KEYSTONE

Digital ecosystem framework

Deliverable 1.4

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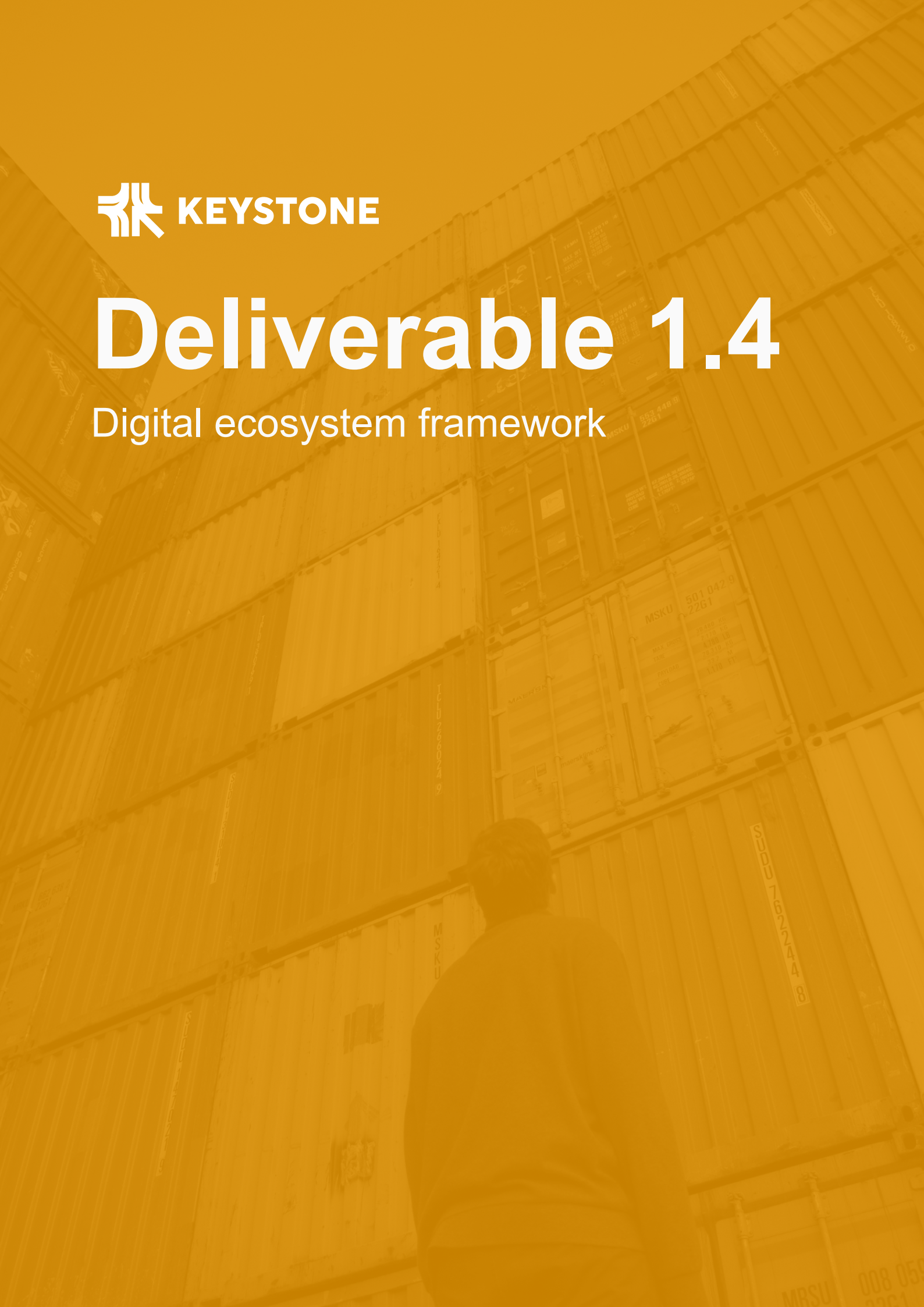

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Acronyms

Acronym	Meaning
EC	European Commission
WP	Work Package
KPI	Key Performance Indicator
SMART	Specific, Measurable, Archivable, Realistic, Time-bound
PCS	Port Community System
TMS	Transport Management System
API	Application Programming Interface
DTLF	Digital Transport and Logistics Forum

Document History

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V0.2	05/03/2024	Paulo Cantillano	UNIMORE/ICOOR	Evaluation Framework
V0.3	29/03/2024	Charilaos Koutsis, Zoi Petrakou	AETHON Engineering	Plug and Play and API Standardisation
V0.4	04/04/2024	Sabino Metta	Cefriel	Summary of WP1 - Theoretical Foundation; Key Insights from Focus Groups, Interviews, and Surveys
V0.5	10/04/2024	Davide Maestroni	T-Bridge	Deliverable 1.3 - Theoretical Framework
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V0.7	15/04/2024	Andrea Mutti	T-Bridge	Use Cases diagrams
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1. Executive Summary

Deliverable 1.4 bridges theoretical insights from Work Package 1 (WP1) with practical implementations foreseen in Work Package 4 (WP4). The focus is to intiate the development of scenarios within KEYSTONE that can help optimize multimodal and monomodal transportation while also facilitating regulatory compliance.

The digital ecosystem examined during WP1 and in this Deliverable involves different stakeholders, including private companies, public entities, regulatory bodies, transportation and logistics operators. Central to this ecosystem are interoperable platforms, standardized protocols, and data exchange mechanisms facilitated by IT systems such as the Port Community System (PCS), Transport Management Systems (TMS), and Terminal Operating Systems (TOS). These components are essential for facilitating seamless integration across different transport modes, enhancing operational efficiency, and ensuring adherence to regulatory standards.

The deliverable also includes the outline of two use cases, that will be further shaped and developed in later work packages. The use cases have also been used to discuss several critical findings. For instance, the first use case demonstrates the integration of multimodal transportation, where an intermodal rail shipment seamlessly transitions to road transport, through processes managed by private entities. KEYSTONE intends to play a crucial role in optimizing data flow across diverse transport modes, thereby minimizing redundancy in enforcement checks and improving overall operational efficiency.

In the second use-case scenario the focus is on monomodal transport, it examines how road transport transitions to maritime operations at ports, overseen by port authorities through systems like PCS. KEYSTONE aims to facilitate pre-arrival notifications and enable seamless data sharing between TMS and PCS, thereby optimizing logistical processes, ensuring regulatory compliance, and enhancing operational transparency within the transport sector.

A list of Key Performance indicators has also been identified in the deliverable to help the future evalauation of usecases and the results that will be developed in the KEYSTONE project. This has been done on the basis of literature review and stakeholder interactions organized during the inception phase of KEYSTONE, notably the workshop held in Brussels in December 2023 as well as surveys and interviews conducted within the framework of Task 1.1, 1.2 and 1.3.

Deliverable 1.4 also leverages visual representations in clarifying complex interactions between entities and systems within the transport ecosystem. These graphical depictions aid in illustrating data transitions and enhancing operational transparency, supporting informed decision-making and effective system integration.

Looking ahead, the insights and use cases presented in Deliverable 1.4 serve as foundational elements for future phases in Work Package 2 and Work Package 4 of the KEYSTONE project. Furthermore, the deliverable also emphasizes the role of Work Package 5 in establishing an evaluation methodology to assess the outcomes and impacts of the project's solutions. The Deliverable shows how, by bridging theoretical research with practical applications and evaluation, the KEYSTONE project aims to foster innovation, streamline logistics, and promote enhanced collaboration among stakeholders across the global transport industry. Future iterations will build upon these findings to refine the KEYSTONE solution, helping them to maximize efficiency gains, and further advance digitalized transport ecosystems worldwide.

2. Introduction

2.1. Background

In comprehending the foundational underpinnings of this deliverable, it becomes imperative to harmonize it intricately with the overarching objectives inherent in the project's characteristics.

These objectives are not mere aspirations; rather, they represent a collective vision to forge a digital ecosystem that seamlessly interconnects all facets of the logistics realm. Within this ecosystem, the inclusion of every logistics operator, from shippers to carriers, freight forwarders to customs brokers, is pivotal. The aspiration is to create an environment where these entities can effortlessly interface with one another's systems sans the need for cumbersome ad hoc connections. This endeavour is facilitated through the standardization of Application Programming Interfaces (APIs) and plug-and-play technology, thereby facilitating direct data transmission sans any redundancy or duplication.

It is incumbent upon us to elucidate from the very outset that our endeavour does not aspire to birth a novel platform per se. The recent trend in the realm of platform creation, though prevalent in numerous European initiatives, has undergone a transformative shift. Rather than embarking on the creation of standalone platforms, the focus has shifted towards fostering a harmonious interplay between existing platforms. This shift in perspective emphasizes the paramount importance of standardizing dialogue amongst platforms, thereby obviating the need for users to grapple with the complexities of interacting with multiple systems.

The overarching objective of our initiative, particularly underscored within this current chapter, is to cultivate an ecosystem characterized by a plethora of interconnected entities and their respective systems. The domain of logistics serves as a fertile ground for the cultivation of such initiatives, owing to the perpetual exchange of data amongst a myriad of operators traversing the supply chain spectrum. From the producers to the end consumers, and even preceding production with inbound logistics, the continuous flow of data permeates every echelon of the logistics landscape.

The concept of KEYSTONE in logistics is not only apt but also indispensable, given the sector's proclivity towards a voluminous array of transactions between one user and the next. Thus, the decision to forge ahead with the implementation of a digital ecosystem wherein all stakeholders in the logistics milieu can connect and transmit data in a standardized fashion holds profound significance. Preceding endeavours, exemplified by the FENIX[1] and FEDeRATED[2] projects, have laid a solid foundation for our current initiative. Each of these endeavours has contributed invaluable insights and fragments towards the overarching objective of digitizing logistics and streamlining the exchange of information through cohesive data ecosystems.

KEYSTONE, in essence, epitomizes a natural progression from these antecedent initiatives, encapsulating and refining the core tenets they introduced. Prior experiences have been steeped in the meticulous delineation of stakeholder needs, the implementation of governance structures, prioritizing requirements, and a meticulous study of extant digital platforms to discern potential lacunae. Our current task is poised at the juncture of synthesizing this theoretical groundwork with the practical exigencies to be encountered within the project's execution.

This heralds a paradigm shift from the realm of abstract theorization to pragmatic implementation, wherein theoretical constructs transmute into tangible action items. The enlistment of Gruber Logistics, a stalwart in the transport and logistics domain, as a strategic partner for this phase underscores our commitment towards

[1] https://fenix-network.eu/
[2] https://www.federatedplatforms.eu/

practical realization. Insights gleaned from both public and private vantage points have engendered a holistic comprehension of the logistical landscape. The ongoing phase is dedicated to honing this understanding, discerning the unique exigencies, characteristics, data typologies, and operator profiles embedded within each sector.

In summation, our project finds itself fortified with a trove of data, insights, and conceptual frameworks to propel it forward. The onus now squarely rests on effectuating these insights, transmuting them into actionable initiatives that actualize the potential for innovation within the logistics domain.

2.2. Objectives of the Deliverable

The objectives of this task and its ensuing deliverable are manifold, encompassing a multifaceted approach to distilling and operationalizing knowledge garnered over several months of rigorous exploration.

At the outset, it is imperative to reiterate our primary aim, which is to synthesize the vast array of information accumulated during the initial theoretical phase and the collaborative efforts of our esteemed partners in preceding tasks. This wealth of knowledge serves as the foundation upon which we seek to build practical insights, laying the groundwork for the operationalization of the KEYSTONE system.

Our journey begins with a meticulous examination of stakeholders' needs and the identification of prioritized requirements for Keystone implementation. Through comprehensive analysis, we scrutinize existing platforms within the European market, spanning both public and private sectors. This phase is critical as it enables us to pivot towards proposing tangible solutions that address real-world challenges. By presenting genuine use cases, we aim to vividly illustrate the innovative potential embodied by KEYSTONE in diverse scenarios.

It is essential to recognize the dual perspective from which we approach this endeavour, viewing it through the lenses of both public and private entities. Central to the KEYSTONE project is the aspiration to foster interoperability between private systems and those of public administration, particularly within law enforcement agencies. Employing a metaphor, one could liken KEYSTONE to the “keystone” supporting the architrave of an arch, symbolizing its “key” role in facilitating a comprehensive and reality-aligned logistical process.

This task and its corresponding deliverable serve as a platform to explore the intricate interactions between KEYSTONE stakeholders and the transport systems under analysis. Our objective transcends a simplistic dichotomy between public and private sectors; instead, we aim to unravel the complex web of interactions and elucidate the symbiotic relationship wherein the needs of one realm facilitate the provision of data by the other.

Within this digital ecosystem, perspectives vary, but our endeavour is to interconnect them, eschewing compartmentalization in favour of a holistic analysis of potential interactions. By leveraging insights generated from previous endeavours, including focus groups, reports, strategies, and plans, we seek to illuminate the pathways through which these realms intersect and collaborate.

The structure of the deliverable reflects our comprehensive approach. It will comprise several sections, each contributing to a nuanced understanding of the subject matter. Initially, we will provide an overview of achievements within Work Package 1, setting the stage for subsequent discussions. Following this, we will delve into evaluative strategies aimed at gauging the efficacy of proposed solutions.

The heart of the deliverable lies in the operational phase where KEYSTONE takes root. Here, we will present concrete use cases that illustrate the intricate interactions between public and private sectors. These

scenarios will depict how a logistics operator's transport mission interfaces with enforcement authorities, showcasing the seamless integration facilitated by the KEYSTONE framework.

This document delves into perspectives, exploring what various stakeholders expect regarding the topic of data sharing. Each party perceives it differently; when discussing data sharing, each entity considers its own interests. The intriguing aspect lies in investigating the interests of these diverse stakeholders. For instance, a public entity may desire data sharing for one reason, while a private entity may have entirely different motivations. Understanding how these interests align or conflict is crucial. This will be solved by conducting an analysis. It's possible that private and public use cases can coexist, especially if there are positive examples illustrating this synergy.

In conclusion, we will draw upon our analyses to derive meaningful insights that inform the most effective mechanisms for practical implementation aligned with the project's overarching objectives. Through this iterative process of exploration and synthesis, we aim to contribute towards the realization of a more interconnected and efficient digital ecosystem, epitomized by the KEYSTONE system.

2.3. Overview of Work Packages 1, 4 and 5

This activity, along with its resulting deliverable, can be seen as a bridge between multiple work packages within this project. Specifically, we are currently situated within Work Package 1, which is still primarily theoretical in nature. It will be in WP4 where the identified use cases will be analyzed and brought to fruition, through real shipments in the pilot actions. WP5, on the other hand, will conduct the necessary evaluations regarding the solutions studied. It is for this reason that this paragraph provides an overview of these three work packages, to understand how they are interconnected with the activity under analysis.

WP1, led by Coventry University, serves as the foundational phase of the KEYSTONE project, focusing on conducting a comprehensive gap analysis and assessing the current state of digitalized transport ecosystems. The overarching objectives of WP1 are multifaceted, aiming to identify, map, and analyze stakeholders, understand their needs and challenges, define requirements for the KEYSTONE solutions, and establish secure interactions within transport ecosystems.

To achieve these objectives, WP1 undertakes several key activities. These include stakeholder mapping and analysis, which involves conducting literature reviews, policy assessments, and targeted surveys to gain insights into the diverse range of stakeholders involved in digitalized transport ecosystems. By engaging with stakeholders, including industry players and enforcement authorities, WP1 aims to understand their readiness to adopt new data-driven business models and their specific requirements for digitalized transport solutions.

Additionally, WP1 involves the generation and prioritization of requirements for the KEYSTONE solutions through focus groups and the analysis of existing digital platforms. This process helps identify gaps between current offerings and stakeholder needs, thereby informing the development of tailored solutions that address specific challenges in the transport ecosystem.

Overall, WP1 serves as the cornerstone of the KEYSTONE project, laying the groundwork for subsequent phases. By conducting a thorough gap analysis and understanding the state of the art in digitalized transport, the project can proceed with confidence, knowing that its objectives are rooted in the realities of the industry.

WP4, led by Gruber, marks the transition from analysis to action, focusing on the practical implementation of the KEYSTONE solutions through pilot demonstrations. Building upon the insights gathered in WP1, the primary objectives of WP4 are to develop and apply demonstration scenarios that showcase the capabilities of the KEYSTONE solutions in real-world settings.

To achieve these objectives, WP4 undertakes a series of tasks. These include a comparison of existing enforcement procedures, the definition of demonstration scenarios for road transport and intermodal operations, and the creation of digital ecosystems that facilitate automatic data sharing among stakeholders. By collaborating with enforcement authorities and logistics operators, WP4 aims to streamline operations, improve efficiency, and enhance compliance with regulations.

One notable aspect of WP4 is its emphasis on practical implementation and operational feasibility. By designing and executing pilot demonstrations, the project can validate the effectiveness of the KEYSTONE solutions in addressing real-world challenges. This hands-on approach not only provides valuable insights for further development but also fosters collaboration and knowledge exchange among stakeholders.

In summary, WP4 bridges the gap between theory and practice, demonstrating how the concepts and technologies developed in earlier phases can be applied in operational contexts. Through pilot demonstrations, the project aims to showcase the tangible benefits of digitalized transport ecosystems and pave the way for broader adoption across the industry.

WP5, led by ICOOR, focuses on evaluating the outcomes of the KEYSTONE project and addressing ethical, legal, and social implications. The primary objectives of WP5 are to establish an evaluation methodology, respond to ethics requirements, conduct impact assessments, and develop guidelines for stakeholders.

To achieve these objectives, WP5 undertakes a range of tasks. These include the development of an evaluation methodology and plan, the assessment of impacts using methods such as cost-effectiveness analysis and analytic hierarchic process, and engagement with stakeholders to ensure alignment with industry standards. Additionally, WP5 addresses ethical considerations by conducting impact assessments and establishing an ethics advisory board comprised of external experts and consortium partners.

One critical aspect of WP5 is its focus on ensuring that the project's outcomes adhere to ethical, legal, and social standards. By conducting rigorous evaluations and impact assessments, the project can identify potential risks and mitigate them proactively. Furthermore, the development of guidelines and policy recommendations helps to ensure that the benefits of digitalized transport ecosystems are realized in a responsible and sustainable manner.

In conclusion, WP5 plays a crucial role in ensuring the success and sustainability of the KEYSTONE project. By addressing ethical, legal, and social considerations, the project can build trust among stakeholders, foster responsible innovation, and maximize the positive impact of digitalized transport solutions.

All three work packages emphasize collaboration among consortium partners and engagement with stakeholders. By involving a diverse range of actors, the project can ensure that its outcomes are relevant and impactful.

Each work package spans multiple months, reflecting the long-term nature of the project. This extended timeframe allows for thorough analysis, iterative development, and comprehensive evaluation of the KEYSTONE solutions.

While WP1 lays the groundwork and WP5 evaluates the outcomes, WP4 focuses on practical implementation through pilot demonstrations. This holistic approach ensures that the project progresses from concept to execution, ultimately delivering tangible benefits to the transport industry.

Ethical, legal, and social considerations are integral components of each work package. From stakeholder engagement to impact assessments, the project takes a proactive approach to address potential risks and ensure compliance with relevant regulations and standards.

In summary, the three work packages of the KEYSTONE project - WP1, WP4, and WP5 - complement each other in addressing the complexities of digitalized transport ecosystems. Through collaboration, innovation, and a focus on ethical and legal considerations, the project aims to drive positive change and pave the way for a more efficient, resilient, and sustainable transport industry.

3. The theoretical foundation of WP1

3.1. The workshop held in Bruxelles on December 2023

The “Keystone: Sharing Knowledge” workshop took place in Brussels on 7 December, as part of the European Keystone project

Aligned to the theme of the project, the theme of the workshop was the so-called "data sharing" or the sharing of data by transport and logistics users in order to speed up operations, automate them and make the supply chain more efficient.

The aim of the workshop was to transfer as much as possible the knowledge accumulated in recent years in other European projects already concluded on the same topic within the new initiative, mainly FENIX and FEDeRATED.

After the introduction by Andrea Condotta, Gruber Logistics Director of the Public Affairs, Innovation and Sustainability area, by the representatives of the CINEA[3] agency Katerina Deliali, Pablo Perez-Illana and Marjolein Salens, the latter Project Officer of the Project, Prof. Mauro Dell 'Amico of Unimore introduced the Keystone project to those present, made up of the project partners plus Gruber Logistics colleagues Gunther Erb and Greta Sartori.

Jef Bauwens, from the Belgian Ministry of Transport, helped the partners to better understand the concept of "plug and play", fundamental in initiatives of this type, while Wout Hofman from TNO recounted the salient experiences of the FEDeRATED project, especially in the context of semantics, to be able to transmit one's knowledge to the protagonists of Keystone.

Immediately afterwards Eusebiu Catana of Ertico[4] illustrated the other completed project, FENIX, showing how it was possible in that context to obtain the so-called "platform ecosystem" which is also one of the objectives of Keystone itself.

Finally, Tomas Ambra from Alice explored the topic of data sharing in the physical internet.

In the afternoon, the frontal session became interactive: two round tables, moderated by Fabrizio Borgogna of Gruber Logistics and Mauro Dell'Amico from ICOOR, explored on one hand the theme of digital ecosystems starting from two different points of view, namely the public one and the private. On the other hand, the participants tried to understand, based on the experiences of the two completed projects, what the expectations could be towards Keystone, to try to capitalize on this experience as much as possible.

After a wrap up of the two discussions, space was given to the final greetings, ensuring that Keystone will try as much as possible to take up the baton of what has been done so far and try, why not, to also add some more ideas for innovation.

[3] https://cinea.ec.europa.eu/index_en
[4] https://ertico.com/

3.2. Key Insights from Focus Groups, Interviews, and Surveys

To collect needs, requirements, and expectations of targeted stakeholders, a survey has been designed and implemented, see "D1.1- Stakeholders' identification and needs"[5]. The main goal of the survey has been to identify relevant needs and obstacles that currently affect the controls performed by enforcement authorities on road cross-border logistics. In particular, the survey was aimed at investigating which kind of data are shared with enforcement authorities and between actors involved in transport operations, which tools are used to exchange data and the current integration of national platforms with the European platforms.

Almost all respondents agree that data and technology play a pivotal role in improving and enhancing compliance checks. Only some respondents of the category of "Logistic operator" disagree and indicated as barriers the complex legislation, the cooperation between member states, the geo-political context (e.g., non-EU borders, Brexit, uncertainty of regulations, different languages), and the type of shipping (dangerous or perishable goods, project cargo).

Around 60% of freight terminals and logistic operators say that they share data with enforcement authorities. According to the answers of the freight terminals, the main barrier for data sharing (both with authorities and other actors) is the lack of suitable tools. On the other hand, the main barrier for logistic operators is confidentiality and competition factors. The lack of a suitable digital tool is a challenge for logistic operators as well. They do not share data because it is not mandatory, and they do not have explicit benefits and incomes.

The responses to the survey highlight that no unique platform (national and/or international) exists. Stakeholders can adopt emails, in-house software and/or commercial tools. Indeed, all stakeholders who have completed the survey are aware of the importance of data and its exchange for enhancing business opportunities. 85% of enforcement authorities, 71% of freight terminals, 57% of logistic operators declare to need further data.

Regarding the integration with the platforms designed and implemented for European enforcement authorities (e.g., ERRU[6], TACHONET[7], EUCARIS[8], IMI[9]), freight terminals who completed the survey state that they have never exchanged information with these platforms. Logistic operators (17% of the respondents) have used these EU platforms at least once. 69% of the enforcement authorities use EU platforms, but 23% of the authorities do not even know these platforms. Among the authorities, TACHONET and IMI are the most used platforms (over 90% of respondents). According to answers given by the authorities, EU platforms are not linked to each other and must be consulted separately to gain a holistic picture. Authorities suggest integrating the different EU platforms and make them accessible by a single interface. A poor accessibility to EU platforms is also claimed, especially during the roadside checks. Finally, more data should be integrated in the EU platforms.

[5] https://www.keystone-project.com/deliverables
[6] https://transport.ec.europa.eu/transport-modes/road/rules-governing-access-profession/european-register-road-transport-undertakings-erru_en
[7] https://transport.ec.europa.eu/transport-modes/road/tachograph/tachonet_en
[8] https://www.eucaris.net/
[9] https://ec.europa.eu/internal_market/imi-net/index_en.htm

3.3. Deliverable 1.2

The Objectives of Task 1.2 (T1.2) were primarily to capture qualitative data on stakeholder requirements and expectations for the KEYSTONE solution, to add value and insight to the quantitative data gathered from the T1.1 survey. More specifically this involved capturing stakeholders' views on:

- The broader challenges and opportunities for enhancing digitalisation in the cross-border logistics and transportation arena.
- The current, developing and future EU (and UK) legislative frameworks regarding the development of digitalisation of cross-border logistics and transportation.
- Challenges and opportunities around IT platforms and tools, cyber resilience, and data sharing security within this arena.
- Propositions and suggestions on how the KEYSTONE programme could positively contribute to a digital solution to the various challenges or opportunities identified.

The Methodology for T1.2 involved:

- Facilitation of focus groups with a diverse range of stakeholders, including from Compliance Authorities, who discussed the key challenges and potential solutions to enhancing digitalisation of cross-border EU transport and logistics. Two focus groups took place – one in Novara (Italy) and one in Madrid (Spain).

Semi-structured interviews (over Microsoft Teams) with a diverse range of 12 stakeholders engaged in all manner of the cross-border transport and logistics arena within the EU and UK, utilising a semi-structured interview schedule involving views on the EU legislative framework around digitalisation of transport and logistics, the key challenges involved, platforms used, data sharing and cyber resilience issues, and view on potential solutions that Keystone could develop. Stakeholders involved those from:

Government Departments responsible for cross-border logistics and transportation, as well as Government Agencies responsible for increasing digitalisation in this arena, and with an overview of customs and other compliance knowledge.

- Stakeholders engaged in influencing or developing policy within this arena.
- Container freight and logistics operators involved in cross-border transportation
- IT platform service providers
- Business Associations with international reach, with specific interests in import-export logistics and transportation.

The results and responses from the focus groups and interviews were developed in initial key themes – many of which were interconnected – as set out below.

Barriers to interoperability of IT platforms: As is already well known, interoperability is a significant challenge. For example, it was claimed by one stakeholder that the vast range of potential IT platforms and tools for B-2-B activity and B-2-A activity (e.g. 'e-CMR solutions'), creates problematic issues surrounding

'interoperability' and data / language definition standards. For example, one stakeholder suggesting 400-500 globally, probably more. Several stakeholders argued this already saturated market could become dominated by large corporates such as SAP or IBM. It was noted by a few stakeholders that any desire for a variety of independent platforms to become one singular digital platform would be a 'mistake' given the impact on a competitive free market.

In terms of B-2-B platforms specifically, LKW Walter[10] was identified by one respondent as utilising their own platform, whilst 'Project 44' (an AI-powered platform for supply chains with a logistics component) was another used by larger operators. Commercial platforms highlighted during the interviews include activity produced by the Open Logistics Foundation[11] (based in Dortmund, Germany); several projects from this organisation have been completed across different modalities including road (e-CMR) as well as considering the role of blockchain in aiding international supply chains. IOTA (Internet of Things Application)[12] – a 'distributed ledger' system headquartered in Berlin, is a completely independent platform which provides the basis for digital exchange across a variety of fields. One major Operator, based in Belgium, stated that they used their own automated and digitialised platforms, and due to the consequences of Brexit they have developed a role as a Customs Agent for clients. They utilised two systems, one based on activity with the UK, and the other for the EU. For these platforms the messages and follow-up actions are bespoke designs, but the vast majority of these systems are based on software tools already available.

In terms of platforms used by Enforcement Agencies, examples cited by respondents included EUCARIS[13], which is a platform which enables the sharing of information related to cars and driving licenses. TRACES[14] is noted as being a key EU-wide platform used for plant and animal product health certification. For companies dealing with the UK, key databases / bodies include the DVSA[15], DEFRA[16], Port Health Authorities, Border Force and Customs (part of HMRC[17]). Due to multiple agencies needs some paperwork is often duplicated, and some systems – such as IPAFFS[18] (similar to the EU's TRACES process) concerning the import of food and animals into the UK – still require paper documents due to the nature of these items. A key challenge for Enforcement Agencies noted by one stakeholder was around 'dangerous goods' – it was claimed it is currently impossible to track the shipment of such goods as this information does not necessarily exist digitally, and/or is unavailable to others, and/or is not held under one central authority.

The business case for digitalisation adoption: One stakeholder claimed that only 1% of all global activity with 'CMRs' is completed via electronic means (e-CMRs), suggesting very low global adoption currently, not just in the EU. Various stakeholders also highlighted perceptions of a 'weak business case' for adoption of digital processes for certain businesses, particularly how SMEs can transition from the 'old world' to the 'new world' of digitalisation and data sharing, without this process compromising their bottom line, given the initial capital outlay, training and temporary disruption to existing operational practices. It was suggested that SMEs will often only 'react' to adoption when a (usually larger) customer requires them to adopt digital approaches, to make processes more efficient for that customer. Indeed, it was anticipated by some stakeholders that large organisations, including Operators, will exert their influence over smaller haulage and shipping suppliers to ensure they utilise the same versions of any digital platforms or tools. A few stakeholders also highlighted

[10] https://www.lkw-walter.com/it/it
[11] https://openlogisticsfoundation.org/
[12] https://www.iota.org/
[13] https://joinup.ec.europa.eu/collection/egovernment/document/eucaris-european-car-and-driving-licence-information-system-eucaris-0
[14] https://webgate.ec.europa.eu/tracesnt/login
[15] https://www.gov.uk/government/organisations/driver-and-vehicle-standards-agency
[16] https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs
[17] https://www.gov.uk/government/organisations/hm-revenue-customs
[18] https://www.gov.uk/guidance/import-of-products-animals-food-and-feed-system

the potential of 'use cases' as one way to demonstrate and evidence the 'business case' to SMEs and other reluctant businesses for adopting digital processes.

Use Cases: A small number of use cases, pilots, trialling activities or supporting programmes were mentioned by some stakeholders, including:

- 'eFTI4EU'[19] – the most commonly known project which aims to establish a harmonised and interoperable eFTI exchange environment Europe-wide.

- 'Data Spaces' – these are federated platforms that link many 'trusted' cloud-based service providers and users together in a transparent environment, for secure and sovereign data exchange. The International Data Spaces Association (IDSA[20]) and Gaia-X[21] are key examples mentioned by interviewed stakeholders. Data Spaces have been mentioned as an approach to data sharing that enables businesses to be 'in control' of how their data is shared, given fears of business data being utilised by others to undermine competitors (see 'Challenges' below).

- 'ADMIRAL'[22] (managed by Awake.AI in Finland) – a project assessing the use of AI solutions in creating resilient and sustainable supply chains and logistics operations. Its aim is to develop a 'cutting edge' digital marketplace for multimodal logistics, enabling businesses to manage their entire supply chain including related emissions.

'Trust' around data sharing: As mentioned above, it was claimed that only 1% of all CMRs are digitally processed – this stakeholder suggested one reason for this low adoption rate may be due to a lack of trust around data sharing. Indeed, a number of stakeholders suggested that Operators do not wish to share data digitally due to concerns that this could risk providing competitors with information about their business activities. One stakeholder also stated that e-CMRs are a potential 'commodity' that could be bought and sold by others, again suggesting private commercial data could be made public or obtained by competitors. Greater alignment between Operators and Enforcement Agencies was also claimed to be required, e.g. around inspection regimes and understanding how data will be utilised and shared, and with whom. However, it was highlighted by some stakeholders that a 'core layer' of trust is imposed in eFTI to encourage participation. There are also concerns surrounding the 'Gates' or platforms in countries where digital processes are not as advanced (e.g. parts of Eastern Europe were cited, but variations were common regardless of which Member State). However, it is currently not known how far such concerns are the result of a lack of awareness (or interpretation) of the EU legislative frameworks, or whether these are concerns are based on real evidence, particularly given the implementation of (for example) eFTI legislation is still being worked out.

Legislative Frameworks and Regulations: One emergent concern raised by some stakeholders relates to understanding how eFTI will interact with the global system for customs data and understanding how eFTI will interpret such data – at the same time, others suggested that there was alignment, which suggests a lack of clarity of understanding or interpretation amongst stakeholders.

There was, indeed, extensive discussion of global interventions regarding the CMR/e-CMR protocols. A recurring theme regarding the implementation of e-CMR was that there is not a singular approach across

[19] https://efti4eu.eu/
[20] https://internationaldataspaces.org/
[21] https://gaia-x.eu/
[22] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/how-to-participate/org-details/885263711/project/101104163/program/43108390/details

Europe and a differing pace of adoption was noted, thus creating further uncertainties for operators and businesses. A number of stakeholders raised the issue of substantial national differences surrounding the acceptance and use of digitalised documents, creating uncertainties for businesses. The introduction of eFTI was viewed positively, but this was only considered as one solution to the challenges of digitalisation in this arena, not a panacea. Differences in national regulations and their implementation include (for example) Germany, where German truck drivers need to provide their own device for documentation, where this is not required in other countries; and in France there are differences around documenting cabotage compared to other countries. Thus, there is still a perception that each Member State is 'doing its own thing' which adds complexity and negatively impacts opportunities for 'standardisation'. However, according to one stakeholder, eFTI, adoption and usage will be critical as this will effectively 'future proof' systems for Customs Agencies in the longer term.

There was mention of these issues in relation to the progress of other European / UK Initiatives (e.g. European Data Strategy, Mobility Package, and Single Trade Window). The European Data Strategy is relevant in terms of creating federated 'data spaces' and controlling the monetizing or commodification of such data. Again, given concerns regarding data sharing (highlighted above), this perhaps highlights that stakeholders' perception of legislative frameworks and their implications is extremely varied, which is an issue in itself.

KEYSTONE 'Solutions': The lack of consensus across stakeholders regarding the 'fit' of global and EU systems was symbolised by one stakeholder when they discussed 'dangerous goods', stating that the international (not EU) regulatory regime is considered to have supremacy, so any solution would need to ensure international protocols 'fit' with EU protocols. Moreover, it must be noted that most (but not all) stakeholders said that it would only be 'reinventing the wheel' to offer another typical B-2-B application, which would increase interoperability challenges in an already saturated market, where five or six firms are claimed to be dominant. There was a general consensus that any 'solution' is always more effective if it involves APIs which 'pull in' already existing data, minimising the need for duplicating inputs. A few stakeholders propose the idea of a solution around 'data sharing' challenges and data commodification risks (as mentioned above), and how these might be overcome via a 'federated' approach to 'controlled' data sharing – i.e. 'data spaces' (or 'data mobility spaces'), particularly within the realm of B-2-A interactions. A few stakeholders also suggested that KEYSTONE could consider a solution that also captures and calculates CO2 emissions, given the legislative developments in the EU around this.

For information only, in terms of specific functions of any 'solution', some stakeholders offered a variety of suggestions, such as: status / tracking (on Document acceptance/responsibilities); interfacing possibilities; overview of shipment progress; qualifications of Drivers (Including the ability to verify these); transport unit (e.g. vehicle type); inspections (e.g. when did they take place); and route/destination.

Another potential broader 'solution' suggested was how KEYSTONE might assist in increasing adoption rates of digital processes by SMEs, given issues highlighted above. For example, one stakeholder suggested the notion of an 'Amazon style' system which, for example, could have no subscription fee for basic data storage – e.g. creating a free-to-use 'front-end' to enable (say) SMEs to scan invoices and send them to others in the supply chain. Overall, however, stakeholders highlighted the need to 'listen to the market' regarding any solution – for example, how are issues of ESG, CSR and sustainability influencing business activities.

3.4. Deliverable 1.3

The deliverable 1.3 provides an analysis of the main data exchange platforms currently available and identifies the gaps between the actual scenarios and the optimal scenarios starting from the needs and

requirements identified in the survey (conducted in Task 1.1) and from the insights gathered through focus groups and interviews (undertaken in Task 1.2), as well as from the analysis of the services and information provided by existing platforms.

The analyzed platforms have different objectives and are used by different users (public and private), both for data sharing between enforcement authorities (A2A), and for the connection among different stakeholders, from authorities to logistics operators and freight terminals (of type B2B or B2A).

The methodology applied in the platform's analysis is consists 4 phases:

1. DEFINE OBJECTIVES
   - Clearly establish the objectives of the analysis
2. PLATFORMS IDENTIFICATION
   - Identify the European and private platforms subject to the in-depth analysis
3. PRELIMINARY RESEARCH
   - Gather information about digital platforms, including their main features and objectives, current governance rules, functionalities, type of data managed and user base.
4. IN DEPTH ANALYSIS
   - Delve deeper into the platform through a potential interview with the contact person.
   - Identify the types of data processed and stored by the platforms
   - Explore the platform's functionalities

The users of the platforms can differ: in the logistic field platforms can exist to support the work of terminals, public enforcement authorities or logistic operators. The objectives of a digital platform can also be different, and the data managed by a platform can also differ.

The European platforms for the exchange of information among enforcement authorities include ERRU[23], RESPER[24], IMI[25], and TACHOnet[26]. In particular:

- ERRU is a specialized platform designed to enable the exchange of information between national electronic registers, which hold different types of information including, for example, data concerning the validity of community licenses, and infringements committed by transport companies.
- RESPER represents an interconnected database of European driving licence archives. Its primary aim is to guarantee effective freedom of movement for licence holders issued in the Member States, ensuring that driving licenses are recognized and valid across borders. But it also helps in identifying the validity of a driving license issued by an EU Member State.
- IMI is a system that allows public authorities of different EU countries to communicate and exchange information effectively. This includes data on companies posting workers to EU countries and about the posted workers themselves, facilitating regulatory compliance and worker protection.
- TACHOnet is recognized as a telematics network that facilitates the exchange of information concerning the Tachograph Cards. It allows enforcement authorities to check that a driver holds only one and not multiple tachograph cards. This network is integral to the enforcement of regulations regarding driving times and rest periods for drivers, contributing to road safety and fair competition.

[23] https://transport.ec.europa.eu/transport-modes/road/rules-governing-access-profession/european-register-road-transport-undertakings-erru_en
[24] https://road-safety.transport.ec.europa.eu/system/files/2021-07/resper.pdf
[25] https://ec.europa.eu/internal_market/imi-net/about/index_en.htm
[26] https://transport.ec.europa.eu/transport-modes/road/tachograph/tachonet_en

Movehub, managed by DG MOVE, is a pivotal platform facilitating interconnection among various authorities, enabling the sharing of information between EU member states.

The EUCARIS application facilitates the exchange of mobility related information among Member States using a peer-to-peer exchange model. The information exchanged is collected from registrations of the Member States, such as the national vehicle register or national driving license register and shared between national focal points of each Member State

Concerning data sharing, EUCARIS facilitates information exchange in relation to different EU regulations.

EFTI will be a disruptive regulation which will change the communication of freight information in the European Union making it digital. With certified private platforms logistic operators could easily share data with authorities during inspections, and avoid using paper documents. EFTI will also enable platforms to communicate with other private stakeholders (B2B) and will also help in monitoring the environmental impact of road transport by allowing calculations related to CO2 emissions..

Regarding other platforms, the Port Community System (PCS) is a tool used by port authorities to expedite port operations through the digitization of administrative and control processes (check the access in the port). For example, the Extended PCS implemented by Circle Group is a system designed to enhance efficiency and traffic flow to and from ports. It also acts as a crucial tool for control and monitoring, supporting the seamless operation of port logistics and supply chain continuity.

Drive Belt is an Italian governance support tool aimed at collecting, homogenizing and valorising Italian logistics and transport data coming from public administration systems and from the actors of the digital logistics chain.

Regarding platforms used by terminal operators, the Terminal operating system (TOS) is a tool used to manage and optimize the operations of a terminal, aiming at enhancing the efficiency and facilitating the flow of goods and cargo by checking access and documents related to the terminal. EDIGES[27] is an example of a TOS that facilitates automatic real-time data exchange among different stakeholders within an intermodal transport chain, adopted in important terminal in the Hupac network, including CIM S.p.A. Circle Milos is another TOS that allows terminals to manage various operations with a single tool. It emphasizes effective control of customs and administrative operations, full interoperability with Port Community Systems. The Almaviva Moova Port Community System and Terminal Operating System is an innovative platform specifically designed to manage the mobility of goods. It facilitates import and export operations through integration between IoT systems and infrastructural assets, supporting the modern logistics and transportation landscape.

The transport companies use a Transport Management System (TMS) to manage their operations. The TMS is an end-to-end software used by transport companies to manage logistics and streamline shipments. SGA is an example of a TMS, used by national and international transportation, logistics, and shipping companies, including Gruber. It offers comprehensive functionalities to manage transport operations efficiently.

Regarding the GAP analysis the methodology applied is characterized by 3 steps:

1. DATA COLLECTION
   - Needs and requirements of stakeholders collected by the survey, focus groups and interviews
   - Studying actual scenarios.
2. DATA PROCESSING AND ELABORATION
   - Analysis of the information received from the previous step and definition of stakeholders' needs and requirements.
3. GAP ANALYSIS

[27] https://cdm.uirr.com/ediges

- Identification of the major gaps that follow from the previous steps (comparison of status with the desired status).

The complete analysis underlines the existence of different categories of gaps: digital gaps, accessibility gaps and legal gaps, that KEYSTONE can support to overcome, through the developed solution.

4. Evaluation Framework

4.1. Definition of Key Performance Indicators

Herein, the first portion of this chapter presents the evaluation framework, which serves as an anchor for KEYSTONE and it's eye-catching idea to transform logistics industry through the creation of a seamless digital infrastructure. The development of this framework is done through a detailed, well noted research on the theory, practitioner's perspectives and practical tool that can upgrade the implementing strategy. We first explain the concept of Key Performance Indicators (KPIs), and their importance for KEYSTONE's circumstances, and then deepen this area by coping with different aspects of its definition.

The KPIs stand for the authenticity of performance measurement at KEYSOTNE and not only at our company. KPIs are critical-to-success factor measurements, allowing stakeholders to get such important information as objectives' and goals' attainment level. In terms of KEYSTONE, the KPIs act as the fundamental building blocks of evaluation that are instrumental in determining the ease of interconnectivity, efficiency, and productivity of the digital realm that is being crafted. They currently manifest as the exact quantifiable metrics meticulously created to gauge and measure the project performance, progress, and outcome effectiveness which allow all the necessary stakeholders to move through the digital logistics landscape with ease and confidence.

Picking the right KPIs in KEYSTONE is achieved by designing the study questions that thoroughly and accurately help in choosing and refining them. These questions will serve as a guide, ensuring that we focus on the most critical areas of research from which the selected KPIs will follow the path of the set goals and the interests of various groups of stakeholders. In this way, KPIs become more meaningful and useful, which allows the organization to tell in one entity how is the performance of the digital ecosystem and its level of impact. Study questions are employed to investigate different features of how a project was perform and how effective it was critically by all stakeholders. Through strategic questions stakeholders can gain deeper comprehension of the underlying challenges, potential and prospects, as well as the priorities embedded within KEYSTONE. To be so, the study questions work for a gap between project objectives and KPIs, providing certainty that performance indicators are in line with the set outcomes. Stakeholders learn to prioritize the key points of the performance of a project thanks to which KPIs are driven to more effectiveness.

Along with exam questions, KPIs within KEYSTONE are part of the process of stakeholder feedback gathered through recommendation reports, strategic and other plans which is also followed up by any feedback on the prepared KPIs list. This input of the feedback of the stakeholders improves the effective formulation of KPIs which will aptly reflect on need of the involved parties in terms of priorities, perspectives, and goals.

By actively soliciting and incorporating stakeholders' feedback, KEYSTONE fosters a collaborative and inclusive approach to performance evaluation, enhancing stakeholders' engagement and ownership. Stakeholders are empowered to contribute their perspectives, experiences, and expertise, ensuring that KPIs are grounded in real-world insights and aligned with the realities of implementation.

Moreover, the crucial issue that is highlighted by the KEYSTONE's approach is the participation of stakeholders' opinion in the planning and making changes to KPI as the tool of transparency, accountability, and trust. Stakeholders dynamically get involved; their opinion is highly appreciated; and they feel like a partner and owner of the company, from which they gain the ability to empathize and integrate. In conjunction the given approach allows for the introduction of new applications and increases of effectiveness of KPIs and widens people's understanding as well as encourages engagement.

A framework for the evaluation of KPIs is constructed using a thoughtfully and systematically structured process that was done in light of the worldly wisdom shared by academics and the own experiences. The Paper introduces the way that is based on the comprehensive set of components, such as the stakeholders' participation, research and review of the previous literature, and constant iterative refinement. The methodology employed encompasses four distinct phases, as Figure 1 shows:The methodology used consists of 4 distinct phases, as Figure 1 shows such a process:

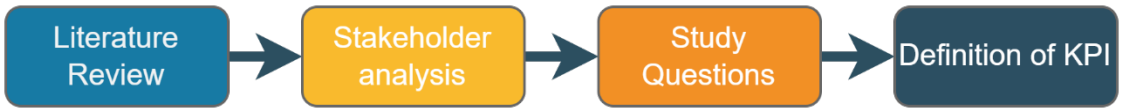

Figure 1: Key Performance Indicator definition framework

In particular, the four phases are better explained below:

- *Literature Review*: a summary of relevant literature, especially about those that have been tested in the academia, presents the first step towards comprehension of models, methods, and practices used in assessing digital systems inside logistics. AEOILIX, FENIX and Federated are illustrating matters of interoperability and efficiency between various logistic parties. EU-funded projects are providing a huge amount of information regarding the challenges and the opportunities that are closely connected with interoperability and efficiency.
- *Stakeholder Analysis*: by means of proactive communication and involvement with players in the logistics sector, this platform can draw out (expatiate) key information that stakeholders can use. Involvement of stakeholders in this regard means analysing their objectives, interests, and priorities to ensure the framework aligns with the stakeholders' needs and aspirations (Huang et al., 2021). Stakeholders assessed feedback of which contributes to checking if KPIs are appropriate and attainable, being in line with stakeholder goals and at the same time easily measurable.
- *Study Questions Formulation*: the development of a set of questions rounded off with the choosing of the corresponding KPIs is shaped by the formulation of study questions. By posing all these questions, the road ahead is outlined, and attention is directed to the main areas to examine and align each KPI with the project objectives and expectations of the stakeholders. Study questions also help with the fact that KPIs can be in proper alignment with project objectives. Thus, the performance metrics are interlinked with general goals and desired results.
- *Definition of KPIs*: the last phase of the methodology demonstrates the definition of KPIs that have emerged from three steps: a careful analysis of the role played by all studies in the literature review, an exhaustive assessment of the stakeholders' position, and a formulation of the research hypothetical questions. The next step will be the refining phase which may be iterative, requiring feedback from stakeholders and partners to check if the changes are in line with their goals, and to assess whether the data is collectible, refine the existing statistics, and verify the data sources.

The evaluation framework within KPIs is a meticulously curated ensemble of performance indicators, meticulously crafted to encapsulate the multifaceted dimensions of success and efficacy within the digital ecosystem. As digital ecosystems continue to evolve, the need for robust evaluation frameworks becomes increasingly pronounced, enabling stakeholders to navigate the complexities of interconnected systems with confidence and clarity. Drawing inspiration from renowned scholars and thought leaders in the field of performance measurement and digital innovation, the framework encompasses diverse categories of KPIs,

ranging from efficiency and interoperability to user satisfaction and system reliability. Each KPI is imbued with a rich tapestry of definitional clarity, measurement criteria, and target values, ensuring comprehensiveness, coherence, and relevance in evaluating the success of the implementations.

The assessment of KPIs within KEYSTONE adheres to the principles of SMART (Specific, Measurable, Achievable, Relevant, Time-bound). By aligning KPIs with these principles, stakeholders ensure that performance metrics are:

- Specific: clearly defined and unambiguous, leaving no room for interpretation or misinterpretation.
- Measurable: quantifiable and objective, allowing for accurate assessment and comparison over time.
- Achievable: attainable within the context of project resources, constraints, and timelines.
- Relevant: linked to project objectives, goals, and desires outcomes, providing meaningful insights into progress and performance.
- Time-bound: associated with specific timeframes, facilitating timely evaluation in pre and post KEYSTONE implementation.

Implementing those smart principles let stakeholders to mantain KPIs dynamically connected to project's goals allowing accurate decision-making and improvement in KEYSTONE's digital environment.

Here is the draft of the evaluation framework, which we have come up with as a result of extensive research, stakeholders' engagement and applied wisdom that should help not only to assess in detail but also to address the challenges of evaluation of the digital ecosystem with the necessary accuracy and focus. To achieve that the organization should adhere to the notion of transparency, accountability, and as well as continuous improvement. This will help them to leverage the potential of KPI to become the force that will drive meaningful change, innovation, and creation into space.

The initial KPI list (Table 1) develops as the end of the methodology already described. Every KPI is accompanied with its title, where in the description explains the purpose. When the table is presented, some columns simply ruin the overall impression of it, and they were omitted to keep the table clean and crisp, like study questions, data collection strategy, and data sources. These factors let us set up the SMART criteria for each indicator. As we discussed before, this is the preliminary list that will be shortened later during KEYSTONE, based on results of its activities and partners' comments during task 5.1.

Table 1: KPI and its description

KPI title	KPI description
Survey Engagement and Data Quality	Evaluate the engagement level and data quality of the survey conducted using CONEY to collect the needs, requirements, and expectations of targeted stakeholders
Readiness of Industry Stakeholders and Enforcement Authorities	Gauge the readiness of European industry stakeholders and enforcement authorities to adopt new data-driven business models in the context of digitalized transport ecosystems.
Methodology Integration Effectiveness	Assess the effectiveness of integrating current methodologies for API standardization into the development of the API reference model.

Ease of Services Mapping between End-Users	Measure the effectiveness of enabling end-users to map services without extensive programming and documentation, as per the KEYSTONE paradigm.
Compliance with Legislative Information Retrieval	Evaluate the degree to which the information retrieval processes outlined in the API reference model align with legislative requirements for accessing information from other platforms.
Efficiency of Information Exchange Processes	Measure the efficiency and effectiveness of information exchange processes between stakeholder platforms within the API reference model.
Library Effectiveness in Information Exchange	Assess the effectiveness of the Python implementation library in facilitating the exchange of information between 3rd party applications and the app
Documentation Accessibility and Comprehensibility	Measure the accessibility and comprehensibility of the library documentation developed using the OpenAPI Specification and hosted on a Swagger (or similar) platform.
Accessibility	Tracking the adoption rate among data producers and consumers through user surveys, feedback sessions, and analytics tools
Multilingual Standard Development Adoption	Measure the adoption and usage of the reference model for developing standards in languages beyond Python, as facilitated by the documentation platform.
Effectiveness of Business Case Evaluation Criteria	Measure the effectiveness of the criteria used to evaluate specific Business Cases implemented in the project
Integration of Strengths and Opportunities in Business Models	Measure the effectiveness of integrating strengths and opportunities identified in Business Cases into the subsequent development of Business Models.
Evaluation and Implementation of Business Cases	Evaluation of the effectiveness of specific business cases and their contribution to the overall success of new business models through business case reviews and detailed competition analysis.
Security and Accessibility Measures	Measure the effectiveness of security and accessibility measures incorporated into the app architecture.
Universal Accessibility and Security	Evaluate the accessibility of the web app across various devices (mobile and desktop) and assess the security measures implemented to meet policing software standards.
Stakeholder Usage Versatility	Evaluate the versatility of stakeholder usage, including drivers, enforcement personnel, and logistics managers, and assess how well the app architecture caters to their specific needs.
Usability Enhancements for Limited-Scale Pilot	Evaluate the effectiveness of features or functionalities designed to enhance usability during the limited-scale pilot.

Data Flow Efficiency	Evaluation of efficiency improvement in data flow resulting from the implementation of API standards and the web app through performance monitoring tools, data flow analysis, and periodic reviews
Feature-rich Web App Development	Evaluate the richness of features and functionalities in the developed web app and assess how well they align with the goals of the KEYSTONE project.
User Engagement with the Web App	Assessment of the level of engagement and user satisfaction with the web app through user analytics, session tracking, and user feedback channels
Efficient Legal Documentation Management	Measure the efficiency of the web app in managing legal documentation related to the load and vehicle.
Stakeholder Collaboration in Digital Ecosystems	Evaluate the level of collaboration among stakeholders, including shippers, carriers, and freight forwarding agents, within the digital ecosystems created in both demonstration scenarios.
Validated Safety and Security System for CCAM	Develop an innovative, efficient, consistent, and resilient system for validated safety and security in connected and automated mobility (CCAM) technologies and systems. Validate the system's robustness and resilience in two scenarios during the project
Accessibility and Compliance with Authorities	Evaluate the accessibility of the API digital ecosystem to authorities and assess its compliance with the needs of authorities for checking data flows and shared documents.
Guiding Pilots with Evaluation Methodology	Measure the effectiveness of the evaluation methodology in guiding pilots, specifically in terms of outlining timelines and data collection requirements.
Quality of service indicator	Assess the efficacy of the services and products enhanced within KEYSTONE
Information management costs	Compare information management costs pre and post KEYSTONE implementation, aiming for a reduction in costs
Working Conditions Improvement	Evaluate the improvement in working conditions based on the results of the CEA. Conduct surveys and interviews among transport operators to gauge their appreciation and assess changes in productivity
% of Documents Exchanged Through Project Apps	Measure the percentage of documents exchanged through the project apps compared to all mandatory documents in each pilot
Number of Implemented "Compliant by Design" Use Cases	Assess the number of implemented "compliant by design" use cases within the project
Speeding Up of Control and Data Collection Procedures	Evaluate the speeding up of control procedures and data collection processes for transport operators through the use of the app

Number of applications developed and tested in the use-case demonstrations; number of new logins; number of active users.	Monitor the number of applications developed and tested in use-case demonstrations, along with the number of new logins and active users
Awareness of Transport Operators regarding Regulations and Warnings	Evaluate the awareness of transport operators regarding the full set of general and local regulations and warnings
Number of automated procedures along the value chain	Quantify the number of procedures fully digitalized and automatically performed along the logistics value chain
Integration of DTLF Findings	Evaluate how well the project integrates DTLF's main findings regarding Plug & Play needs of development into its design.
Seminars for Private Sector Engagement	Organize at least three seminars for the private sector, each lasting 60/90 minutes with at least three presenters, to facilitate engagement and collaboration.
Building a Strong Public-Private Transport Community	Measure the strength and growth of the public-private transport community resulting from the project
Collaboration with Research Institutions	Establish collaboration with a minimum of 10 research institutions
KEYSTONE Community Creation	Create a KEYSTONE community including at least 20 European institutions active on the platform

4.2. Linkage to Work Package 5 - Evaluation Methodology (5.1)

The conception of KPIs and approach work interstingly in terms of measurable and assessment concepts of project results and achievements. They have one of the most interesting relationships which could be understood as the symbiotic relation. Task 1.4 does not only explain but also illustrates the indicators within the project and, in addition, provides the basic knowledge required to comprehend the position indicator in development projects. Through this process, the fundamental notions, methods and factors that the KPIs comprise of will be arranged, that serve as are instruments to measure and evaluate the performance.

In addition, Task 5.1: Role of "Evaluation Methodology" in the pipeline, and Task 5.1 is the preparation stage for Task 5.1, the practical and theoretical guidance that guide the choice of KPIs, which are the main criteria. A systematic tool that follows its methodology principles, which are aligned with the goals of the project and solve the problems of the stakeholders, is referred to as framework development in Task 1.4.

Task 5.1 is the subsequent stage in task 1.4, where theoretical frameworks are converted into practical action. It deals with the evaluation process implementation through the creation of a general plan of evaluation that would be implemented in the pilots and use cases of KEYSTONE. This plan contains parameters, which are the assessment requirements, study questions and the KPIs, as a whole guiding way of assessing the effectiveness and impact of the digital system in a real life setup. Adding to that, the evaluation managers in each pilot take charge of their assessments, which ensure that the use cases success is evaluated. The managers of these KPIs are responsible for designing and implementing the framework for assessing the

key performance indicators along with the methodology for the same, ensuring the timely completion of the tasks and assisting in data compilation.

Briefly, task 1.4 deals with the theoretical concepts of KPI formulation and evaluation framework development, which are the fundamental elements of the evaluation methodology, whereas task 5.1 is focused on operationalizing these concepts by defining their methodology and by leading the pilot assessments. Therefore, the combination of the described tasks create a comprehensive and consistent approach to KPIs setting, ensuring that the performance is properly measured and KPIs are used to empower KEYSTONE digital logistics ecosystem to achieve success, optimization and innovation.

Even if the KEYSTONE project does not fall within the umbrella of projects promoted by the CCAM association, some aspects of the CCAM world will be considered within the KEYSTONE pilots (as requested by the call on which the KEYSTONE project is based). For this reason, ICOOR, as leader of the KEYSTONE evaluation and as a member of the CCAM association, will participate in the Common Evaluation Methodology Summer School (June 2024) promoted by the Fame project[28].

Given that the timing allows it, we believe that participation in this summer school can improve the evaluation methodology of KEYSTONE which will be defined in Task 5.1 (October 2024 - April 2025) giving it a more coherent perspective with the other ongoing projects in the Horizon Europe framework.

4.3. Clarification on Timing of Evaluation

The formalization of the framework for KPIs definition is brought to fruition within the initial project year, with the deliverable scheduled for submission during M12 of the project timeline. Throughout this phase, ICOOR rigorously conducts extensive research and cultivates stakeholder engagement for meticulously selecting and defining KPIs in the following and linked task. This established framework serves as the cornerstone for subsequent evaluation initiatives, offering a structured approach to performance measurement and assessment across the KEYSTONE project lifecycle.

The transition from framework establishment to active evaluation activities unfolds with the inception of WP5, notably within Task 5.1, "Evaluation Methodology," commencing in M17 of the project timeline and led also by ICOOR. Task 5.1 is tasked with translating the framework into actionable steps aimed at deriving the final list of KPIs. Adhering closely to the prescribed methodology, this process entails collaborative efforts with project partners to ensure alignment of objectives with pertinent indicators and measures. Task 5.1 concludes in M23, with the submission of deliverable D5.1 "Evaluation Methodology and Plan." This document underscores the pivotal role of the KPI definition framework, serving as a foundational element for subsequent tasks within the work package.

The link between task 1.4 and the evaluation activities has been graphed in Figure 2:

[28] https://www.connectedautomateddriving.eu/methodology/common-evaluation-methodology/

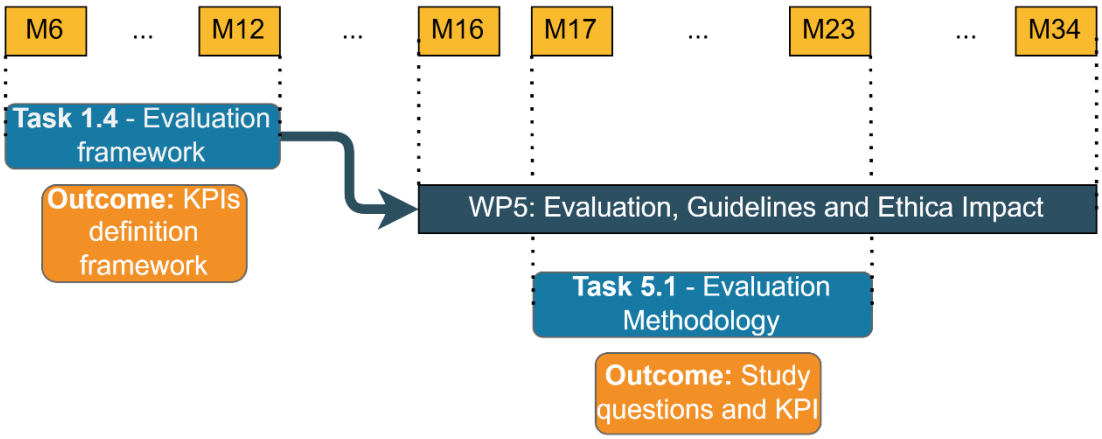

Figure 2: Key Link and timing view for Evaluation activities

5. Operationalization of the Project

5.1. Generation of use cases leading to Task 4.2

5.1.1. Plug and play and API standardization

As the WP1 highlighted, through its investigation, there are certain needs, requirements and pressing challenges which are faced by the stakeholders in the logistics ecosystem that are crucial to be tackled. These challenges, to highlight the most prominent ones, include lack of standardization and harmonization, data fragmentation, the presence of data silos, particularly among small and medium-sized enterprises (SMEs). Many rather small operators struggle to join the digital world due to the complexity of establishing infrastructure and the daunting task of navigating diverse regulatory landscapes. There is also fragmentation among platforms and apps that already exist for the authorities to utilize for their purposes such as compliance checks, while among the economic operators different levels of digitisation and utilisation of systems may exist. This divergence in needs further complicates efforts to create a cohesive digital infrastructure that caters to the diverse stakeholders within the logistics ecosystem.

Therefore, we can reach the safe conclusion that, in the landscape of logistics, the integration of technology has become a cornerstone of success. The organizations are leveraging technology to optimize processes and improve productivity. Against this backdrop of challenges and complexities, the concepts of Application Programming Interfaces (APIs) standardization and Plug-and-Play emerge as critical solutions, that are being thoroughly investigated in the dedicated WP2 of KEYSTONE project. These concepts offer a pathway towards simplifying technology integration, promoting interoperability, and fostering collaboration across the logistics landscape. By establishing standardized protocols and interfaces, API standardization facilitates seamless communication between disparate systems, while Plug-and-Play streamlines the process of connecting to platforms and accessing services without the burden of extensive technical configurations.

In essence, the adoption of API standardization and Plug-and-Play principles represents a strategic response to the multifaceted challenges facing the logistics industry. These solutions hold the promise of driving efficiency, enhancing collaboration, and unlocking new opportunities for innovation in the digital era of logistics.

Plug and Play is a concept developed by the Digital Transport and Logistics Forum (DTLF[29]) and implemented in projects like FEDeRATED and FENIX projects. It focuses on creating a standardized framework for interoperability and seamless integration of digital platforms and systems within the transport and logistics sector. By adopting the Plug and Play framework, projects like FEDeRATED and FENIX have been able to overcome interoperability challenges and facilitate the integration of various digital platforms and solutions. This approach not only enhances efficiency and transparency within the transport and logistics sector but also promotes innovation and collaboration among stakeholders. Therefore, it is established that the concept of Plug-and-Play represents a very promising approach to technology integration and data sharing. In the context of KEYSTONE, the establishment of the API standardization is an essential key for the implementation of the Plug-and-Play. APIs enable communication between various software applications and platforms, while standardizing APIs involves developing uniform protocols, formats, and interfaces to ensure seamless interoperability across diverse systems.

Within the scope of technological integration and data exchange, Plug-and-Play represents a user-centric approach, aiming to simplify the complex process of connecting diverse systems, and it emphasizes accessibility, inclusivity, and ease of use for each user. The idea behind this concept is to enable the users to register and connect to a platform, selecting the services of their choice without facing complicated technical requirements or compatibility issues.

Plug-and-Play focuses on standardization and interoperability, aiming to streamline the integration of the API standard, ensuring compatibility and coherence across different organizations, and highlights the importance of openness and neutrality in data sharing infrastructures. Plug-and-play relies on several components such as semantic model, Service Registry, and ontologies to facilitate data sharing and interoperability. These components enable organizations to define their capabilities, map their data requirements, and ultimately support the seamless exchange of data. Furthermore, Plug-and-play simplifies processes, standardizes the data infrastructures, and encourages collaboration and innovation across various organizations.

In addition, the significant role of API standardization highlights its importance in development and adoption of uniform protocols and interfaces, enabling seamless communication and interaction among different software applications. API standardization is essential for enhancing interoperability and simplifying the integration of diverse systems. Moreover, API standardization contributes to the consistency and reliability of software development by providing pre-defined interfaces and functionalities that developers can leverage, as a result of reducing complexity, minimizing errors, and accelerating the development process.

In conjunction with Plug-and-Play, and by adhering to established standards and protocols, API standardization promotes organizations to ensure compatibility and interoperability between the various systems.

Combining API standardization and Plug-and-Play principles offers a robust framework for seamless data sharing and interoperability within the logistics ecosystem. This approach involves developing standardized APIs that define uniform protocols and interfaces for data exchange, alongside Plug-and-Play profiles that detail organizations' capabilities and services. These profiles are published to a centralized Service Registry, enabling stakeholders to discover and connect with partners offering desired capabilities. Flexible protocol selection, semantic integration, and access points further facilitate connectivity and real-time data access. By promoting collaboration, ensuring compliance, and iterating on improvements, this integrated approach fosters innovation and efficiency across the logistics industry.

In summary, by simplifying processes, promoting standardization and inclusivity, Plug-and-Play facilitates collaboration across various organizations and API standardization ensures interoperability, reliability, and

[29] https://transport.ec.europa.eu/transport-themes/digital-transport-and-logistics-forum-dtlf_en

openness. Together, Plug-and-Play and API standardization are fundamental pillars of a connected digital ecosystem, driving progress and innovation in the dynamic technological landscape.

WP2 is delving into those two, in order to investigate and develop the first API reference model, while also taking into account all the key outcomes stemming from WP1, determine connectivity with platforms that contain legal information, develop the API standard, as well as develop and evaluate business models regarding the API standard extended to the facilitation of Plug and Play adoption.

5.1.2. Derivation from Transport Ecosystems

The ecosystem, in the context of the Keystone project, represents a complex and interconnected system of actors operating within the logistics process. These actors include goods producers, freight forwarders, transportation carriers (maritime, aerial, terrestrial, etc.), different types of government agencies/regulatory bodies and other entities involved in the supply chain and transportation of goods.

The term "ecosystem" was chosen because it reflects the diversity and interdependence of the various components of the logistics and transportation world. Much like in a natural ecosystem where different species interact with each other and the surrounding environment, actors in the logistics process are bound by relationships that can be more or less direct but converge toward a common goal: the efficient transfer of data to facilitate the transportation process of goods.

In the Keystone project, primary attention has been directed toward land transportation modes such as road and rail transport, but the ultimate goal is to extend the solutions developed to other transportation modes such as air and maritime transport.

The logistics ecosystem connects actors through the exchange of data and goods, as well as through customer-supplier relationships. To optimize this interconnection, Keystone aims to make the ecosystem as organic as possible, allowing different actors to communicate using standardizations and modern technologies such as standardized APIs and plug-and-play technology.

A crucial element of the project is the standardization of the data exchange process. The goal is to eliminate data duplication and ensure the uniqueness and consistency of information within the entire system. This means that information entered once must be accessible and usable by other systems within the transportation ecosystem.

This approach enables the definition of specific use cases derived from the transportation ecosystem, which will be developed throughout the Keystone project. In summary, the ultimate goal is to create a standardized data exchange system to optimize and simplify the logistics process, ensuring efficiency and consistency throughout the entire transportation ecosystem.

To further delve into the concept of "ecosystem" in the context of the Keystone project, let's analyze some key aspects:

Interconnection of Actors: The logistics ecosystem is characterized by the presence of various actors, such as producers, freight forwarders, transportation carriers and government agencies/regulatory bodies, who are interconnected through a network of relationships. These relationships can take various forms, including contractual agreements, data and information exchanges, strategic collaborations, checks related to regulatory compliance and so on. The interconnected nature of the ecosystem implies that the actions of a single actor can influence other actors and the overall efficiency of the system.

Exchange of Data and Goods: A fundamental element of the logistics ecosystem is the exchange of data and goods among the involved actors. This exchange occurs through a variety of channels and platforms, such as computer systems, standardized communication protocols, and electronic documents. The fluidity and efficiency of this exchange are crucial to ensure the continuous flow of goods along the supply and transportation chain.

Customer-Supplier Relationships: In addition to the exchange of data and goods, the logistics ecosystem also involves complex relationships between customers and suppliers. These relationships may involve aspects such as production planning, order management, goods delivery, and inventory management. An important aspect is to ensure transparency and trust in customer-supplier relationships to ensure effective collaboration within the ecosystem.

Standardization and Modern Technologies: To optimize the efficiency and consistency of the ecosystem, the Keystone project aims to use standardization and modern technologies. This includes adopting standardized APIs to facilitate integration of the computer systems of the involved actors, as well as the use of plug and play technologies to simplify the implementation and maintenance of logistics solutions.

Objective of Optimization and Simplification: The main objective of the logistics ecosystem is to create a standardized data exchange system to optimize and simplify the logistics process as a whole. This means reducing transit times, operational costs, and errors associated with goods management, while ensuring a high level of customer service.

In conclusion, the logistics ecosystem in the context of the Keystone project represents a complex and interconnected system of actors, data, and goods, where the primary goal is to create a collaborative and standardized environment to optimize the transportation and delivery process of goods.

5.1.3. Identification of Stakeholder Interactions with the transport system

Identifying and understanding the interactions of stakeholders within the ecosystem of the transport system is crucial for effectively managing and optimizing logistics operations. Stakeholders encompass a broad spectrum of entities involved in various capacities throughout the transportation process, from the initial production of goods to their final delivery to customers. Examining these interactions in detail involves delving into the roles, relationships, and influences of each stakeholder within the ecosystem.

Producers/Manufacturers: Producers play a fundamental role as the originators of goods within the transport ecosystem. Their interactions involve not only the production and packaging of goods but also decisions regarding transportation modes, routes, and scheduling. Producers must coordinate with other stakeholders, such as suppliers of raw materials and components, to ensure the timely availability of inputs for production. Their decisions impact the volume, type, and timing of shipments, affecting the entire logistics chain.

Freight Forwarders: Freight forwarders act as intermediaries between producers and transportation carriers, facilitating the movement of goods from origin to destination. Their interactions involve coordinating transportation logistics, including booking cargo space, arranging customs clearance, and managing documentation. Freight forwarders often leverage their expertise and network of contacts to optimize shipping routes and minimize transit times, thereby enhancing overall efficiency within the transport ecosystem.

Transportation Carriers: Transportation carriers, encompassing maritime, aerial, terrestrial, and other modes, form the backbone of the transport system. Their interactions revolve around the physical movement of goods, encompassing loading, transport, and unloading activities. Carriers must maintain effective communication with producers, freight forwarders, and other stakeholders to ensure the smooth execution of

transportation operations. Additionally, carriers face regulatory and operational challenges that necessitate collaboration with relevant authorities and industry bodies.

Government Agencies and Regulatory Bodies: Government agencies and regulatory bodies play a pivotal role in shaping the transport ecosystem through the formulation and enforcement of laws, regulations, and standards. Their interactions involve overseeing safety, security, environmental compliance, and infrastructure development initiatives. Government agencies collaborate with stakeholders to address emerging challenges, promote innovation, and enhance the overall sustainability and resilience of the transport system.

Technology Providers: Technology providers contribute to the transport ecosystem by developing and deploying solutions aimed at optimizing logistics processes and enhancing efficiency. Their interactions encompass the provision of software platforms, tracking systems, and data analytics tools that enable stakeholders to streamline operations, improve visibility, and make informed decisions. Technology providers collaborate with stakeholders to customize solutions, integrate disparate systems, and address evolving industry needs.

Customers and End-Users: Customers and end-users represent the ultimate beneficiaries of the transport ecosystem, receiving goods and services at their desired locations and timeframes. Their interactions involve placing orders, tracking shipments, and providing feedback on the quality and timeliness of deliveries. Customer preferences and demands influence supply chain strategies, prompting stakeholders to adapt their operations to meet changing requirements and expectations.

Financial Institutions and Insurers: Financial institutions and insurers play a vital role in facilitating transactions and managing risks within the transport ecosystem. Their interactions involve providing financing, insurance, and risk management services to stakeholders involved in transportation and logistics activities. Financial institutions collaborate with stakeholders to optimize working capital, mitigate financial risks, and ensure the financial viability of transport operations.

Industry Associations and Advocacy Groups: Industry associations and advocacy groups represent the collective interests of stakeholders within the transport ecosystem, advocating for policies, initiatives, and best practices that promote the industry's growth and sustainability. Their interactions involve facilitating knowledge sharing, fostering collaboration, and representing stakeholders' concerns to policymakers and regulators. Industry associations collaborate with stakeholders to address common challenges, share resources, and promote innovation and continuous improvement within the transport ecosystem.

In summary, the interactions of stakeholders within the transport ecosystem are multifaceted and dynamic, encompassing a wide range of activities, relationships, and influences. Effective management of these interactions requires collaboration, communication, and alignment of interests among stakeholders to achieve common goals such as efficiency, reliability, and sustainability within the transport system.

5.1.4. Relevance of Information Flow within the ecosystem: consistency and localization

The relevance of information flow within the ecosystem of the transportation and logistics industry cannot be overstated, as it is essential for ensuring smooth operations, optimizing efficiency, and meeting customer demands. Two critical aspects of information flow within this ecosystem are consistency and localization.

Consistency

Consistency refers to the uniformity and accuracy of information across the entire logistics ecosystem. Inconsistencies in data can lead to misunderstandings, errors, and inefficiencies, ultimately disrupting the flow of goods and services. To maintain consistency, stakeholders must adhere to standardized processes, protocols, and data formats when exchanging information. Consistency can be related to the following aspects:

Decision-making: Relevant information serves as the foundation for informed decision-making at every stage of the logistics process. Whether it's determining optimal transportation routes, managing inventory levels, or scheduling shipments, stakeholders rely on accurate and up-to-date data to make strategic and tactical decisions. Consistent access to relevant information enables stakeholders to identify potential issues, mitigate risks, and capitalize on opportunities, thereby driving operational excellence.

Efficiency: Efficient information flow streamlines logistics operations by reducing delays, minimizing errors, and eliminating redundancies. When stakeholders have access to consistent and timely information, they can coordinate activities more effectively, synchronize workflows, and optimize resource allocation. For example, real-time visibility into inventory levels enables manufacturers to replenish stock proactively, avoiding stockouts and excess inventory holding costs. Similarly, carriers can optimize load planning and route scheduling based on accurate demand forecasts and shipment data.

Customer Satisfaction: Meeting customer expectations hinges on delivering products reliably, punctually, and accurately. Relevant information flow plays a critical role in achieving these objectives by enabling stakeholders to provide superior service levels. For instance, customers expect real-time updates on the status and location of their shipments, allowing them to plan accordingly and anticipate delivery times. Consistent communication throughout the transportation process builds trust and confidence, fostering long-term customer relationships and loyalty.

Risk Management: Effective risk management relies on timely access to relevant information to identify, assess, and mitigate potential threats to the supply chain. Whether it's disruptions due to adverse weather conditions, geopolitical events, or supply chain disruptions, stakeholders must be equipped with accurate data to respond swiftly and effectively. Consistent information flow enables stakeholders to monitor key performance indicators, anticipate risks, and implement contingency plans to safeguard operations and minimize disruptions.

Compliance: Compliance with regulatory requirements and industry standards is essential for maintaining the integrity and legality of logistics operations. Relevant information flow ensures that stakeholders adhere to applicable regulations, such as customs documentation, safety regulations, and environmental standards. Consistency in data exchange and reporting facilitates regulatory compliance, auditability, and accountability, reducing the risk of fines, penalties, and reputational damage.

Localization

Localization refers to the adaptation of information and processes to specific geographic regions, regulatory requirements, or cultural contexts within the logistics ecosystem. Localization ensures that information is

relevant, compliant, and meaningful to stakeholders operating in different locations. It can be related to the following aspects:

Regulatory Compliance: Different regions may have unique regulatory requirements governing transportation, customs clearance, and trade documentation. Localization involves adapting processes and information systems to comply with these regulations, ensuring smooth cross-border movements of goods. For example, localization may involve integrating customs clearance procedures and documentation requirements into the logistics workflow to facilitate international trade.

Cultural Considerations: Cultural differences can also impact communication and information flow within the logistics ecosystem. Localization involves considering cultural nuances and preferences when designing communication strategies and interfaces. For example, providing multilingual support and culturally sensitive communication can improve stakeholder engagement and collaboration across diverse cultural backgrounds.

Geographic Considerations: Geographic factors such as infrastructure limitations, weather conditions, and transportation networks can influence logistics operations and information flow. Localization involves tailoring logistics strategies and information systems to address these geographic challenges effectively. For example, optimizing transportation routes based on local infrastructure conditions and weather forecasts can help minimize delays and disruptions in goods delivery.

Customer Preferences: Localization also extends to meeting the unique preferences and requirements of customers in different markets. Understanding local customer preferences, delivery expectations, and service standards is essential for providing a seamless and satisfactory experience. Localization involves customizing services, communication channels, and delivery options to meet the specific needs of customers in each market segment.

In summary, ensuring consistency and localization in information flow within the logistics ecosystem is essential for promoting efficiency, compliance, and customer satisfaction. By promoting consistent access to relevant information and adapting processes to local contexts, stakeholders can unlock operational synergies, mitigate uncertainties, and deliver value across the supply chain.

5.1.5. Assessment of Existing Security Mechanisms

Assessment of existing security mechanisms within any system, particularly within the context of transportation and logistics, is a multifaceted endeavour requiring a comprehensive understanding of the diverse threats, vulnerabilities, and mitigating measures involved. In today's interconnected and globalized world, where the movement of goods is critical for economic prosperity, ensuring the security of transportation systems is paramount to safeguarding not only the flow of commerce but also the safety of individuals and the integrity of supply chains.

Before delving into the assessment of existing security mechanisms, it's crucial to understand the broad spectrum of threats faced by transportation systems. These threats range from physical attacks, such as terrorism, sabotage, and theft, to cyber threats targeting critical infrastructure, including ransomware attacks, data breaches, and system vulnerabilities. Moreover, natural disasters, accidents, and geopolitical tensions further compound the complexity of the threat landscape, underscoring the need for robust security measures.

Identifying vulnerabilities within transportation systems is essential for devising effective security strategies. Vulnerabilities can stem from various sources, including outdated infrastructure, inadequate security protocols, human error, supply chain disruptions, and insufficient coordination among stakeholders. Conducting vulnerability assessments involves analysing infrastructure weaknesses, operational gaps,

regulatory compliance issues, and emerging threats to pinpoint areas requiring immediate attention and remediation.

Assessing the effectiveness of existing security mechanisms entails evaluating the policies, procedures, technologies, and resources deployed to mitigate identified threats and vulnerabilities. This assessment encompasses a thorough review of physical security measures, such as surveillance systems, access controls, perimeter fencing, and security personnel, as well as cybersecurity protocols, encryption methods, network monitoring tools, and incident response plans. Furthermore, assessing the resilience of supply chains, emergency response capabilities, and contingency plans is vital for addressing unforeseen disruptions and crises.

Conducting a gap analysis involves comparing the current state of security measures against established standards, best practices, regulatory requirements, and industry benchmarks. Discrepancies identified during this process highlight areas requiring improvement and investment. Risk management plays a pivotal role in prioritizing mitigation efforts based on the severity and likelihood of potential threats. Implementing risk mitigation strategies, such as risk transfer, risk avoidance, risk reduction, and risk acceptance, enables organizations to proactively address security challenges and minimize their impact.

Incorporating emerging technologies, such as artificial intelligence, machine learning, blockchain, biometrics, and Internet of Things (IoT) devices, into security frameworks offers new opportunities for enhancing threat detection, response capabilities, and resilience. Leveraging advanced analytics and predictive modelling enables proactive threat intelligence gathering, anomaly detection, and behaviour analysis, empowering security personnel to anticipate and mitigate security breaches before they occur. Moreover, blockchain technology enhances the integrity and transparency of supply chains by enabling secure and immutable data sharing among stakeholders, thereby reducing the risk of fraud, counterfeiting, and tampering.

Effective security assessments require collaboration and coordination among government agencies, law enforcement authorities, private sector entities, academia, and international partners. Sharing threat intelligence, best practices, and lessons learned fosters a collective response to evolving security challenges and promotes information sharing and capacity building. Additionally, adopting a culture of continuous improvement ensures that security mechanisms remain adaptive, agile, and resilient in the face of emerging threats and changing operational environments. Regular audits, exercises, and training programs help validate the effectiveness of security measures, identify areas for enhancement, and foster a culture of preparedness and vigilance.

In conclusion, assessing existing security mechanisms within transportation systems necessitates a holistic approach that encompasses threat assessment, vulnerability analysis, evaluation of current security measures, risk management, integration of emerging technologies, collaboration among stakeholders, and a commitment to continuous improvement. By prioritizing security investments, enhancing resilience, and fostering a culture of security awareness, organizations can mitigate risks, safeguard assets, and ensure the safety, security, and reliability of transportation networks in an increasingly complex and dynamic threat landscape.

5.1.6. Identification of the Use Cases

Now we come to the part crucial for understanding how to proceed with our project in a practical and concrete manner, leveraging real and implementable use cases as much as possible for everyday use.

As we well know, the validation of the keystone solution will be demonstrated within a specific sector, namely that of logistics and transportation. First and foremost, let's seek to understand the definitions of logistics and transportation. It is crucial to grasp the differences between these two terms and, most importantly, their

boundaries in order to design use cases that are as representative as possible and possess unique characteristics usable for the project's purposes.

Logistics: The process of planning, implementing, and controlling procedures for the efficient and effective transportation and warehousing of goods, including services and related information, from the point of origin to the point of consumption with the aim of meeting customer needs. This definition encompasses the procurement of raw materials and semi-finished products, distribution, internal and external movements.

Transportation: The movement of people or things from one place to another via a communication route and using a vehicle.

It's important to note that logistics includes transportation, which is just one part of it. Logistics falls within the realm of goods production, involving shippers, essentially entering the secondary sector, while transportation is a service, predominantly outsourced nowadays, thus falling under the tertiary sector.

With these key points in mind, we will outline use cases for our keystone solution. These use cases will relate to a specific segment of logistics, namely transportation, in our case, the movement of goods from one point to another. As we know, transportation comprises four fundamental elements: the route, the vehicle, stopping points, and driving force. The chosen route defines various “modes” of transportation, such as road, rail, sea, air, and so forth.

In our use cases, we will specifically refer only to a part of logistics, which is transportation. However, this part can be executed in various ways. Transportation can be carried out exclusively through a single mode or utilizing multiple modes. This is the primary criterion we will use for defining our use cases. Hence, we'll have:

1) *Monomodal transportation*: Utilizing a single mode of transportation, in this case, road transportation.

2) *Multimodal transportation*, specifically intermodal (where there is no break in transported cargo): Utilizing more than one mode of transportation. In this specific case, we will choose road and rail transportation.

Restricting the use cases to these two types of transportation, monomodal and multimodal, allows us to appreciate the differences that may arise in each scenario. For instance, there are variations in documentary requirements and regulatory checks during a road shipment compared to a maritime or rail transportation. Moreover, when dealing with the need to transfer intermodal cargo from one mode to another, the process becomes more complex, requiring different procedures, permissions, and involving various authorities. Thus, this kind of situation needs to be analyzed differently.

Furthermore, there could be specific use cases concerning the authorities involved in Transport missions. So far, our perspective has been purely transport-centric; however, we could shift the focus and tailor our use case research not based on transportation but rather on the authorities involved.

1) In this case, there are various types of authorities that may intervene, including customs, law enforcement agencies like the police, financial guards, port captancies, etc. These enforcement authorities play their roles within Transport missions.

2) Moreover, there might be authorities managing specific territories, such as regions, municipalities, or port authorities.

Hence, in our use cases, we'll aim to focus as much as possible on these dichotomies: monomodal vs. multimodal transportation, authorities with control powers vs. authorities without control powers.

As we'll see, generating these use cases will materialize in the actual implementation of pilot actions, derived from this type of reasoning. The subsequent tasks will involve identifying from the listed use cases which ones can serve as pilot actions to demonstrate the validity of the keystone solution.

There's another difference to consider in identifying potential use cases for the keystone project: the fundamental distinction between public and private entities.

1) Public entities naturally have entirely different needs compared to private ones. Public entities, whether enforcement authorities or managers of logistics platforms or territorial authorities like states, regions, or municipalities, have specific requirements, which we'll delineate in subsequent paragraphs.

2) On the other hand, private entities aim to generate profits through their activities and have entirely different characteristics and needs, which also need to be considered in the implementation of pilot actions derived from the identified use cases

In conclusion, our analysis has shed light on several key aspects regarding the development and implementation of our project within the logistics and transportation sector. Here are the main conclusions drawn from our exploration:

1. *Understanding of Logistics and Transportation*: We have clarified the definitions of logistics and transportation, recognizing logistics as a broader process encompassing transportation among other elements. This understanding is crucial for framing our project's objectives and scope accurately.

2. *Use Case Design*: By distinguishing between monomodal and multimodal transportation, and considering the involvement of various authorities, we have laid the groundwork for designing diverse and representative use cases. These use cases will serve as practical demonstrations of our keystone solution's validity and applicability in real-world scenarios.

3. Complexity of Multimodal Transportation: Our examination of multimodal transportation has highlighted its inherent complexities, particularly concerning regulatory requirements, permissions, and the involvement of multiple authorities. Addressing these challenges will be pivotal in ensuring the effectiveness and efficiency of our proposed solution.

4. *Consideration of Public and Private Entities:* Recognizing the differing needs and objectives of public and private entities within the transportation ecosystem is essential. Tailoring our pilot actions to accommodate these distinct requirements will enhance the relevance and impact of our project across various stakeholders.

5. *Focus on Authorities and Enforcement:* The role of authorities, including enforcement agencies and regulatory bodies, is significant in facilitating and overseeing transportation operations. Incorporating considerations related to authority involvement enriches the depth and breadth of our use case scenarios.

6. *Importance of Pilot Actions*: Pilot actions derived from our identified use cases will serve as tangible demonstrations of the effectiveness and feasibility of our keystone solution. These pilot actions should be carefully selected to encompass a range of scenarios and address the specific needs of different stakeholders.

7. *Future Directions*: Moving forward, our focus will be on further refining and implementing the identified use cases and pilot actions. Continuous engagement with stakeholders, rigorous testing, and iteration will be essential for optimizing the performance and scalability of our solution.

By synthesizing these conclusions into actionable strategies, we can advance our project with clarity and purpose, ultimately driving positive impacts within the logistics and transportation domain.

As annex of this analysis on use cases, it is advisable to further explore this type of action by conducting a series of illustrative practices of the aforementioned. We will limit ourselves to two examples that encapsulate all the characteristics and diversities listed in this paragraph.

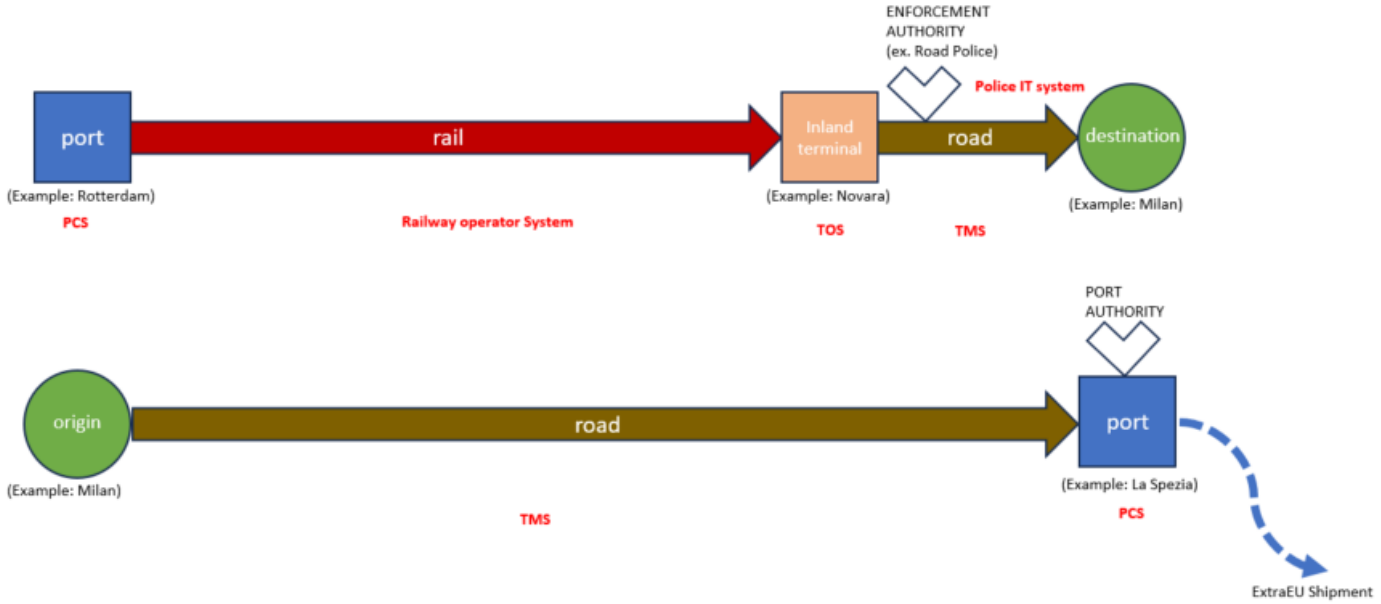

Figure 3: Possible Use Cases

Firstly, let us identify a solution involving multimodal transportation, utilizing various modes of transport. For instance, we have identified an intermodal rail shipment originating from an origin port, such as Rotterdam, and forwarded by rail to an inland terminal, potentially Novara's terminal. Subsequently, the last-mile transportation operation, typically conducted via road, involves enforcement authorities, such as police, which can check for compliance with regulations by carrying out necessary controls. Notably, this operation is entirely carried out by private entities, encompassing both railway and road sectors. Each step in this process is supported by its own information system, which projects like Keystone aim to integrate, forming the transportation ecosystem previously discussed.

In another scenario, a different type of shipment, namely monomodal, predominantly employs a single mode of transport and a single route. In the example provided, road transport via truck is utilized, envisioning the collection of a container from a manufacturing company and its transportation to the loading port. While this shipment is predominantly monomodal, a shift to maritime transport occurs at the loading port. Notably, administrative authorities, like port authorities, are involved in this scenario, albeit lacking powers to penalize compared to enforcement authorities seen previously, as they hold administrative rather than enforcement powers. Additionally, public entities, such as the port authority itself, are involved, with control exerted through systems like the Port Community System.

In the first case, no checks are envisaged in the first leg (rail). The documents are sent to the terminal by the MTO, or the multimodal transport operator, who organizes the transport.

In the second case, moreover, we did not expect any checks during road transport. The interactions with port authority will be realized in advance by a prenotice of arrival to the PCS, possible just thanks to KEYSTONE.

The Cooperative, connected and automated mobility (CCAM) will be considered in the use case selected, gaining the necessary data from the single vehicles involved.

These examples serve as a preliminary exploration into transportation realities, encompassing variables such as private and public entities, regulatory and administrative authorities, monomodal and multimodal transport, among others. The actions undertaken in this task serve as a starting point for subsequent activities, such as those outlined in Work Package 2 and Work Package 4, which will delve deeper into Keystone's objectives. It was deemed fitting to provide an initial concretization at this juncture, enabling progress in the project's developmental steps.

In delving deeper into the processes involved in these two use cases, we'll employ graphical visualization to illustrate the entities involved and the systems reacting to them. Additionally, we'll outline all the necessary steps for information transition between systems.

In the first scenario, we have the road police interfacing with Keystone to obtain truck-related data directly from the Transport Management System (TMS) of the transportation company.

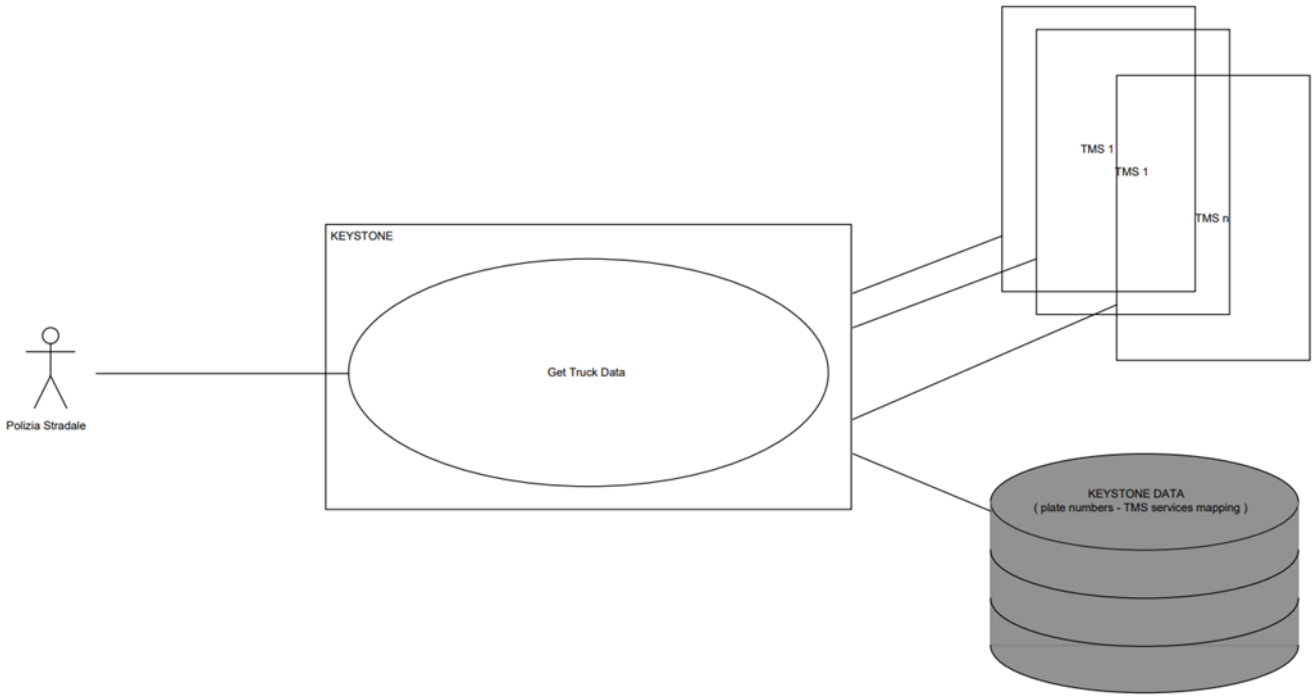

Figure 4: Diagram of Use Case 1

These are the steps of the process:

1) Submit to Keystone the plate number of the vehicle to be checked

2) Keystone obtains the references to the services of the TMS platform of the transport company (by example the Keystone could be configured with a map among plate numbers, transport company and TMS services)

3) Keystone connects to the correct TMS and downloads the data of the truck and the transport identifier

4) The data of the truck are at the disposition of the Polizia Stradale for a check (by example before stopping the truck) optional

5) With the transport identifier it is possible to obtain the data of the transport

In the second scenario, we have a subject interacting with the Keystone interface, specifically the port authority. This authority will acquire transport data from the Keystone interface, which in turn interacts with both the Transportation Management System (TMS) of the transporter and the Port Community System (PCS) of the port authority.

Please note thay the Port Authority is not a completely different entity compared to PCS, but PCS is just the IT system of the Port Authority. The role of PCS is to connect all the stakeholders involved in port operation with a single interface. Between UC1 and UC2 the difference is just in this, we have now a more system to connect to the KEYSTONE solution.

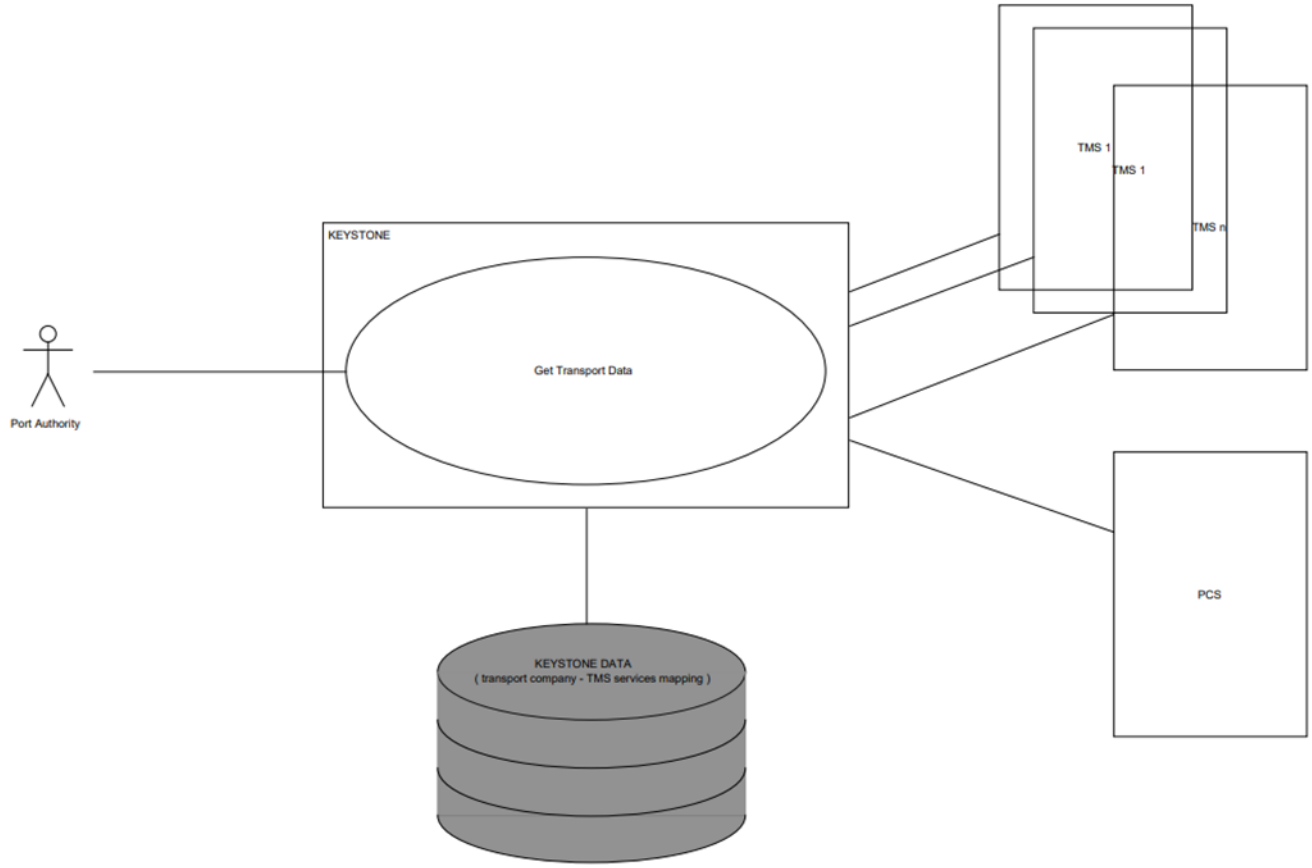

Figure 5: Diagram of Use Case 2

These are the steps of the process:

1) Submit to Keystone the transport identifier and the Transport company name.

2) Keystone obtains the references to the services of the TMS platform of the transport company (by example the Keystone could be configured with a map among transport company and TMS services).

3a) Keystone connects to the correct TMS and downloads the data of the transport (e-CMR).

3b) Keystone connects to the correct TMS and downloads the estimated time of arrival (ETA).

4) Keystone connects and provides data to PCS.

5) Return data downloaded in 3a and/or 3b.

In conclusion, we have thoroughly examined all possible processes related to the two use cases we have chosen to implement. For each of them, processes have been detailed to enable precise intervention at every stage of transportation. This involves identifying the requirements and functionalities necessary for the IT system in use to effectively interoperate with the Keystone platform.

5.2. Use Contexts and Evaluation KPIs

5.2.1. Public Perspective

The role of enforcement authorities in transport is key for achieving several different policy objectives. Different types of enforcement authorities are involved in ensuring compliance with a range of International, EU and national regulations. At borders and ports, custom authorities conduct checks to ensure security and lawful economic activity. On road, the road police as well as transport/labour authorities control for compliance with rules on road safety, social aspects, and fair competition.

To be effective, enforcement authorities need information on different aspects. While customs authorities may be interested only in the data related to goods, the roadside enforcers usually require data also on the driver, the company transporting the goods, the vehicle as well as the type of transport operation being conducted. Below is a list of data points that may interest enforcers involved in a road-side checks:

- Driver: professional competence, authorization to drive and to perform certain road transport operations, records of driving, working and resting times.

- Transport undertaking: authorization to engage in a profession and to operate on the market, good repute, risk score, professional competence.

- Vehicle: technical condition of the vehicle, its weights and dimensions, registration, conformity, required inspections.

- Load: types of goods, authorization for carrying specific goods, cargo securing.

- Transport operation: cabotage, cross-trade, occasional, regular.

The nature of the information required by enforcers may also differ:

- Some information may be available upfront from a primary source to be used as such (e.g. tachograph data)

- Some information may need further validation from authorities in another country from where the driver or vehicle comes from (e.g., validity of licenses and cards.

- Some information may still need to be collected from authorities in another country (e.g., information on past infringements) or from the company to which the driver/vehicle belongs (e.g., documents on posting of drivers and other regulatory compliance documents).

In this context there are several different platforms that are used by enforcement authorities to get the information they still need or validate the information that is available to them. A number of these platforms (including ERRU, Tachonet, RESPER, IMI, eFTI) have been discussed above.

The challenges in relation to these platforms have also been discussed and primarily relate to their multiplicity, lack of access, lack of interconnectivity/interoperability and complexity of use. This creates difficulties for enforcement authorities, which already struggle with limited resources, have short times to complete checks and are faced with increased traffic. Inefficiency during checks can also strain the fluidity of supply chains, resulting in economic losses.

In this context, the solutions offered by KEYSTONE project are important for several different reasons:

- The need to foster connections between different platforms is widespread. It is relevant not only for businesses but also for enforcement authorities, which face difficulties in quickly accessing the information they need due to the lack of a single entry point to different platforms. Having to shuffle through separate platforms on the road to try and gain a holistic picture about the drivers, transport companies and operations is counter-intuitive and can result in frustration and delays.

- At the same time entities may also want to avoid introducing new platforms, distinct from what their officers may be presently using. Since this may lead to organizational costs related to training and familiarization with new platforms, which poses its own challenges.

- Furthermore, the KEYSTONE initiative aligns with the efforts of the European Commission to combine different EU level platforms and ease the difficulties faced by stakeholders in accessing them. As mentioned before, the Digital Transport Logistics Forum (DTLF) has been working to realize the eFTI framework. The European Commission's DG MOVE has also launched a call to understand steps for establishing a Single European Digital Enforcement Area, which intends to identify and assess different models of smart enforcement systems. Similarly, the initiative on a common European mobility data space (EMDS) aims to enable technical, organisational, semantic and legal interoperability for data access, reuse and data-sharing between actors (both public and private).

To measure the success of KEYSTONE for the public (enforcement) authorities it will be important to ensure that public authorities are able to perceive the practical added value that KEYSTONE results can offer during roadside and company checks. While on one hand they should allow authorities to work within their existing systems, on the other they should offer seamless connectivity and a single window entry to different platforms providing information needed for completing the checks.

Ensuring security will also be crucial, as enforcement authorities will be unable to use the information collected during checks in court, if the system providing the information can be manipulated or if its security is shown to be compromised. The system needs to ensure that enforcers receive authentic information that can be used as evidence in court to prove non-compliance with rules.

Lastly, KEYSTONE results should also allow for easy connection with existing EU platforms. The existing platforms (be it ERRU, Tachonet, RESPER or IMI) have been developed after investing considerable time and resources and are undergoing constant evolution, KEYSTONE results should allow for easy connectivity without requiring heavy technical adaptation of these platforms, which may not be feasible due to practical considerations.

5.2.2. Private Perspective

The project represents a significant initiative aimed at fostering interoperability and facilitating the exchange of data between private and public operators within digital ecosystems.

This chapter embarks on a nuanced exploration of use contexts and evaluation Key Performance Indicators (KPIs) specifically tailored to the private sector. Through a comprehensive analysis of various scenarios and stakeholders' needs, coupled with a detailed evaluation framework, this chapter seeks to shed light on optimizing interoperability and standardization practices, ultimately enhancing operational efficiency and fostering innovation within the private sector.

The digital landscape is undergoing rapid evolution, characterized by an increasing reliance on interconnected systems and data exchange between private and public entities. In response to this evolving landscape, the Keystone project emerges as a beacon of innovation, aiming to bridge the gap between these sectors and streamline operations through enhanced interoperability. This chapter specifically focuses on understanding the unique use contexts within the private sector and proposes a robust framework for evaluating Key Performance Indicators (KPIs) to gauge the effectiveness of Keystone implementation.

Within the realm of the private sector, various industries and sectors exhibit distinct use contexts that warrant careful examination. One such area is logistics and supply chain management, where the Keystone system holds the potential to optimize processes such as real-time tracking of shipments, inventory management, and route optimization. By analyzing use cases within this domain, organizations can assess the impact of Keystone on reducing costs, improving delivery timelines, and enhancing overall customer satisfaction.

Similarly, in the realm of manufacturing and production, interoperability facilitated by Keystone can significantly streamline processes and enhance production efficiency. Use cases such as predictive maintenance, quality control, and resource optimization highlight the potential benefits of Keystone integration. Organizations can evaluate the impact of Keystone on minimizing downtime, reducing defects, and increasing overall equipment effectiveness, thus driving productivity and profitability within the manufacturing sector.

Another crucial area of focus is intermodal transport, where Keystone plays a pivotal role in enhancing data exchange between different modes of transportation, such as rail, road, air, and sea. By optimizing intermodal transport operations through features such as multimodal route planning and modal shift optimization, Keystone enables organizations to improve efficiency and sustainability in transportation networks. Evaluating the effectiveness of Keystone in reducing transit times, minimizing environmental impact, and enabling seamless information exchange becomes essential in this context.

To measure the success of Keystone implementation within the private sector, it is imperative to define robust evaluation KPIs across various dimensions. These include assessing data quality and integrity, measuring the level of interoperability achieved, quantifying operational efficiency and cost savings, and evaluating the impact on customer experience and satisfaction. Through a structured evaluation framework, organizations can effectively gauge the effectiveness of Keystone implementation and identify areas for improvement.

Case studies and best practices further elucidate the practical implications of Keystone within the private sector. By showcasing real-world examples of organizations leveraging Keystone to optimize supply chain management, streamline manufacturing processes, and enhance intermodal transport operations, this chapter provides valuable insights into the potential benefits and challenges associated with Keystone implementation.

In conclusion, the Keystone project holds immense potential for revolutionizing operations within the private sector by enabling seamless interoperability, data exchange, and standardization practices. By understanding use contexts and defining robust evaluation KPIs, organizations can harness the full benefits of Keystone implementation, driving innovation, efficiency, and competitiveness in the digital era.

6. Conclusions

6.1. Synthesis of Theoretical and Practical Components

The synthesis of theoretical and practical components is essential for the success of any project, especially in complex domains such as logistics and transportation. This section explores the integration of theoretical frameworks with practical implementations within the context of the KEYSTONE project. The KEYSTONE project aims to transform digitalized transport ecosystems by bridging the gap between theoretical advancements and real-world applications. Through a comprehensive analysis of logistics and transportation, the project seeks to design use cases that reflect the complexities of the industry while addressing the diverse needs of stakeholders. By synthesizing theoretical insights with practical considerations, the KEYSTONE project aims to drive positive change and innovation within the logistics and transportation domain.

The integration of theoretical frameworks with practical implementations is crucial for advancing innovation and driving positive change within complex domains. In the logistics and transportation sector, this integration is particularly important due to the diverse range of challenges and stakeholders involved. The KEYSTONE project exemplifies this integration by combining theoretical advancements with real-world applications to revolutionize digitalized transport ecosystems. This chapter synthesizes the theoretical and practical components of the KEYSTONE project, highlighting its innovative approach to addressing industry challenges and driving positive outcomes.

The theoretical framework of the KEYSTONE project is rooted in comprehensive research and analysis of logistics and transportation systems. This framework encompasses a deep understanding of logistics processes, transportation modes, stakeholder dynamics, regulatory frameworks, and technological advancements. By leveraging theoretical insights from academia, industry best practices, and regulatory standards, the KEYSTONE project aims to develop innovative solutions that address key challenges within the logistics and transportation domain.

The practical implementation of the KEYSTONE project involves the design and execution of pilot actions derived from theoretical insights. These pilot actions serve as tangible demonstrations of the project's validity and applicability in real-world scenarios. By focusing on use cases that encompass both monomodal and multimodal transportation scenarios, the project aims to address the complexities of the industry while catering to the diverse needs of stakeholders. Additionally, the project considers the involvement of various authorities and the differing requirements of public and private entities, ensuring that solutions are tailored to meet the specific needs of different stakeholders.

The synthesis of theoretical insights with practical implementations is achieved through a holistic approach that emphasizes collaboration, innovation, and stakeholder engagement. By involving a diverse range of stakeholders, including industry players, regulatory bodies, and academic experts, the KEYSTONE project ensures that its solutions are relevant, impactful, and sustainable. Furthermore, the project adopts an iterative approach to solution development, allowing for continuous refinement and optimization based on real-world feedback and insights.

Several case studies exemplify the synthesis of theoretical and practical components within the KEYSTONE project. These case studies showcase the project's innovative approach to addressing industry challenges and driving positive outcomes in logistics and transportation. From designing use cases that reflect the complexities of multimodal transportation to developing solutions that cater to the differing needs of public and private entities, the KEYSTONE project demonstrates the power of integrating theoretical insights with practical implementations.

Looking ahead, the KEYSTONE project aims to continue bridging theory with practice by further refining and optimizing its solutions. This includes expanding the scope of pilot actions, scaling up implementation efforts, and fostering collaboration across the logistics and transportation ecosystem. By remaining adaptive and responsive to evolving industry trends and challenges, the project seeks to drive continued innovation and positive change within the logistics and transportation domain.

In conclusion, the synthesis of theoretical and practical components is essential for the success of the KEYSTONE project and similar initiatives within the logistics and transportation sector. By integrating theoretical insights with practical implementations, the project aims to transform digitalized transport ecosystems and drive positive outcomes for stakeholders. Through collaboration, innovation, and stakeholder engagement, the KEYSTONE project exemplifies the power of bridging theory with practice to address industry challenges and unlock new opportunities for growth and development.

6.2. The importance of the two different perspectives (private and public) for Digital Ecosystem, its interface, and its functionality

Digital ecosystems have become integral components of modern economies, facilitating interactions among diverse stakeholders and driving innovation and growth. However, the perspectives of both private and public entities within these ecosystems play crucial roles in shaping their interface and functionality. This section explores the importance of considering these perspectives in the design and implementation of digital ecosystems, highlighting their implications for interface design, functionality, and overall effectiveness. By examining the unique needs, objectives, and challenges faced by private and public entities, this chapter offers insights into how digital ecosystems can be optimized to accommodate diverse stakeholders and foster collaboration and innovation.

Digital ecosystems have emerged as dynamic environments where various stakeholders interact, collaborate, and innovate to create value and drive economic growth. These ecosystems encompass a wide range of actors, including private companies, public organizations, academia, and individuals, all contributing to the exchange of goods, services, and information. However, the perspectives of private and public entities within these ecosystems differ significantly, with each having distinct needs, objectives, and constraints. Understanding and accommodating these differences is essential for designing digital ecosystems that are inclusive, effective, and sustainable.

From a private perspective, companies operating within digital ecosystems are primarily concerned with generating profits, gaining market share, and maintaining competitiveness. Private entities seek to leverage digital technologies to streamline operations, enhance customer experiences, and drive innovation in products and services. As such, their priorities often revolve around efficiency, scalability, and profitability. Interface designs and functionalities that cater to the needs of private entities should focus on facilitating seamless transactions, data exchange, and value creation while minimizing friction and complexity.

In contrast, public entities within digital ecosystems, such as government agencies, regulatory bodies, and public utilities, have different objectives and priorities. Public organizations are tasked with serving the public interest, ensuring compliance with laws and regulations, and promoting fairness, equity, and transparency. Their involvement in digital ecosystems often revolves around providing essential services, enforcing regulations, and safeguarding public welfare. Interface designs and functionalities aimed at public entities should prioritize accessibility, accountability, and inclusivity while upholding principles of governance and social responsibility.

Considering the divergent perspectives of private and public entities is crucial for informing interface design decisions within digital ecosystems. Interfaces should be intuitive, user-friendly, and adaptable to

accommodate the varying needs and preferences of different stakeholders. For private entities, interfaces should prioritize efficiency, customization, and seamless integration with existing workflows and systems. Meanwhile, interfaces designed for public entities should emphasize transparency, accessibility, and compliance with regulatory requirements to ensure accountability and public trust.

The functionality of digital ecosystems must also align with the needs and objectives of both private and public entities. Private entities may require features such as secure payment processing, data analytics tools, and integration with third-party services to support their business operations. On the other hand, public entities may need functionalities for data governance, regulatory compliance, and public engagement to fulfill their mandates effectively. Balancing these requirements while maintaining interoperability and scalability is essential for the overall success of digital ecosystems.

Despite their differences, private and public entities within digital ecosystems have opportunities for collaboration and mutual benefit. Private companies can leverage public resources, data, and expertise to enhance their offerings and expand their market reach. Similarly, public entities can partner with private firms to leverage innovative technologies, streamline service delivery, and improve overall efficiency and effectiveness. Interface designs and functionalities should facilitate such collaborations by providing interoperable platforms, standardized protocols, and transparent governance frameworks.

Designing digital ecosystems that cater to the needs of both private and public entities presents several challenges and considerations. These include addressing privacy and security concerns, ensuring data sovereignty and regulatory compliance, and fostering trust and cooperation among stakeholders. Additionally, addressing disparities in resources, capabilities, and expertise between private and public entities requires careful planning, coordination, and stakeholder engagement.

In conclusion, the perspectives of both private and public entities are essential considerations in the design and implementation of digital ecosystems. By understanding the unique needs, objectives, and challenges faced by these stakeholders, designers and developers can create interfaces and functionalities that accommodate diverse requirements while fostering collaboration and innovation. Digital ecosystems that effectively balance the interests of private and public entities have the potential to drive economic growth, promote social welfare, and enable sustainable development in the digital age.

6.3. Significance of Bridging WP1 and WP4

In the realm of project management, the seamless coordination between different work packages (WPs) is vital for the success of any endeavor. Within the context of the KEYSTONE project, the integration of WP1 (Theoretical Foundation) and WP4 (Practical Implementation) holds particular significance. WP1 sets the theoretical groundwork through research and analysis, while WP4 is tasked with translating these theoretical insights into tangible outcomes. This section delves into the importance of bridging WP1 and WP4, the challenges encountered in this process, and the strategies to facilitate collaboration and integration.

The integration of WP1 and WP4 is paramount for ensuring that the theoretical knowledge gained in the initial stages of the project is effectively translated into practical applications. WP1 provides valuable insights into the complexities of the digitalized transport ecosystem, identifying key challenges, stakeholder needs, and opportunities for innovation. Meanwhile, WP4 is responsible for implementing solutions derived from this theoretical foundation. By bridging the gap between WP1 and WP4, project managers can ensure that theoretical insights are effectively translated into tangible outcomes, thereby driving innovation and fostering positive impact within the project.

Despite its significance, bridging WP1 and WP4 poses several challenges for project managers. One such challenge is the presence of communication barriers between theoretical researchers and practical implementers. Differences in language, terminology, and communication styles can hinder effective collaboration and understanding between the two groups. Additionally, misalignment of objectives and expectations may arise, with WP1 researchers prioritizing academic rigor and theoretical exploration, while WP4 implementers focus on practical outcomes and deliverables. Time constraints and resource limitations further exacerbate these challenges, making it difficult to synchronize activities and allocate resources effectively across WP1 and WP4.

To overcome these challenges and bridge WP1 and WP4 effectively, project managers can employ several strategies. Firstly, establishing clear communication channels between WP1 researchers and WP4 implementers is crucial. Regular communication and collaboration facilitate information exchange, feedback, and updates, fostering a shared understanding of project objectives and requirements. Interdisciplinary teamwork between researchers and implementers is also essential, as it allows for the integration of diverse perspectives, expertise, and skills in problem-solving and solution development. Aligning objectives and expectations between WP1 and WP4 ensures that all stakeholders are working towards common goals, minimizing misunderstandings and conflicts. Additionally, adopting a phased approach to project implementation allows for iterative development, testing, and refinement of solutions, mitigating risks and uncertainties. Finally, strategic resource allocation ensures that sufficient support is provided for research, development, implementation, and evaluation activities across WP1 and WP4, maximizing the project's impact and value.

Bridging the gap between WP1 and WP4 is imperative for the success of the KEYSTONE project and similar initiatives in project management. By effectively translating theoretical insights into practical actions and outcomes, project managers can accelerate innovation, drive positive impact, and achieve project objectives. Despite the challenges involved, employing strategies such as clear communication, interdisciplinary teamwork, alignment of objectives, phased approaches, and strategic resource allocation can facilitate collaboration and integration between theoretical knowledge and practical application. Ultimately, by bridging WP1 and WP4, project managers can optimize project outcomes, enhance stakeholder satisfaction, and contribute to the advancement of the project's goals.

6.4. Preview of Next Steps - Detailed Use Cases (Task 4.2) and Evaluation Methodology (WP5)

As the KEYSTONE project progresses, the focus shifts towards Task 4.2, which involves the development of detailed use cases, and WP5, which focuses on establishing an evaluation methodology. These next steps are critical for translating theoretical insights into practical solutions and assessing the effectiveness and impact of the project's outcomes. This section provides an overview of Task 4.2 and WP5, highlighting their objectives, challenges, and potential strategies for success.

Task 4.2 represents a pivotal stage in the KEYSTONE project, where theoretical insights from WP1 are translated into detailed use cases for practical implementation in WP4. The objective of Task 4.2 is to design use cases that reflect the complexities of the digitalized transport ecosystem while addressing the diverse needs of stakeholders. These use cases serve as blueprints for pilot actions, demonstrating the validity and applicability of the project's solutions in real-world scenarios.

Developing detailed use cases presents several challenges for project teams. One challenge is ensuring that the use cases accurately capture the intricacies of the digitalized transport ecosystem, including various transportation modes, stakeholder interactions, regulatory requirements, and technological dependencies. Additionally, balancing the needs and priorities of different stakeholders within the use cases requires careful

consideration and stakeholder engagement. Furthermore, aligning the use cases with the project's overarching objectives and budget constraints can be challenging, as it may involve trade-offs and compromises.

To overcome these challenges and succeed in Task 4.2, project teams can employ several strategies. Firstly, conducting thorough research and stakeholder analysis is essential for understanding the complexities and dynamics of the digitalized transport ecosystem. Engaging with stakeholders through focus groups, interviews, and workshops can provide valuable insights into their needs, priorities, and pain points, informing the development of use cases. Additionally, adopting an iterative approach to use case development allows for feedback and refinement based on real-world insights and feedback. Collaborating closely with WP1 researchers and other project partners ensures alignment with theoretical insights and project objectives, fostering synergy and cohesion across work packages. Furthermore, considering scalability, interoperability, and sustainability in use case design enables solutions that can be scaled up and adapted to different contexts and environments.

WP5 focuses on establishing an evaluation methodology to assess the outcomes, impacts, and effectiveness of the KEYSTONE project. The objective of WP5 is to ensure that the project's solutions adhere to ethical, legal, and social standards while maximizing their positive impact on the digitalized transport ecosystem. This involves developing metrics, tools, and frameworks for evaluating the performance, efficiency, and sustainability of the project's outcomes.

Establishing an evaluation methodology poses several challenges for project teams. One challenge is defining clear and measurable metrics for assessing the outcomes and impacts of the project's solutions. This may involve selecting appropriate indicators, data collection methods, and evaluation criteria that align with project objectives and stakeholder needs. Additionally, addressing ethical, legal, and social implications requires navigating complex regulatory landscapes, privacy concerns, and stakeholder expectations. Furthermore, ensuring the reliability, validity, and relevance of evaluation findings requires robust research methods, data analysis techniques, and validation processes.

To overcome these challenges and succeed in WP5, project teams can employ several strategies. Firstly, engaging stakeholders throughout the evaluation process ensures that their perspectives, priorities, and concerns are taken into account. This may involve establishing an evaluation advisory board comprised of external experts, stakeholders, and project partners to provide guidance and oversight. Additionally, aligning evaluation metrics with project objectives and stakeholder needs ensures that the evaluation is relevant, meaningful, and actionable. Furthermore, adopting a participatory approach to evaluation enables stakeholders to actively contribute to the design, implementation, and interpretation of evaluation findings, fostering ownership and accountability. Finally, fostering transparency, openness, and accountability in the evaluation process enhances credibility, trust, and confidence in the project's outcomes and impacts.

Task 4.2 and WP5 represent critical next steps in the KEYSTONE project, where theoretical insights are translated into practical solutions and their effectiveness is assessed. While both tasks pose unique challenges, they also present opportunities for innovation, collaboration, and impact. By employing strategies such as thorough research, stakeholder engagement, iterative development, and participatory evaluation, project teams can overcome challenges and achieve success in Task 4.2 and WP5. Ultimately, these next steps are essential for driving positive change and innovation within the digitalized transport ecosystem, enhancing efficiency, sustainability, and resilience.

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