	Cloud Packet Core	Ericsson Cloud Packet Core platform is fully deployed at 5TONIC and offered to 5G-INDUCE project. 5G-INDUCE may bring new inputs and learnings, based on the specific use cases' scenarios and demands, for consideration in its evolution strategy and roadmap for products and services	ERC	Copyright
2	Ericsson NFVI	Ericsson NFVI solution consists of software and hardware products as well as support and system integration services forming a complete solution for telecom operators. 5G-INDUCE project motivates a more complete deployment bringing new insights for its evolution at HW, SW and services levels.	ERC	Copyright
3	MATILDA OSS/BSS	Vertical-oriented OSS/BSS system supporting numerous functions that have direct business value to OTT players. System solution to be based on MATILDA OSS/BSS and extend towards open interfaces with standardised ETSI MANO and in support of distributed multi-tenant operation for both Application and Network Functions	Consortium	Open Source (BSD license)
4	MATILDA network slice intent and instance metamodels	The network slice instance, intent and slice metamodels, as specified by MATILDA, will be adopted and extended within WP2 in order to fit the 5G-INDUCE network slice definition.	UBITECH, CNIT	Copyright
5	NetworkApp Application Orchestrator	Orchestrator for application deployment over containerized and multi-cloud execution realms following the provisioning of network slices. It includes the provisioning of graphical interfaces for connected users or service deployment brokers and dashboard for network operator managers with advanced analytics. Extended with NetworkApp API for porting of new services through a friendly UI.	UBITECH	Copyright
6	NetworkApp Graph composer	The graph composition is currently performed manually. The new tool will include automated features as well as capabilities to combine previous graph compositions from related NetworkApps.	UBITECH	Copyright

#	Name	Short Description	Partner	Type of Protection
7	UWS Flow Control Agent	FCA is a distributed SDN controller that is not invasive with other SDN controller (e.g. OpenDayLigth, ONOS, OpenStack Neutron) and provides network slicing for 5G end-users over a multi-tenant network infrastructure	UWS	Copyright
8	Docker stack and Kubernetes	5G-INDUCE will package and support "dockerized" services, extending descriptions for multi-objective policy definition based on open topology-aware specifications, and overcome Kubernetes limitations by developing novel and efficient algorithms for multi-tenant orchestration and trust management across NetworkApps.	Consortium	Open Source
9	Oculavis SHARE	Oculavis SHARE and all existing features and modules of the software platform will serve as a basis for all developments with respect to the research results. After the project, all newly developed algorithms or deployment procedures will be commercialized on the basis of Oculavis SHARE.	OCULAVIS	Copyright
10	Tribot AGV	Tow AGV with a capacity from 3 to 10 Tons prepared for indoor and outdoor operation. Towing AGVs are used for pulling trolleys one by one or in logistic trains, typically used in the automotive sector. It will be used in the AGVs use case.	ASTI/ABB	Copyright
11	EBOT AGV	Small platform AGV to transport around 350Kg only prepared for indoor environments. Omnidirectional AGV to carry loads on top. With its low height and lifting table, they can go under most load carriers and transport them to their destination. They can be also equipped with a roller system to pick up or deliver on traditional conveyors. It will be used in the AGVs use case.	ASTI/ABB	Copyright
12	SIGAT MULTIAGV	SW AGV fleet management system. It will be modified in the AGV use case	ASTI/ABB	
13	SIGAT MULTIAGV	SW AGV fleet management system. It will be modified in the AGV use case	ASTI/ABB	Copyright

#	Name	Short Description	Partner	Type of Protection
14	AGVs movement NetworkApp	Fivecomm has an initial software to integrate AGVs execution movements through the 5G network, this software will be updated to integrate the specific needed requirements to achieve the connected AGVs, management and operation use case. This NetworkApp will be demonstrated in a real industrial environment thanks to the collaboration with ASTI	5COMM	Copyright
15	Gesture recognition NetworkApp	Fivecomm along with Gestoos will develop a gesture recognition software, thanks to this NetworkApp the AGVs will be controlled by human gestures and actions. This NetworkApp will have two different parts, on one hand, Gestoos will adapt their AI software of human gestures recognition to the use case. On the other hand, 5CMM will integrate it into the Valencia 5G facility so that the use case will be showcased in a real industrial scenario.	5COMM	Copyright
16	VR immersion on the AGVs NetworkApp	YBVR in cooperation with Fivecomm and ASTI/ABB will develop and integrate into the Valencia 5G experimental facility a VR immersive application, with it, the operator will have a real experience over the AGV control. This NetworkApp will be demonstrated in the Valencia 5G experimental facility	YBVR, 5COMM	Copyright
17	YBVR Direct VR streaming	YBVR Direct VR solution will perform between 1 to 5 seconds latency for video VR streaming. It can be used as a starting point for selected audiences	YBVR	Copyright
18	qMON PNF agent monitoring	qMON agent component for active e2e performance monitoring and QoS/QoE evidence collection is used for the 5G infrastructure performance monitoring UC8.	ININ	Copyright
19	iMON drone-based video streaming	iMON solution extended with the drone-based video streaming component is used when required to capture and process real-time video for monitoring purposes.	ININ	Copyright

#	Name	Short Description	Partner	Type of Protection
20	UWS TRex Android App	TRex is a Mobile App that: A) provides UAV real-time control capabilities to UAV operator. B) provides advance AI capabilities over the video feed for realtime detection of people. UWS leverages this technology to be split and ported to NetworkApp execution environments and thus train the algorithm for the purpose of the use cases being led by UWS (pipe inspection)	UWS	Copyright
21	vIDS	vIDS is a NIDS uses signature and scripting based detection to examine network traffic, identify threats and provide IPS functionality via a separate NFV (L3 Filter). Threat detection and events can be sent upstream to a SIEM for analytics.	8BELLS	Open Source

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