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Management models for the EU inland freight transport industry at the convergence with the knowledge economy

ABSTRACT

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The current research was directed towards answering a series of questions related to the possibility of bringing innovation into the inland freight transport sector, and possibly transforming the way in which business operations and activities are performed.

The **first chapter** of the thesis projects around the reasoning behind following the above-mentioned topic, as well as answering to the research questions: Is the EU freight transport industry transforming into a knowledge intensive business service? Will it become a significant part of the knowledge economy? Does the public policy agenda try to shift the gear into this direction? The freight transport sector is intrinsically a secondary demand within the background of economic activity, and it mostly comprises of services – either for shipments and distribution, or for logistics and storage. The current research is mainly focused on the distribution dimension of the freight transport sector, by considering the inland transport modes – road, rail, and inland waterways. The discussion, from its initial stage to its dissolution, revolves around the actual status of the sector, as well as possible/probable conditions that might arise given changes within. The entirety of the research is, basically, a manuscript of general knowledge, measured responses from the industry (through econometric analyses), and personal inputs on the topic. Moreover, the main scope of the paper resides in the investigation for the discovery of the future application and impact of the freight transport through the statistics and policy within the knowledge economy and KIBS sector. The EU international freight transport industry has been a particularly close topic within the author's research performed in the last three years. The direction towards discovering and unveiling some truths about this business sector started as very personal and with direct and subjective importance. As a derived demand, the freight transport is not a huge value-adding economic sector and might be perceived as a necessary bad. The freight transport sector within the European Union refers to all the activities that are performed with the ultimate scope of distributing freight goods from point A to point B in order to feed the economy with final products and/or services. Although its activities are fundamentally linked to the extensive usage of heavy machinery, the freight transport sector is providing a connectivity service to all the other economic sectors. The fact that the freight transport is a service brings a conditioning to the overall mechanism, especially at the precipice of innovation and technology, of extensive ICT inclusion, and of widely spread knowledge creation. The management dimension is to be assessed, through the understanding of different impact levels based on types of enterprises involved in the service provision. Since the greater part of the freight transport sector in the EU is carried out by SMEs active in the road freight transport, since the modal split heavily relies on the road traffic, and

since the public policy attention towards the freight transport is growing, the research will imperatively command and focus on those aspects when dealing with the topic.

The **second chapter** of the research brings into discussion the knowledge around inland freight transport public policy through the gate of management in decision-making and impact assessment, by running throughout the history of the subject, and gradually underlining its impact on the economic activities and organisations. Moreover, the paper forwarded notions related to the societal behaviour and the changes that occurred through the guidance of the public policies, basically creating the modern infrastructure of connected links between the population, the economy, and the governmental authorities. The public policy has gradually succumbed to the idea of innovation and technology, and its realm of application, by acknowledging its formative and evolutive behaviour on the business sector, as well as on the society at large. Across the observations aligned with historical moments, the clarity of the power behind knowledge for the policy decision-making processes brought up new dimensions in the application of neoliberal policies, including the notorious Single European Act. The latter was the culmination of all ideas for economic growth, venture capitalism, international validity, and fair trade and competition agreements. It also meant that the social progress, global recognition, and economic growth were the backbone of the European public policy. From that moment onward, the European Union started a movement towards cohesion, development, convergence, transformation, with the vision of constructing a space for growth and inclusion. The dimension of the public policy within the business sector was genuinely pursued through the formulation of the Small Business Act for Europe, recognising the paramount importance of the SME sector in the economy. Subsequently, all the strategies included in directives and regulations have been based on innovation, technologization, knowledge transfer, and international cooperation.

Generally, a public policy has one of three possible roles, and those can be restrictive, facilitating, or regulatory. Starting in 2017, the EU proposed a series of public policies contained under the name of Mobility Package, a three-stage legislative body created with the scope of bettering the opportunities of the human capital, and those of the active businesses across EU. The first part of the package was voted in July 2020, and most of its proposals will come in effect starting from the second half of 2021. The directives have a direct and significant impact on the freight transport industry, so much so that it makes one raise the following questions: how can one understand and decide what is the right direction, without first having a global perspective? What does it happen when the policies are more restrictive and protectionist than facilitating and regulatory? What is an economy without a solid backbone –

its infrastructure and freight transport? How do goods circulate and arrive to the European consumer? Why are there differences between transport SMEs from Western versus Eastern European countries?

The European Union has regulated the movement of people and goods throughout the Member States within the Common Transport Policy, integrated in the Treaty of the Functioning of the EU, at Title VI, art. 90-100. The latter comprises of legislation regarding customs, fuel consumption, climate change, human capital rights, consumer rights, market liberalisation, implementation of the TEN-T network, etc. From this perspective, the main priority of the EU has been that of creating a common transport market, and, thus, offering the opportunity to provide services across borders and to enter intercommunity markets. Moreover, the standardisation process across the EU for all the regulations and directives had the advantage of working on fair competition and market access for each mode of transport – road, rail, inland waterways, pipelines, and air. Some of the effects of the standardisation process included the increased competition (within the EU, and internationally from an economic perspective, as the EU experienced volume and value-added growth), drop in transport prices, changed internal dynamics for the transport industry, challenges for a sustainable environment and mobility, and for the innovation and technology allocation within the sector. The inclusion of Eastern European countries in the context of a still developing transport system within the EU has been, to say the least, challenging. The enterprises active in the Eastern European countries determined a significant growth in the traffic volume of transportation across Member States, also implying the probability of congestions and negative effects on the environment and the people of the EU. In 2001, the EC has worked on a White Paper forwarding the reintroduction of multimodal transportation, with particularity on the revival of railway and inland waterways transport modes, the creation of an interlinked infrastructure, the introduction of clear rights and obligations on behalf of users and providers of transport services (especially road safety, and price transparency), as well as the introduction of technology within the system through different projects such as Galileo, ERTMS, SESAR. The European Commission continued to work on further occasions, and developed more action plans in the following years, never losing sight of the aspects addressing logistics, deployment of intelligent transport systems, urban mobility, inland waterway programmes such as NAIADES and NAIADES II, recommendations for maritime transport policy, harmonisation of transport policies across the EU, the creation of a Single European Transport Area, easy access on the market, introduction of more operators on the market, development of precise systems for law enforcement, establishing of minimum standard levels for all the parties

involved in the transport process, decarbonisation of the European transport, developing a zero-emissions transport community, etc. All those topics have been assessed and addressed to some extent in various White Papers, published between 2001 and 2016. From 2015 onward, there was a consistent focused approach to the greening of the transport network within the EU, as Green Papers were pushed upfront, promoting so-called sustainable goals for the environment and the people of the EU – drop in GHG emissions, intermodal integration for efficiency and cost-related reasons, sustainability and accessibility, modern infrastructure, green urban mobility, cohesion, radical innovation, renewable energy sources, alternative fuels, high-tech integration, and autonomous transport systems. In 2018, the TRAN Committee of the EP underlined the importance of multimodal strategies, transparent price strategies and digitalisation of the transport chain.

Already established, the mechanisms and systems created around the freight transport sector are fundamental in the carry-on of daily economic activities. This is the case not only at EU level, but globally. The freight transport supports and promotes the operations across the supply chain, while burdening the entire system with its costs – a double bladed sword. A significant number of enterprises are trying hard to control their transportation costs, in order to remain competitive, but also to survive. For low value-added, high volume freight goods, the transport and its related costs are covering a significant share of the total costs of an enterprise. In this category it can be discussed the case of construction materials, liquid products, etc. Roughly 10% of the total revenue within the EU economy is created by the logistics and transportation services, and those also include the warehousing, inventories, storage, and administration of goods. The degree of efficiency in the transport mechanisms and systems is directly correlated to economic processes, as transport services are responsible for the supply timeframe, the consistency and frequency of the service, the viability of different management systems, and the connectivity to the consumer market. Depending on the type of freight goods, the consumer market requires different approaches. For instance, the perishable goods demand timely and technological transports to ensure their usability and availability on the market. From this perspective, the freight transport sector is determinant in the allocation of costs, with the goal of increasing and guiding the competitiveness in the industry, and of purposefully trigger economic growth.

Within the EU-28, the transport sector (freight and passenger) accounts for 5% of the total labour force in the union. Although the value-added percentage, and the human capital employed might seem ridiculously small compared to other sectors, the freight transport system in the European Union has granted an unparalleled gift to the Member States – the European

integration. The latter was achieved through the creation of the common market, where the trade and connectivity has been facilitated and encouraged via the uniformised transport network. Consequently, the pan-EU legislation, namely transport policies and system development, have determined the open, free access across borders, for a more concentrated and efficient trade. The Single European Market represents one of the most important opportunities for European enterprises and allows for a swift and efficient internationalisation of SMEs. Nevertheless, the regions within the EU that are characterised by limited infrastructure are also those highly affected from an economic and social perspective. The less developed infrastructure is mostly visible in the CEE countries, which, in turn, determines a lower transfer of knowledge and technology, even though the EU transport market liberalisation improved the performance of the TEN-T and, consequently, the functioning of the regional economy.

In the **third chapter**, it is discussed the current direction of the European freight transport sector heavily reliant on the decisions being made in regard to the general energy consumption, as well as the measures to protect the environment. The influence of legislation on the freight transport is determined, to some extent, by the European Agenda for greening the industry. Lately, it has even been the case of underlining the apparent impact the freight transport sector might have on the health of the environment and of the society. The policy decision-makers must abide to such concerns and attend the potential consequences of the situation, through the drafting and implementation of directives. Nevertheless, the freight transport is of paramount importance for the entire economy, meaning that the legislative decisions must follow the path of innovation and high technology implementation. The means by which the greening of the sector can be made is through creative solutions, specific to the potential of each Member State, of each region within the EU. Through the Treaty of Maastricht, the European Union proposed the social and economic cohesion policies, after recognising that the key to development and economic growth relies in a high-tech, innovative transportation system. Furthermore, the EU transport policy considered the potential of the Single European Market, and the relations and communication that could be established with international parties.

The EC has also forwarded a White Paper under the title of Europe on the Move, consisting of 3 legislative packages concerning the mobility within the road freight transport sector. The first policy package includes the following topics – the access to the road haulage market and to the profession for passenger and freight transport operators, the vehicles hired for freight transport, the road charging and tolling, the rules on driving and rest times, the

mobility of workers, the law enforcement, the taxation of vehicles, and the HDVs' CO_2 monitoring and controlling. The regulation is mainly focused on the HDVs, while the LGVs (light goods vehicles) are driving unruled by any enforcement on driver's programme and working time. The tachograph is, momentarily, only used by HDVs. Furthermore, the legislation also included the additional criteria required for the access to the profession of drivers within the road freight transport. The body of law stipulates that the letterbox phenomenon should be obliterated for reasons ranging from unfair competition, to lack of physical documentation at premises. The second mobility package underlines the topics of bus and coach market access, clean vehicle directive, combined transport directive, the CO2 standards for cars and vans, and the battery initiative. The EC has proposed a sustainable development of the road freight transport sector, which implies the upgrade of the fleets and the operations of transport enterprises. The Clean Vehicles Directive (CVD) identifies the vehicles motorised for alternative fuels, which are categorised under lower emission class. The Combined Transport Directive proposes a framework for road, rail and inland waterways combined traffic. This is supposedly more environmentally friendly and sustainable for the transport network. There is also a proposition for the use of e-CMR, and the flexibility of multimodal logistics and freight transport. The third mobility package covers the topics of CO_2 standards for HDVs, the digitalisation process of the freight transport documents for all modes of transport, the deployment of advanced vehicle technology, and the management of infrastructure safety. This third part of the initiative is very much inclined in the direction of turning the freight transport market into a digital, knowledge intensive service sector. In 2018, the EC released the CO_2 emission performance standards for HDVs, classified into four categories, for the decarbonisation of the sector. This was supposed to incentivise the transport carriers to opt for greener technologies, since the EC has lifted all toll costs for 2019 and 2020. The target for CO_2 emission levels was to decrease by 25% until 2025. The pandemic did part of the job, although the number of enterprises buying into electric and/or alternative fuel engine vehicles is still marginal. The Commission also proposed a credit system, which offers manufacturers flexibility in their task completion, and allows them to further invest in innovative technologies. The EC made sure to keep the VECTO tool updated, and to include fuel-efficient technologies. The idea was to create an Intelligent Transport System (ITS), which supports the electronic freight transport information regarding customs, logistics, e-CMR, etc. The strategy for road safety was included in 2018 in an action plan, which creates the new policy framework for the period 2021-2040. This plan was realised according to the ETAC in 2005. The EC also worked on an impact assessment on the propositions made and has come

upon some challenges regarding the coherence and consistency of the proposal, of the mechanisms and the reasoning behind the legislation. The proposal directed changes in the cabin design of the HDVs in the idea of safer conditions for the driver, such as better visibility, better performance when driving in lower gears, etc. The plan included the implementations of systems for the detection of vulnerable road users, as to avoid any road hazards. The legislative package is based on the convergence of all Member States to the data exchange for multi-platooning, standardised data formats, and, later, deployment of fully autonomous vehicles.

The directives for the rail freight transport are comprising of the following topics – ensuring the compatibility of the EU rail system, the organisation of the international carriage by rail (OTIF), ensuring a safe and interoperable railway area in the EU, the creation of the European rail network for competitive freight transport, the monitoring of rail freight transport statistics, the telematic applications for freight transport on the rail system in the EU, the implementation of the Single European Railway area, state aid for railway companies, and rail safety.

The legislative measures for IWT are consistent with a wide range of dimensions, including fleet capacity of inland waterway transport, that would help promote this mode of transport, an additional regulation laid out the measures for implementing the fleet capacity policy, the development of competitiveness and sustainability of the inland waterway transport, and the equipment and commercial vessels for transport, except for the vessels shipping on the Danube, or those used exclusively to store goods. Moreover, the rules apply to those EU countries that have a fleet capacity of over 100000 tonnes, and that have an inland waterway connectivity to other countries. Those Member States are obligated to have separate funding reserves for carriers, tankers, and pusher vessels. The funds can be accessed in case of market disruptions. The regulation also states that any new vessel purchase would either determine the necessity to pay a fee, or to scrap old vessel in turn. The regulations include additional measures, such as information support for workers in the sector, vocational training, skills' improvement, initiatives to join trade associations, support in upgrading of vessels, incentives for innovation in vessel craft and environment protection, financial facilities (e.g., Horizon 2020, Connecting Europe Facility), the port infrastructure and enhanced port security, introducing measures for the handling capacity in case of threats and incidents. Each port has a designated port authority, responsible for the identification and implementation of specific security measures based on prior port assessment and planning. The inland navigation and the market access on the inland waterway transport sector are introduced in six bodies of regulation, and two directives, formulating the competition rules, the fleet capacity, the

chartering of contracts and pricing, the conditions for freight goods transport operators, access to carrier market through qualifications, Rhine navigation conditions, and eradication of transport discrimination. The focus of legislation is the market liberalisation through free access of IWT operators, through the dismantling of unfair market practices, especially related to taxation and pricing, the fair competition rules for carrier occupation. One interesting aspect of the inland waterway legislation refers to the river information services (RIS), discussed in five regulation bodies and one directive, drafted from 2005 to 2019, and proposing the rules on technical specifications for electronic ship reporting, vessel tracking systems, electronic chart display and information system for inland navigation, notices to skippers, technical guidelines referring to the planning, implementation and management of RIS usage, and harmonised RIS across the EU Member States. The RIS system was set in place to increase the competitiveness of the sector, to optimise the existing infrastructure, to improve safety and health at work, during inland waterway transports, and to reduce the sector's negative impacts on the environment. The RIS services comprise of the following elements – information about the waterway (geographical, hydrological, administrative), traffic information and management, calamity support, transport management, statistics and customs services, bridge management, transport logistics, law enforcement, and waterway charges and port dues.

In the **fourth chapter** of the paper, it is disclosed the perspective of the knowledge economy, commencing with the statement that the society is based and has evolved around knowledge, and, today, that society is facing a turning point where knowledge is no longer limited to niche markets, but spreads across all economic sectors – in agriculture through the new dimensions imposed by the blockchain technologies, in manufacturing by changing the mechanisms and systems behind not only production processes, but mostly by changing the strategic management approaches, and in services by starting a deconstruction process and turning it into a new historical milestone (e.g., moving the banking system into the cryptocurrency market, shifting from governmental controlled processes toward decentralized, transparent solutions). Within the knowledge economy, there is the context of knowledge intensive activities, and knowledge intensive services, floating around three key dimensions – knowledge, as in expertise, skills, strategic information, knowledge transfer, generation, and diffusion of knowledge at national, regional and global levels; innovation, which permits access to key expertise, change and extent of change, market domination; and spatial proximity, where there are no more boundaries to what it can be achieved.

The next important aspect included in the research is the applicability of knowledge economy dimensions to the inland freight transport sector. This part was as extensive as the

public policy analysis, and followed the dimension of the services revolution, and their impact on the economic development of the area. Furthermore, the intellectual capital was classified as the main generator of knowledge and knowledge intensive services, as well as knowledge transfer. It was established that the high technology sectors are open to absorbance, creation, and transfer of knowledge, through their intensive research and development investments and activities, and through the inclusion of learning networks, and hubs for creative experience and technological expansion. The justification of the inland freight transport sector's possible connection with the knowledge economy was realised by observing one of its major characteristics – interconnectivity at global and regional level. Moreover, the inland freight transport sector has gained considerable attention during the last year, when the health crisis drowned the entire world. Authority bodies and professionals have concluded that freight transport is invariably fundamental, even vital to our existence, and, therefore, the sector must be properly attended. The introduction of innovation and high-efficiency technologies, not only in terms of machinery and transport equipment, but in means of communication, of data transfer, of interoperability across the EU Member States, and inter-modality of the modes of transport, will represent the basis for the new management model of the sector.

The knowledge economy, and the knowledge intensive business services were regarded in the paper through the application of three key dimensions, namely knowledge, innovation, and spatial proximity. Each one of the key dimensions were scrutinised in the research, observed, and analysed in complementarity to the economic system, to the economic growth indicators, through tangent areas consistent with R&D expenditure, patents, publications, education, ICT exports, ICT imports, etc. Furthermore, the innovation was given the perspective of sustainability at the precipice of human, social, economic, and environmental development, and support, challenging the ad infinitum status of the present through new ideas, new knowledge, and new technologies. The radical innovation, and even the incremental innovation, are meant to transform the entire system, although, at this moment, they are faced with a non-continuous character. The spatial proximity characteristic of the KIBS is visible at the level of large enterprises, as they are usually confined within hubs of creativity and technology application.

At this moment, the knowledge economy is visible through extremely restrictive lenses, mainly due to the shifts in the labour market, as schedules and skills changed drastically during the last few years. Consequently, the wave of digitalisation and digital transformation triggered the attention of both public and private entities, as new programmes and new practices are embraced on the market. Nevertheless, the vanguardism of the knowledge economy and the

knowledge intensive business services is momentarily not clearly visible within the inland freight transport sector. Currently, the services have a significant impact on the environment, which is transferred in pollution related policies, on the artefacts (meaning all the outputs of the secondary sector – which basically also include the freight transport), on people, and on the symbols. The latter are represented by information knowledge services that use intelligence within the operations and high-technologized communication structures. These have given birth to the knowledge-intensive business services, a result from the combination of R&D, innovation, technological knowledge, professional knowledge, wide array of information sources, problem specific knowledge, and generic knowledge (or experience, due to supplier-user interaction). Moreover, the terminology was updated to include concepts such as learning by networking, and learning to learn, all in the general acknowledgement that data turned into information, and experience turned into patterns forms the highest level of competitive advantage on the market today. The growing KIBS are the first output of a transitioning and changing economy, as the demand for knowledge increases due to the generalised uncertainty of the structural performance determined by the emergence and development of new technologies. Momentarily, the only plug in this technological expansion resides in regulation and public policy (e.g., environmental regulation, technology-related standards, trade liberalisation, globalisation of production), but the power of many obliterates that of the strong few. That civilization, that went and conquered so many spaces and times, is today going shyly towards the new era – knowledge economy.

The freight transport industry is a derived demand, and has a slow, steady, and small output in the economy. Nevertheless, its impact is considerably higher when observed from a different perspective. Taken into consideration the bigger picture and observing for afar the interconnectivity of the global economy, a single element comes as a constant – the transport industry. Within the latter, two directions are identified – the freight transport and the passenger transport. This paper will further develop the case of the freight transport, where it is understandable the futuristic planning for externalisation of functions and demand for KIBS enterprises. The reasoning behind this option is that like many other services, passenger transport services can be very easily substitutable with goods and self-service. Take for instance the case of new business models in KIBS, especially coming from the technology enterprises, such as Uber – a decentralised passenger transport service with fares and costs considerably lower than those proposed by taxies, but with higher quality of transport than the public transport system. Moreover, the knowledge economy continues to be restricted to insular vanguards, through precision agriculture, advanced manufacturing, and KIBS, although it

should acquire an adaptive operational functioning for the generalised model. The potential of knowledge economy to produce goods and services at any scale would represent an advantage for the SMEs, to the extent to which knowledge remains exclusive due to all sorts of reasons, including financial ones. Considering knowledge production as the most advanced practice, one could argue that this is also the reasoning behind the developments that took place within the human capital and labour force sector. This niched knowledge economy can be observed across all major economies of the world; the interconnectivity of those developed economies offers the perfect system for the spread of people, procedures, ideas, technologies, and other resources. The anthropic habitats supported by the knowledge economy are particularly visible at large enterprises' level, where the latter dominate and factor out elements of the production process for routine displacement or commodification. The elements of the process are structured for the basic use by semi-skilled workers, remotely, under conventional mass production. A practical application of these systematic movements could be observed when a few thousand employees of a USA based enterprise arrange for hundreds of thousands of people located in China to execute routinized segments of the production plan. This mega-enterprise will have an advantage over SMEs in its capacity to bear profitability even in the situation where fixed costs are distributed towards investment in the most advanced equipment. Those enterprises can create ecosystems (e.g., Google, Apple, Microsoft, Amazon) that permit consumer access to a wide array of products/services, and even though the consumers might not be mandated to spend additional costs on the firm's outputs, the simple adherence of many consumers to the organic platform of the enterprise creates more value over time for the latter. The form of that value stems from knowledge, as communities of users generate knowledge and create value greater than that of material products or processes. More so, since, unlike products that are victims of life cycles, knowledge and communities are not degrading over time.

The consistent movements of the economy in terms of labour force and human capital determined a change of skills requirement, as increasingly enterprises employ high-skilled workers. At the same time, the intensity of employment is determined by two major trends: ICT and the ageing of the world's population. With the downfall of natality, enterprises will have a limited supply of skills, and they will be forced into investing in lifelong learning. Consequently, the ICT represents one of the major factors influencing the biased response to skill-based technical change. An OECD study from 2019 showed that technological change represents one of the main causes of fluctuations in the relative demand for unskilled labour in the detriment of the trading agreements with emerging economies. Moreover, the correlation

between PC use and the raise of demand for high-skilled labour has reversed; thus, high-skilled workers use PCs more intensively, rather than PC usage being the major factor in the demand for high-skilled workers. This basically means that the knowledge economy is not a response of the extensive usage of technology in the world today, but rather it was born out of the importance human capital has placed on technology to support the increased set of skills on behalf of the labour force. So, radical innovation gives way to high technology, which is only a mean for the people to further advance the entire economy.

There are three stages in the technologization process of the economy – the digitization, the digitalization, and the digital transformation. The first step of the process, namely digitization, was basically the movement from analogue to digital, while the second was represented by all the introduction of digital technologies into the business model. The final step or the digital transformation of the economy is one topic highly motivating for the European Union. In order to remain competitive on the global market, the EU economic sectors have to ascend to the digital transformation, and the primary focus was on the development of the European network of Digital Innovation Hubs, for which the Commission has converged the mission of supporting the business sector, improving management structures and models, as well as products/services through the intensive usage of digital technologies. According to the European Commission, only 1 out of 5 enterprises in the EU are highly digitalised, as 60% of the large enterprises and 90% of the SMEs are lagging in digital innovation. This revolution was meant to bring sustainable opportunities for all enterprises, but the lack of knowledge on behalf of the latter is prominent in the difficulty to abide and to invest in a certain technology. More so, the gathering and analysis of data is still an issue for most enterprises, and the EC constructed the support they need through the DIHs. The latter provide technical expertise for enterprises to test an idea before investing in it, they also offer trainings and skills development to enterprises so that they have better chances of success. Within the DIHs, enterprises find the support they need to find investments, and they also provide with an innovation ecosystem and a capable network for partnership development. Between 2021 and 2027, the Future Financial Framework will be consolidated as the first ever Digital Europe Programme, directing more than EUR 9 billion in the digital transformation of the European business sector. Among the key elements of the programme will be the uptake of a wide array of technologies, such as artificial intelligence, cybersecurity systems, big data, digital manufacturing, blockchain technologies, etc. Across regions, there are considerable differences between countries and their digital attainment level, as well as their consistency for innovation. The liability comes from countries that could not align during the first wave of digital transformation, which started

in 2020. The moderately innovative countries have incomplete systems for innovation, in science, technology and industry. These are the areas that will face the biggest challenges in order to improve their innovation processes, especially through a reform in policies, strategies and measures that would trigger the densification of the business market and the establishment of international relations. Various national systems present disparities in the way they strategize the institutional frameworks, the organisational management, the R&D investment planning, and the performance measurement. Most public institutions are regulated at national level, but, in the EU, there is a supranational force setting the pace. Moreover, there are also examples of countries where the lack of internal coherence represents a downside of the implementation of innovation processes, and a hindering of the potential to bring to existence a national innovation system. Assessed separately and intrinsically, innovations are merely particularities in technologies that have the characteristic of disturbing the equilibrium of the market dynamics, but a meta-stabilised system can be achieved at a global level. The connection established between knowledge-intensive processes and the social impact of technological innovations can be mediated through management solutions. The configuration of enterprises to address these processes is based on strategic and operational planification, for decision-making to occur at moments when external influence is pinned. The R&D management offers new technological perspectives in planning the economic cycles, based on geographical considerations. An anticipatory system would reduce the uncertainty, and accommodate the continuous influx of novelty in production, thus incurring more knowledge-intensive services. The economy, in its generality, will resemble a living digital creature, which continuously and systematically transforms and evolves, by learning from its own environment and from its internal structure. The meaning of information is codified through knowledge, as big data is gathered, analysed, and transformed. In 1986, the OECD has addressed for the first time, and defined the notion of knowledge-intensity in the manufacturing sector, based on the R&D intensity. The calculation of the knowledge-intensity in any given sector would have been the ratio between R&D expenditure to the GDP at national level, or value-added at the level of the sector. Later on, this method was expanded to encompass also the technology embodied in the purchasing process of immediate and capital goods, which ensured the application to the services' sector. The latter is rather more of a technology user than a technology producer.

As part of the knowledge economy, public policies must also focus on promoting innovation and technology transfer. Moreover, the trend is not intrinsically characteristic to the innovation policy, as broader policies must also abide to this new movement, including education policy, regional development policy, etc. Therefore, here is the reasoning behind

testing the freight transport market output against regressors such as teachers per 1000 people, tertiary graduates per 1000 people, urban population, higher education attendance alongside R&D and innovation related indicators. The testing would enforce the correlations between the transformation of the freight transport into KIBS, and the overall inclusion into the knowledge economy. Based on that assumption, an advanced economy, with the highest form of production being knowledge, presents connections and establishes relationships between the higher education and consistent focus on R&D and innovation (elements extensively discussed and regulated by public policy), and any sector of the given economy, including the chain that interlinks all the activities performed on the market, namely the freight transport sector. The Triple Helix model introduces the high performance of the interconnectivity established between academia, business, and government, for the proliferation of knowledge transfers, and for the sharp uptrend of innovation research and technology allocation to everyday activity. The creation of these trilateral connections, networks and partnerships represents the first step in the push towards new organisational mechanisms that would act as incubators for science and technology. Some examples of such hubs of technology are visible within the group of high-tech companies and venture capital enterprises, that managed to become the main generators of innovation, economic growth, and community building.

At regional level, the European Union motioned towards the creation and implementation of various indicators and programmes to develop and assess the performance of the domestic enterprises in the direction of innovation and technological adoption. One of the means applied by the EU for this assessment is the European Innovation Scoreboard, which comparatively observes the R&D and innovation performance of the Member States. This is particularly helpful to the policy decision-makers, and functions as a framework for instituting the next order of regulation and directives, by observing the strengths and weaknesses, tracking the progress, and identifying the priorities for each Member State. The innovation performance is calculated through indicators such as R&D expenditure, human resource and employment, and innovation activities within enterprises, and results in four performance groups – innovation leaders, strong innovators, moderate innovators, and modest innovators.

The EC has released the documentation on the performance of EU Member States' innovation systems, categorising the Member States based on innovation performance, namely innovation leaders, comprising of countries such as Sweden, Finland, Denmark, the Netherlands, and Luxembourg, the second group represented by Belgium, Germany, Austria, Ireland, France, and Estonia as strong innovators, while most of the other EU countries were classified as moderate innovators, with only Romania and Bulgaria as the only two modest

innovators. Some of the main elements that were observed as applied by those high-ranked countries are represented by developed research systems, with intracommunity partnerships and networks, innovation hubs for SMEs (with Portugal being the leader in this initiative), public-private cooperation and funding programmes, as well as development of intellectual assets and human capital. Conclusively, the national and supranational public policy in the EU Member States has been focused on keeping up with the wave of innovation, as the EU was listed in 2019 as the fifth innovator across the current global performance, just below South Korea, Canada, Australia, and Japan, and followed just below by the US and China. The innovation performance is measured with the use of some indicators that are combined under four categories – framework conditions (main drivers of innovation performance: human capital, research systems, innovation-friendly environment), investments (public and private investments in R&D), innovation activities (at enterprise level: innovators, linkages, and intellectual assets), and impact (of innovation under the form of benefits for the overall society and economy: employment, sales, etc.). Therefore, within the current research some of the variables that were tested to understand the possible correlations that the attainment of a KIBS level in this sector might enquire are tertiary education graduates, population having completed tertiary education, business R&D expenditures, innovation expenditures, medium and high-technology products, knowledge-intensive services exports, etc.

Considering the context of public policy, the major organisations at European level have actively engaged in advocating the government policy in favour of the knowledge economy, and of the contribution that governments can bring to the economic growth. See for instance the impact of the government decisions during the pandemic crisis that have displaced the entire economic and societal activities, but, at the same time, have had a significant contribution to the drop in pollutant emissions, in the rise of high-tech enterprises, in the introduction of innovation as the major formulator of future perspectives for the global market. The OECD considers that governments are the greatest enablers for access to new information technology, for higher education attainment, for stimulated research centres and innovation hubs, for the development of national innovation systems, and the transfer of knowledge through networks. These perspectives have prioritised the enhancement of knowledge diffusion, the upgrade in the skills umbrella of the human capital, and in the promotion of innovation and management change within enterprises. Among the suggestions made by the OECD have been compatible with the following suggestions: projects in science and technology based on missions and objectives, economic and technological policies for innovation, diffusion-oriented programmes, and frameworks for collaborations between

universities-industry-government, that promote the diffusion of the new technology to the economic sectors and to the active enterprises through the facilitation of information infrastructures development; the necessity of policies that promote the broad access to competencies and skills, especially learning capabilities (thus, the education system is to broaden, and encourage enterprises and individuals to continuous training and life-long learning, with the ultimate scope of matching the labour supply with the market demand); the highlighting of technological change which can be updated through enterprises' organisational changes that could pertain to the perspectives of flexible work arrangements, multi-skilled workforce, decentralisation and networking (these perspectives could be achieved by improving the conditions of organisational changes based on financial, competition, information, and policy shifts). The European Commission demonstrated its involvement in the formulation of strategies and policies for regional development, and focused its attention to the human capital sector, where it emphasised the need for skill retention and update to align with the knowledge economy demands. Moreover, the Commission observed the colossal retention of ICT in the global economy, as well as its impact on the latter. Products and services sector experiences growth, while the human capital moves from geographically bounded jobs to teleworking, and the education system reserves consistent timeframes for the acquiring of skills needed in this new work environment. The recommendations of the European Commission, since 2000, went along the following lines: Internet connectivity in all schools across EU, teacher attainment of informational and technological skills, wide opportunities for human capital to acquire ICT skills, creation of circumstances favourable to teleworking, entrepreneurship encouragement, and promotion of ICT usage by SMEs. It is quite clear that, 20 years later, most of the Member States still lag behind the completion of those particular recommendations, although significant achievement has been registered in 2020, with the stimulation from the avalanche created by the health crisis, which, from a positive perspective, has reintroduced, implemented and even stabilised the majority of the terms proposed in 2000 by the EC. The alignment of the economic sectors to such public policy directives would push the entire system into the broad registration of knowledge economy. Since the major incentive for knowledge economy is represented by innovation, a new category of services came into existence, namely the knowledge-intensive business services. Basically, this regenerative wave of novelty proposes a constant and undivided attention toward the enterprise behind the service supply, and toward the other party involved in the process – the customer interface. Moreover, the KIBS have an intrinsic feature that creates the premises for the development of new market relationships as a form of innovation, and technology usage. The innovation creation stems

today only from the perspective of the actors who design and deliver services, and they are known as knowledge workers. Among the most technical and scientific services there is the challenge of distinguishability based on the output. The complexity of the latter has direct impact on the relationship between innovator and service supplier. Subsequently, the European Union policy for research and technological development or the RTD is one of the areas of interest within the European legislation. The framework for 2021-2027 is mainly focused on the aspects of science and technology development, through technological excellence, societal problem-solving, through the inclusion of green and digital transition and advancement in the realisation of Sustainable Development Goals, and, of course, the economic challenge of boosting Europe at global level, increase the innovation output, the competitiveness of the region and the job supply. 70% of the budget is directed solely towards SMEs, and their introduction to the possibility of having dedicated R&D departments, as well as for the possibility of radical innovation development and implementation within the sector. Although the EU works on the transition toward the knowledge economy – with the goals of strengthening employment, economic reform, social cohesion, shift to digital, knowledge-based economy, prompted by new goods and services – as powerful engine for growth, competitiveness, and jobs, capable of improving the quality of citizens' life and of the environment, this new concept will be majorly determined by the dynamics of the market and political-based economy.

The interconnectivity of megaregions is held by the flux of information, goods, people, and knowledge. The geopolitical shift from territorial states to relational city networks is supported by the infrastructure, including the freight transport industry. Globalisation forms the dominant keyword, and the entire world comes down from the Keynesian welfare economy rush toward embracing the features and potential of knowledge-based economies. The latter is not only a variation of the capitalist economy, but rather a sinuous structure of socio-spatial practices, political decision-making, and various strategic management equations depending on the scalability of a given context. Such a combination depends on the predisposition of the parties involved at market and at political level in relation to the growth and development of society and economy, and how those parties consider enhancing, regulating, and governing the overall system. Although kept in vanguard premises, the knowledge economy gradually becomes a fact within the global society, and it continues to push in the direction of heavy influence on the policymaking. As mentioned before, within the realms of knowledge lies the new trend of lifelong learning (LLL), for the human capital to update the skills and expertise department continuously and systematically. This is another department which should provide

interest to policy makers, which might include and articulate the expanded framework of the knowledge economy within the public policies. Moreover, they must be ready to thread the flow of influence and aspirations stemming from the knowledge society versus the knowledge economy. Here, the focus is not to be divided, but rather combined forces should allow for better and equal access to higher education, as well as the development of intellectual products and services. Capitalism could be viewed as a competition ground for enterprises to grow, reinvest profits, to survive, while benefiting from the natural and societal resources in ways that might border or even cross the border to exploitation and robbery. The non-material aspects of the economy, as well as the desire to minimise and dissolve the massive polarisation of wealth and poverty at global level are not necessarily elements that bring the focus of today's capitalist democracies. Nevertheless, the lack of significant economy growth over the last 60 years was a sign that the general economic and political scene had been particularly ill directed. During that period, innovation has continuously but unsustainably made way to technologies that gave the world the gift of hope and higher expectations. Knowledge became so important, not only in the technology handling, but also in the creation, stabilisation, and development of relationships. The advantages of LLL and higher education attainment for the human capital were consistent incentives for the increased usage of them as proxies for the measurement of the economic and societal growth. Alongside R&D, formal qualification of the labour force, and the introduction of extensive knowledge changed the occupational composition of the human capital within the geopolitical scene.

The innovation process, a form of combined and recombined technological knowledge for the creation of new technologies, is reinvented in different regions of the globe, especially within the regional clusters of knowledge economy. That means that, geopolitically, this is a breaking point, where the power is shifted from a place to another, from a handler to another. The feature of knowledge that makes it infinite is also the one giving an optimistic view on the capabilities technology might bring to the sustainability of the system, and to the new combinations and possibilities of a future knowledge society. The entrepreneurship wave led the way to the world today, and the acknowledgement of the opportunity cost and risk premium of securing such a position determined the increased importance of intellectual property (IP), and the means of protection – patents, copyright, etc.

Conclusively, there are two potential geographic developments that were determined by the knowledge economy – one that contains the negative aspects of internationalisation on behalf of enterprises and factors of production, and one referring to the regional clustering of complementary activities resulted from regional knowledge and skills.

Universities and research organisations do pose a dilemma for enterprises, and the latter increasingly relies on the former. It is mainly a relationship based on the vertical integration of a mode of knowledge production that would determine the bettering of the cooperation and creation of market knowledge within the sphere of KIBS. Externalities of the KIBS enterprises include, at this point, research laboratories, direct research division, and universities. Of paramount importance is the identification on behalf of universities and research centres of their exact role in the knowledge creation and transfer. Moreover, those also need to avoid the bias effect due to funding of less fruitful research for the KIBS, while the policy makers must avoid being trapped in the other situation, where they incentivise universities to further only the applied research to the exclusive priority of the enterprises.

The production of knowledge and the transfer of knowledge realised at university level, more so than that produced at market level, does not pollute, thus the knowledge economy is a high-quality system. At the same time, the new economy has another feature that attracts the attention, and that is its capability of connecting various, apparently separated processes. An example of such combinations could be the projection of financial, consultancy and research services to the advance of Internet usage, teleworking, e-commerce, and ICT-related activities, and the introduction of new management models for enterprises to organise their activities in such a manner that would eventually improve the dedication of employees, the responsiveness of the customer base, high flexibility of processes, and the drop in bureaucracy. This system is supported by the policies and measures that work so that the knowledge expands and intensifies in utilisation, as a basic requirement for the operational performance of the knowledge economy.

Further on, the **fifth chapter** continued the study through the introduction of the inland freight transport methods for research in the sector, linking the idea that the backbone of the economic activity in the EU is represented by SMEs, which, as expected, are also majorly represented in the researched sector. The inland freight transport sector comprises of the road, rail, inland waterways, and pipelines transport services, but considering the limitation of the last mode of transport (in terms of types of freight goods transported, available data, flexibility, etc.), the paper followed the dimensions imposed by the provision of freight transport services via road, rail, and inland waterways. Among the three modes of transport, the road freight transport subsector is dominating the market with around 580000 active enterprises, while the other two modes of transport (rail and inland waterways) both account for almost 12000 active enterprises, although, in this case, the enterprises continue to be state owned and/or controlled in their majority across the EU Member States.

As of 2018, the SME sector within the EU-28 was represented by almost 25 million enterprises, in their majority, around 93% of the total, having less than 10 employees (micro-SMEs). In the non-financial business sector (NFBS), 99.8% of the enterprises were SMEs, and they generated almost 60% of the value added, and 66% of the employment within the EU-28. The key issue on the freight transport market today is represented by the market pricing, and the pricing policies. The infrastructure costs have, during the last 10 years increased significantly, especially for second-hand shipping equipment, without funding and development policies to cover the difference. Mathematically, the costs of transport operations are comprising of the marginal cost and the efficiency measurement of the transport. In the equation, one can also include the role of economies of scale and economies of scope, the impact of goods' value on the costs of transport, and the mean in which the transport is realised, namely franchising or outright ownership. The costs of transport are not solely attributed to the enterprises involved in the process of shipping freight goods across the EU, but also to the final user of that service, to the consumer of the transported freight good, and, also, to the society at large. Those externalities have an impact on the decision-making process, especially for all the things related to the traffic amplitude. Moreover, these factors are valuated in terms of monetary quantum, through the decision of the parties involved in the process to make the exchange available and possible. The implications of the congestion context as an external cost reside in the changes observed in the quality of the service – including the longer travel times (quantified also through speed flow curves), and whose capacity can be translated into public policies by creating micro-simulated environments for the assessment of such causalities. The testing of congestion and scarcity of different modes of transport proposes another indicator to be monitored by the policy decision-makers, particularly for the railways and airways transport. The availability and correctness of the transport timetable represent the major cost cut in the process. It is of paramount importance to track the occurrences of traffic congestion for a better predictability and for the identification of the major causes, and to introduce the outcomes within the enforcement of the policies. One aspect that proves to be of lower utility is the idea of including a rather high rate of capacity utilisation, which was determined in previous studies as a cause of congestion, as well as a determinant of higher unreliability. This is a statement that comes backed up by numerous examples in the economy – from micro to macro levels, underlining the potential for higher efficiency and effectiveness when discussing micro-environments. Going back to the discussion of efficient timetables, the freight transport service will bear an externality cost in the situation of a delay, even though that did not result from the fault of the transport operator, and, therefore, will determine a congestion externality within a

scheduled mode. Adding that to the low-capacity effect, the problem just goes downhill from here, pressuring the policy makers into creating an efficient investment planning programme in order to avoid such difficulties. Moreover, the incidence of accidents incurs various costs on the transport operators, as well as on the public authorities.

Transport demand is a very sensible subject, as it is quite the challenge to make a consistent forecast. The latter must rely on the overall economic capacity and valuation, considering that the transport demand depends on the production and consumption activities, a situational happening that cannot very easily be prognosticated. The freight demand is also impacted by factors within its own industry scope, such as distribution depots, consignment frequency and size, origin and destination of freight flows, transport capacity, transport mode allocation, etc. At the same time, the type of freight goods shipped across different territories, as in their value, size, frequency of consignments, determine to great extent the overall transport demand.

The assessment of the economic impact of public policies related to the freight transport sector is constructed around agglomeration economies, where transport investment could determine an increase in the labour productivity of the area (as it has previously been explained within the geopolitics context), and around technological and behavioural change in the society. Moreover, the economic sectors that generate negative externalities or adverse effects (including here the transport sector with its polluting effects on the environment and on the breathable air of the EU citizens) are prone to the Pigouvian tax, which is meant to correct any undesirable impacts on the market, to the extent of redistributing the cost back to the producer or the user of the negative externality. Among the adverse effects of the transport service can be included the environmental pollution, the strains on public healthcare, the damage to natural habitats, the noise pollution, etc. The consequences of those effects must be assessed and undermined by the public policies, through packages of measures that include pricing and regulation of the EU transport. One of the issues that freight transport policy faces is related to the equity of the latter, as it is not defined and does not present any form of evaluation framework.

When modelling freight transport indicators, there are certain aspects to be underlined: the diversity of production and regional attraction, the distribution patterns, modal split, and assignment to different decision markers (shippers, carriers, drivers, etc.), the freight goods transported (parcels, containers, bulk, etc.), and the limited availability of data. Generally, in freight transport, the studies are based on aggregate data, and tested using time series, gravity

models, elasticity-based models, aggregate modal split, direct econometric demand estimation, microsimulation, or multimodal network.

Within the freight transport industry, there are numerous layers of decision-making that range over long term, medium term, and short-term situations. There are three main sectors of the market that implies the decision-making process – freight goods (production, consumption, trade), inventory networks/supply chain/logistics chain (warehousing services), and transport organisation (mode of transport, means and route choice). The first market sector that refers to the prospect of freight goods, including their production, consumption, and trade, involves decisions that pertain to long-term planning, which include the plant location, the production systems, factors of production, product range, retail outlets, suppliers, shipment size to customers. Each decision that occurs at this level is taken either by the producer or by the consumer of the good. The second decision-making stage is medium-term and involves the marketing and logistics manager of the given enterprise, as well as that of the logistics service provider. The decisions here revolve around the location of distribution centres, inventory volumes, and intermediate shipment sizes. The last part of the decision-making process is short-term and refers strictly to the freight transport enterprise. The decision-maker is the logistics and transport manager, and the logistics service supplier, while the decision stems from the choice of mode of transport, means of transport (type of vehicle used within a mode of transport), scheduling and routing.

Furthermore, the scheme of freight goods transport contains a pattern of costs related to each component: transport costs, storage costs, ordering and handling costs, and risk costs. The first category comprises of costs related to drivers (i.e., salary, daily allowance, hotel, transport costs to and from the country of origin, etc.), fuel, vehicle (i.e., leasing, insurance, repairs, maintenance, etc.), infrastructure use (i.e., tolling systems across transited countries and regions), capital cost during transit. The next cost category is related to the storage resources that freight transport enterprises need, including capital, building and equipment, land, energy, etc. Moreover, the risks that freight transport enterprises are exposed to further determine the raise in costs on behalf of stock utilisation, loss and damage claims, spoilage, obsolescence, etc. If the freight transport enterprises have an internal department of logistics, and offer logistics services, there is another cost category comprising of handling, picking, packaging, ordering, and processing freight goods.

The basics of the freight transport sector are covered through the array of modes of transport. For this research, there will be a major focus on the road freight transport, together with the railway, and inland waterways. The freight transport sector performs its services

through the use of specific equipment for each mode of transport. For instance, the road freight transport supports an array of services that can be performed with the usage of vans, small trucks or lorries, and heavy-duty vehicles. The railway freight transport uses block trains, wagonload trains, and intermodal transport systems, while the inland waterways provide direct shipments, and indirect shipments, with ships that carry from 300t to 4500t of freight goods.

The entire freight transport sector operates according to the drivers for distribution structures – namely, demand, supply, goods, logistics system, and resources. The demand category comprises of factors that pertain to the volume of freight goods to be transported, the spatial distribution of the freight goods (loading/unloading points), the volatility of demand, and the required lead time of each transport. The supply of the freight transport services is structured the same as the demand, only that it has a major factor that characterises it – the reliability of the freight transport service. Any freight transport is organised based on the features of the goods to be shipped – value density, handling requirements (which will determine the necessary mode(s) of transport), and perishability. All these operations are meant to be managed under a centralised system – the logistics system, where the planning of the operations is laid out considering its scope and the degree of automation needed or supported. Subsequently, the entire process operates due to the allocation of different resources, including the transport infrastructure, the real estate, and different types of energy (for consumption during the transport, and for support).

In the **sixth chapter**, the paper addresses the econometric research, including the perspective of correlations between the EU-28 international freight transport output, calculated for the road freight in million-vehicle kilometres, for the railways in million ton of freight goods per kilometre, and for the inland-waterways in million tonnes-kilometre, and the regressors from different categories, such as environment, business and economics, innovation and technology, education, population and labour, and infrastructure and transport. The research is based on a panel data multiple regression model, performed on a database assembled around Eurostat, World Bank and OECD data. The study covers the period 2007-2018 (in order to avoid unbalanced datasets), and the econometric model was estimated with the statistical software Stata 13. The main objective of the research is that of accepting or rejecting the correlation between the inland freight transport sector and the knowledge economy – through adherence to KIA and KIS and unlocking the potential development of the sector through a set of proposed management models.

The econometric analysis is based on the hypotheses development, which will determine the degree of adherence of the inland freight transport sector to the key dimensions

of the knowledge intensive services. Each mode of inland freight transport, namely road, rail, and inland waterway, is closely tested, by imposing the dependent variable (i.e., total international road freight transport, total international rail freight transport, total international inland waterways freight transport) to be tested in relation to several regressors that are categorised as follows: Environment; Business and Economics; Innovation & Technology; Labour & Population; Education; Transport & Infrastructure. Within these categories, there are specific independent variables that are heavily connected to the knowledge economy and the knowledge-intensive business services, such as R&D expenditure, ICT imports and exports, Educational attainment, Urban population, High technology exports, Individuals using the Internet, or the Mobile cellular subscriptions. The six categories are classified based on their component independent variables and the type of relationship is established between the latter and the knowledge-intensive business services. From this perspective, the model's methodology formulates the testing of the dependent variables against regressors that either pertain to the new economy vision or remain focused on the premises given by the current context. The study is meant to observe each mode of transport individually against variables from the categories mentioned above, and to refer to only those regressors that have a clear, significant impact on the regressand. Initially, each model was created based on the group categories of the independent variables, and then, the research continued with a combined model of the regressors that were explaining the total road freight transport quantity in million tonnes-km of freight goods. The testing of the panel data was initiated with performing an OLS regression. Further, the Hausman test was used to test for either a random effect or a fixed effect suited the panel data.

For the road freight transport, the pump price of diesel fuel, the GDP per person employed, and the R&D expenditure have had a clear impact on the sector. The model used a fixed effects testing, as the Hausman results indicated. The correlation between the pump price of diesel fuel and the road freight transport is negative, thus, underlining the fact that the road transport is elastic to price changes. The increase in the pump price of diesel by 1 USD triggers a drop of 0.29 million tonnes-km of freight goods that could, otherwise, be transported via road. Moreover, the GDP per person employed is positively correlated to the road freight transport, as any 1 USD increased in the GDP per person employed determines a growth of 0.69 million tonnes-km of freight goods that are shipped via road. Furthermore, the R&D expenditures from governments have a positive impact on the quantum of road freight transport. Any 1% increase in the R&D expenditure of the GDP influences the increase of road freight transport by 0.24 million tonnes-km. This model points out the fact that the road freight

transport sector is still trying to transform into a KIBS, but it has a long way to go. One way that would made it possible is by developing and implementing public policies that validate the positive performance boost, hence, the expansive usage of innovation and technology dimensions within the sector. Indeed, consistent work was performed on behalf of the industry manufacturing the HDVs, through the implementation of diverse technologies such as blind spot indicator, GPS connectivity, Bluetooth connectivity to smartphones, various diagnostic indicators, and systems for the vehicle, driving performance monitoring systems, etc. The road infrastructure or the TEN-T network in the EU has been upgraded with health and safety measures for the traffic participants, including the heavy traffic. The policy regulates the entire freight transport sector, with focus on the performance and safety of the drivers – programme schedule according to law, enforced through monitoring systems and control patrolling from police or other authorities.

In the case of rail freight transport, the regression model was constructed and included the regressors that had the highest impact on the rail freight transport, namely rail lines, transport services imports, communication and computer services exports, general government final consumption expenditure, and the volume of goods exports. In most of the EU Member States tested, the same influences appear to be the standard, exception being made in the case of countries 6 – Czech Republic; 13 – Hungary; 15 – Italy; 16 – Latvia; 17 – Lithuania; 23 – Romania; 26 – Spain; 27 – Sweden; 28 – United Kingdom. For each 1% increase in the transport services imports, there is a 1.09 million tonnes-km of rail freight goods transported in the EU. The same positive relationship is established between the goods exports and the rail freight transports, while the 1 unit increase in the general government final consumption expenditure drops the rail freight transport operations by 0.7 million tonnes-km of freight goods. The Hausman test is indicating the compatibility to a fixed effects model, which proposes the disclosure of the effects of infrastructure and transport, innovation and technology, and business and economics on the rail freight transport sector. Apparently, the consistent correlations are established with the infrastructure and transport variable, and the innovation and technology one. The rail freight transport sector is, therefore, heavily reliant on the increases in the general government final consumption expenditure, as well as on the growth of the transport services imports. Moreover, the development of new routes and the improvement of the existing rail lines, while introducing the innovation and technology dimension for persistent effects, have a negative correlation to the total rail freight transport sector. This underlines the fact that the sector is still based on outdated operations, it has an ageing market image, and even with extensive investments in the development and

modernisation of the industry, the rail transport is still lagging, and forwards the idea that there are other modes of transport more attractive for demand. The structural model of the influences of the regressors on the rail freight transport sector highlights the impact that is visibly coming from the business & economics, innovation & technology, and infrastructure & transport categories. It is interesting that, to some extent, there is a certain correlation of the rail freight transport sector to some tendrils of the knowledge economy, based on the information forwarded by the econometric analysis, taking the form of technology as percentage of the services exports.

In the inland waterways transport sector, it was identified a cumulative impact from: goods imports, medium and high-tech exports, fixed broadband subscriptions per 100 people, ICT exports, labour force with advanced education, and labour force (total). Except from the population and labour variables, all the other regressors have a positive correlation to the variance of the dependent variable. The positive effect is determined by the business and economics, and the innovation and technology variables. The combined regression equation was based on a fixed effects model, as the Hausman test indicated. The fixed effects were visible for the goods imports and labour force (total), demonstrating that, in the end, the IWT is still not infused with innovation and technology, and the only factors deeply influencing it are of traditional output – the value of the goods imports within the EU economy, and the totality of the human capital involved in the management of activities and operations. The countries which showcase positive reminiscent correlations of the IWT sector and the business and economics, labour and population variables are Belgium, France, Germany, and the Netherlands.

The study continues with the **seventh chapter**, which comprises of the assessment on the results of the analysis, where each mode of freight transport is regarded as either knowledge intensive or not, and the European Union, as a geographic space, is divided in clusters of knowledge (creation and transfer) hubs. Due to the particularities of each inland freight transport mode, the research proposed management models for the public policy adjustment and for the strategic regional development of the sector. This ensured the objective understanding of the current situation, and the probable strategic directions available. The next phase of the research comprised of the drafting management models for alignment of inland freight transport to KIBS, and the introduction of a recommended action plan. It has been established, somewhere across the paper, that some form of KIBS is realised within the sector through the intermediaries or freight forwarders of inland freight transport services. Therefore, the model was drafted from that example, and was polished through the inclusion of new

technology, innovation, and intellectual capital. At this point, the perspective focuses on both macro and micro levels, assessing the situation from the business level, through the general economic framework, and at the convergence with innovation and technology. Finally, the study combined all the previous work into a colossus management model, at the precipice of blockchain technology inclusion, for all the modes of inland freight transport. This part is entirely dedicated to creating a strategic management model, following a vision, mission, and a set of strategic objectives, that was furthered into policies and programmes. Moreover, the strategic implementation of the model proposed the organisational structure and will discuss the necessary resources. Lastly, the model dedicated a set of measures for evaluation and control of the strategic implementation. The research is meant to uncover significant information on the status of the inland freight transport sector, from a vantage point (macro level), and further into specific spheres of the sector. The main advantage of the research is that of having had hands on experience in the field and being able to forward a strategic perspective into how the sector might look like if it were to become more efficient, transparent, traceable, as well as defined by fair competition, and innovation and technology adoption.

The econometric analysis on the inland freight transport market has drawn the attention to the fact that, although the EU invariably tends to direct the sector's compatibility to the knowledge economy, and to the knowledge intensive activities, and services, the former is still to demonstrate any resemblances to the new movement either in the management and business model of the enterprise, or in the application of the public policies to the market practices. The knowledge economy, as a basic concept, was first brought up by Fritz Machlup in the 1960s. Six decades later, that idea is still clustered in vanguard markets and niched segments, as it is still stubbornly misunderstood, or, simply, the world is not ready for such a fundamental change. The knowledge economy constructs a system of economic activities that are based on knowledge intensive activities (KIA) and services (KIS), realised at the intersection between the human capital, intellectual property, ICT, and innovation and technology. In such a regime, the enterprise is supposed to capitalise the knowledge within the production system for the ultimate purpose of business development and economic growth. The mean by which the knowledge economy recircuits the entire process is represented by intangible assets such as highly skilled workforce. In the Information Age, technology and scientific innovation are taking the leading role of guiding the entire society towards a new dimension. The fault of this equation resides in the rapid formulation of new concepts, products, services, trends, etc., and their immediate obsolescence. Nevertheless, the valuation of knowledge has achieved new

frontiers as new notions bubble up – information society, knowledge society, knowledge intensive business services (KIBS).

The key dimensions of the knowledge economy and KIBS are comprising of the knowledge, the innovation, and the spatial proximity. Those three elements determine the way, means, and processes though which enterprises and their management relates, implements, and develops into knowledge intensive business services. The realms to which KIBS are mostly attributed to are those related to economics and management. In essence, this study revolves around the premises determined by the knowledge economy, even as niched as it is today, for the creation of the hypotheses of the research.

The road freight transport sector was analysed against various regressors from all six categories mentioned previously, in order to understand the extent to which it complies with the dimensions of knowledge intensive activities, and knowledge intensive business services. From the six RFT research hypotheses, three were confirmed, and three were rejected, determining the argument that the road freight transport sector might have dots of technology attainment, and innovation attributes within its business and management model, and external influences from the perspective of environmental policies, and safety and health measures for habitats, nature, and society.

The rail freight transport sector and the quantum of freight goods shipped via this mode of transport have confirmed the correlation to three dimensions, namely business and economics, transport and infrastructure, labour and population, while the environmental perspective was invalidated through hypothesis 6. Generally, the research underlined that the total rail freight transport, calculated in million tonnes-km, relies heavily on the rail lines infrastructure, on the exports of communication and computer services, and on the general government consumption expenditure.

The inland waterways freight sector has been regarded, in the study, according to 6 hypotheses, among which 5 were accepted, and one rejected. The rejected hypothesis was relying on premises for this freight sector not to be correlated to the education perspectives. Strictly from an education dimension, the IWT is not influenced by the former, although, when testing from the dimension of workforce with advanced education the correlation becomes visible. Overall, in a combined model, the IWT is influenced by business and economics, and labour and population variables. Nevertheless, there are some countries that pertain to higher levels of correlations between the IWT freight and the KIBS dimensions (i.e., Belgium, France, Germany, the Netherlands). Although enclosed in the premises of those countries, the IWT portraits some shades of knowledge intensive activities and business services.

Given the unfolded case study, it can be concluded that the key elements of the knowledge economy, and of KIA and KIS – education, labour force, and innovation and technology, are visibly unrelated to the general activity within the inland freight transport sector. The road freight transport accepted the hypothesis that the innovation & technology dimension has a limited impact on the former, that the correlation between education and the development and growth of the road freight transport operations and business is non-existent, and that the labour & population perspective has no influence on the sector. The railway freight transport rejected the hypothesis that the innovation & technology dimension might influence the sector, as well as the one stating that education does influence the activities and services forwarded by the former, while accepting the hypothesis that the labour & population effect is significant. For the IWT, the innovation and technology dimension does have an impact on the sector, although there was no confirmation of the intellectual capital involvement in the growth and development of this mode of transport (only to limited extent). The labour and population hypothesis was accepted, as the total labour force does have an apparent effect on the total inland waterways freight transport.

The closest to the ideal shape of the freight transport sector within the knowledge economy is, momentarily, the inland waterways mode of transport. Although highly clustered, the IWT appears to be performing a knowledge intensive activity type and might even pertain to the premises of knowledge intensive business services. The second mode of freight transport that showcases some resemblances to the knowledge intensive activities and services is the road freight, which performs within the EU in two compact country clusters. The road freight transport sector seems to have introduced, at least partially, some form of innovation and technology within the system, although, in terms of knowledge, especially from the perspective of intellectual capital, and high-skilled workforce, is unreliable. The rail freight transport sector appears to have introduced, to some extent, the knowledge capacity in the sector, but only through limited involvement of some technicians that organise the transports and must use advanced software and other technologies. From the other two perspectives, the rail freight transport is lagging, although the EU has constantly pushed the legislation toward promoting this mode of transport.

For the road freight transport sector, the research has pin-pointed to the clustering on innovation and technology attainment around the Western European countries, and the Eastern European countries. Moreover, the situation showcases the spatial proximity of innovation hubs, of technology development, and knowledge creation and transfer. The regional economic development of the EU is also responsible for the degree of innovation and technology

attainment within a specific geographical space. For the inland waterway transport, the spatial proximity is illustrated via the waterway axis Rhine-Main-Danube, and the inland waterway Seine-Scheldt, creating a special area for the knowledge transfer, and technology implementation.

The research continued with an impact assessment of the public policies enforced so far within the inland freight transport sector and responded through the development of a public policy adjustment management model, and a strategic regional development action plan. The idea was that of uncovering the solutions and the gaps created on the market due to public policy implementation. One disturbing fact, disclosed by the European Commission, referred to the lack of proper impact assessment analysis for the drafting of one of the legislative measures included in the Europe on the Move, Mobility Package I. Apparently, there are public policy propositions that were not priorly identified as needed measures for the development of proper practices and applications in each sector. Across the recommended action plans proposed within this paper, one main challenge has been tackled, that of accurately assessing the initial status of the market/sector, and of following an organised model for the responses formulated. The management models were linked to the information management cycle, as the action plan is a continuous process, that will be infinitely updated based on the adaptive behaviour of the sector.

Furthermore, the paper proposed a management model for the inland freight transport to the perspectives of the knowledge intensive business services, mandating actions for each mode of transport based on the current business model, the general constructs of the sector/economy/global market, and the innovation and technology adherence observable in the sector. The action plan was realised for each mode of transport individually and was developed considering the good and the bad practices, applications, systems, and processes already available in the subsectors.

The research culminated with the creation and forwarding of a management model for the inland freight transport sector with a focus on interoperability and inter-modality, this time relating to the combined effects of all three inland freight transport subsectors. The model has the form of a strategic management model, which initiates through the assembly of key dimensions attainable for the sector under the form of a vision, and through the proposition made under the form of a mission statement. Furthermore, the strategic management model continued with the introduction of strategic alternatives for the inland freight transport model, connected to the six key dimensions included in the vision, and forwarded under the form of strategic objective, policies, and programmes. The format of the proposition is meant to adhere

to a key dimension through the enforced legislation and the sectoral application via European programmes accessible by all Member States. The basis for the strategic objective, policy formulation, and programme application resides in the results obtained through the econometric analysis, and through the policy and regional development analysis priorly performed during the research. The next phase of the management model creation was that of thoroughly explaining the entire strategy implementation, evaluation, and control. The management model for interoperability and inter-modality of the inland freight transport sector is based on a blockchain technology, where the supply and demand meet, under the supervision of the EU authority bodies, allowing for public-private partnerships, access to market and to market information, knowledge creation and knowledge exchange, traceability and transparency of transactions, cargo and orders, control over operations in real time, financial aid and support, job portal, and state-of-the-art technology. This model will allow the market to become automated, and autonomous, with the usage of artificial intelligence that learns by itself how to regulate and efficiently operate the platform, and will completely remove all traces of unfair practices, price dumping behaviours, and inequality. The entire system is constructed around networks and partnerships. Moreover, the implementation of the model would respond to the major policy problem of the EU – The European Green Deal, as the cargo movements will be traceable, and uniquely identified through a coding system, completely removing the chances of the same cargo to be shipped multiple times as it happens today. Moreover, the inland freight transport is considered, as far as this proposed model is concerned, to transform into a knowledge intensive business service, and not only a knowledge intensive activity. The overall scope of the sector is the provision of transport and business services, as the market turns to follow on the blockchain technologies with a more transparent and traceable mechanism for operations and transactions. It is also important to keep close to topics that forward negative aspects of the different inland transport modes, in order to better answer through strategies and public policies.

The online platform should be in majority coordinated by a supra-national authority, specially designated by the EU, comprising of mandated organisations and professionals from each Member State, and partially coordinated by private investors and/or enterprises active in the inland freight transport sector. The reasoning behind this resolution comes from the need to have a(n) parity/equal control over the internal operations of the sector on behalf of each Member State (in an equalitarian mode), and on behalf of each entity group active on the inland freight transport market. One of the most important aspects of the platform will be the algorithm that will combine the three modes of transport into the cheapest, fastest, and best combination

suggestions for the client when putting out a transport order. The client will have the possibility of selecting from the list of suggestions, which will be determined on the requirements of the cargo – slow movement, cost effective/fast movement, no price cap/fast movement, high weight, and volume, cost effective, etc. The calculations and suggestions will be made automatically based on a cost per km unit, and will also project the ETA for delivery, the routing for the transport, the necessary insurance level for each freight good category, and the combination of transport modes necessary for the transport.

The platform will also comprise of an automatically updated page from the police of each Member State regarding road, rail and IWT traffic, and rerouting options, as well as a page for the road transport linking to available parking spaces, hotels, fuel stations (through partnerships with fuel card companies), etc. The platform will include pages connected to the port and terminal authorities, for updated schedules, and available time slots for different types of cargo. Moreover, for fix transport orders (that repeat constantly over the same route), clients can opt for subscriptions for trains or vessels. Consequently, the cohesion at policy level across the Member States will become reality, the freight data problems will be obliterated, and the unfair practices completely removed from the market. All the systems and processes will be verified through the algorithms, and necessary human resources allocated to open positions.

The knowledge gained through the intensive usage of the platform will be the main source for policy decision-making. The public-private partnership will administer the platform, the system, and all the processes and operations, through designated human capital, the payments will be traceable and transparent, and the commission from the payments will be reinvested for the further development of the freight transport infrastructure in each Member State of the EU. The platform will allow for knowledge transfer between the active enterprises and will be based on a spatial proximity factor at EU level, removing differentiation between Western/Eastern regions. The platform will become a hub of supply and demand for freight transport services, based on a KIBS management model, with the main scope of interoperability and inter-modality in the European Union.

Ultimately, the **eighth chapter** contains the final statements on the study, discussing the main conclusions of the paper, as well as limitations, and potential for further assessment of the topic. The limitations of the study are aligned with the fact that there are still concerns regarding the freight data (e.g., limited availability), the correct connections to the economic indicators, and the information on the entities involved in the activities and processes within the sector of freight transport. Furthermore, the information available on the processes and dimensions of the knowledge intensive business services and its potential to be absorbed within

the inland freight transport sector relies on the observation of some attributes on the freight forwarding services scene, although the finality of such a management model implementation could not be assessed within this study. It is recommended to further the research on the strategic management model for interoperability and inter-modality of the inland freight transport sector by proposing a questionnaire specifically designed for all the entities active in all subsectors and within the authority bodies, to better replicate their needs within the model, and for the strategic management model to have even better chances of receiving good feedback and priority in implementation.