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The role of digital platforms in the modal shift of road to rail freight transport

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Abstract

Digital, two-sided, multimodal freight transport platforms are assumed to accelerate the growth of rail freight transport in the EU. The hypothesis is that such platforms enable stakeholders to easily and transparently agree on delivery of transport services, even in uncertain times. This paper presents selected findings from a case study that investigates such a platform by applying a dedicated theoretical framework described in Jain (2020). The framework links theories on industrial dynamics, platform economy and maturity growth.

The EU-single market policy and technological innovation in ICT, have triggered the rise of platforms in freight transport network industries. Recent observations on multimodality and cross border freight transport show that road freight platforms are organizing matching of demand and supply for combined transport services, in cooperation with inland shipping platforms or occasionally with shippers for rail transport. Multimodal platforms operate more mature by offering speed, transparency in the sales and established matching mechanisms, in combining air, ocean and road modes to deliver reliable transport services. A gradual integration of rail services can be observed, however the visibility of such services is currently low.

An in-depth case study with real-world stakeholders confirms that digital platforms have a potential to improve multimodal transport within Europe. Success factors include the specification of concrete goals (e.g. on economic benefits, climate neutrality, and geographical focus of supply chains spanning markets within Europe and beyond). Of critical importance is the offering of standardized transport services that facilitate the integration of service providers from multiple modes who share similar goals with the platform. The complex cross border rules, mindset of low prices and earlier experiences with rail performance appear to restrict the speed of development. The analysis shows an increase in trust from the demand side in the ability of platforms to offer competitive services including rail transport. The rise of such platforms pushes the level of competitiveness in the freight transport market.

Key words: Modal shift to rail, platforms, policy, multimodal, freight

1. Introduction

The situation of rail in the European Union (EU) freight industry remains a cause for concern. As Figure 1 indicates, the modal split on the EU-28 is not promising for rail (EUROSTAT, 2021). The increase in market share of competitors until 2018 (RMMS, 2021) was not effective for competition as the rise of the modal share of rail plunged to a new low of 17% in 2019. This suggests that the competitiveness of rail cannot be considered structural and sufficient yet to reach the earlier modal shift goals of EU white paper 2011 (shifting 30% of road freight over 300 km to rail or waterborne transport by 2030 and 50% by 2050). The European Green Deal, aimed at doubling the rail share by 2050, at present appears

ambitious. Freight transport by road continues to dominate in the EU both in the modal split and in the adoption of technology innovations e.g. in digital platforms and greener transport.

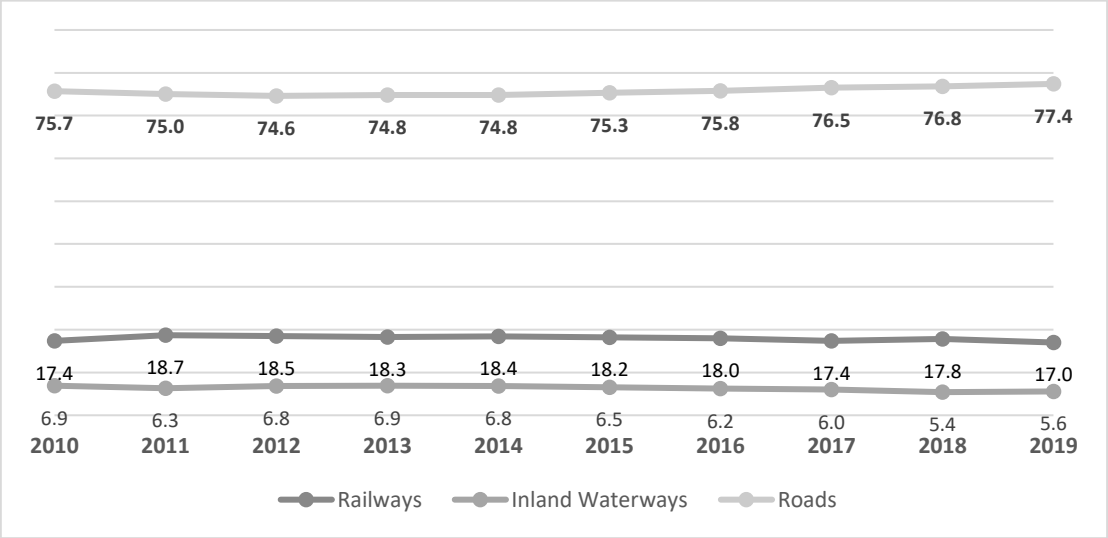

Figure 1: Freight transport in the EU-28: modal split (% share in tonne-Kilometres). *Note:* Figures may not add up to 100% due to rounding, *Source:* EUROSTAT (2021)

The Phd-research project underlying this paper, assumes that platforms focussing on reducing CO_2 emissions and multimodal transport services have the potential to successfully integrate rail. It can be observed that such platforms offer (mainly overseas) ocean, air and road transport services. Moreover, platforms offering single mode (road) transport services, occasionally also appear to organize rail transport while working with global customers. These observations indicate that the ability to organize multimodal transport is there when demand exists.

The Phd-research focuses on the rise and performance of digital platforms in the EU freight transport market. In particular, it analyses how such platforms can attain maturity in their service offerings that simultaneously provides an answer to the variety of demands. The "Online Exchange Maturity Framework" (OEMF)that integrates different theoretical views was developed by specifying indicators and conditions for maturity growth (Jain, 2020). Maturity in this context relates to organizing sustainable multimodal transport e.g. using rail and road. Higher maturity implies offering the stakeholders a greater value through additional platform services e.g. economic, environmental and social benefits (e.g. reduction in CO_2 emissions, and reducing congestion on specific transport routes) within the given regulatory context. The framework describes the requirements towards the functioning of a theoretical highly mature platform that contributes to accelerating the growth of multimodal transport using rail. Analyses of platforms from other mature network industries provide lessons for this theoretical framework and on possible transitions for rail freight.

This approach was followed to study the influence of two major external drivers on the evolution of independent third party (hereafter called unrestricted) mature two-sided (demand and supply side) platforms in network industries including freight transport. Jain et al. (2019) drew lessons on the influence of the first driver, being de(regulation), by analysing platforms in industries similar to rail freight transport i.e. energy transmission, rail-based public passenger transport and road freight transport. Jain et al. (2020) drew lessons on the influence of the second driver (technological innovation) by analysing matching of supply and demand on single and multimodal platforms in freight transport industries. An emerging picture on the state of competition indicates that these two drivers also influence the maturity of freight platforms, having a disrupting effect on the conventional freight

transport markets. Notably, trends and patterns in performance from aforementioned mature industries can be also observed for freight platforms.

The learnings on the design, operations and performance of digital platforms in the freight transport indicate that growth in maturity improvements are possible. To test these learnings, a real-world case study was conducted between August 2020 and October 2021. It focused on the functioning of a selected platform based on its interaction with multiple stakeholders (demand and supply side) for a specific transport service demand. The individual relationships between these stakeholders and the platform are considered as so-called embedded cases. Comparing these relationships enables to collect different stakeholder views on research questions on the functioning of the platform's practices. Practices refer to a set of related business process activities. When carried out in a structured and consistent fashion they can improve the platform's performance. The strategic practices deal with platforms, as firms, making critical choices on their business model in reference to their market (e.g. platform goals, market focus, benefits to be offered, product and services, technological innovation). The operational practices and technical practices of platforms coordinate and implement the strategic decisions in the platforms' operations.

The two main research questions in this paper relate to (i) the preferred business models, benefits/risks and value addition/challenges perceived by the stakeholders regarding platforms in general and the selected platform in the case in particular, and (ii) their requirements towards specified strategic practices that shape the role of the platform in the next decade in favour of the growth of rail freight in multimodal transport.

This paper summarizes core elements of the framework and insights from earlier analyses in the research project that are relevant for the case study. Section 2 briefly describes the theoretical framework. Section 3 summarizes the analysis on the state of competing unrestricted freight transport platforms that are active in mainland Europe. Section 4 briefly explains the choice for the case study approach. Section 5 outlines the set-up of the case study and highlights views/positions of stakeholders on the two aforementioned research questions. Finally, section 6 concludes with key takeaways and open questions regarding the potential role of digital platforms for supporting the required modal shift.

2. Theoretical framework

Definition of online exchange platform

As indicated, the focus in the PhD-research is on how flexibility, balance and more opportunities for rail freight transport can be organized in bringing rail and road together by using platforms. Given the absence of a standard definition of platforms, the specification of 'online exchanges' (OE as from now on) from Chang, Easely and Shaw (2003) was adopted. It states that unrestricted platform operators apply online matching mechanisms to bring buyers (demand side: e.g. shippers, freight forwarders) and sellers (supply side: e.g. carriers, logistics service providers) together in a virtual place to interactively 'discover' the (transaction) price for a product or service on a dynamic basis. Since prices in cross border rail freight are not transparent (Endemann, 2016), in this research the price discovery is viewed as the heart of a platform's matching mechanism, and considered key to transaction finalization on mature exchanges.

Online exchanges maturity framework (OEMF)

The earlier mentioned integrated "Online Exchange Maturity Framework" (OEMF) links three theories: industrial organization theory, platform economy theory, and maturity growth theory. It facilitates studying the dynamics and transitions of OEs (as homogenous units) in light of the influence of regulation and technological innovation.

In industrial theory, the so-called structure-conduct-performance (SCP) framework (Bain, 1959) is helpful in assessing
i) the market *structure* of OEs (e.g. in terms of the number and size of OEs, number of stakeholders involved in ecosystem of OEs, views of shippers and service providers on OEs),
ii) the *conduct in practices* of OEs as homogenous units and
iii) their *performance* in terms of practices.

The industrial dynamics theory suggests that knowing the past behaviour of OEs and understanding the influence of key drivers for change, supports assessing the capabilities of an OE to become more mature, e.g. in successfully gaining trust of shippers (Dosi, 1997; Teece, Pisano & Schuen, 1997). OEs as firms, need to develop and continuously improve their capabilities to become a game changer in their market.

In platform economy theory, the OEMF is inspired by a simple concept that enables benchmarking of practices and performance of varied business models of OEs across industries. The concept is that all OEs across industries are based on a common underlying business model (e.g. Rochet & Tirole, 2003; Montero & Finger, 2017; Evans & Schmalensee, 2012). OEs, while responding to market requirements, reconfigure their business models and apply these changes in their practices. The theory claims that this ability of platforms to reconfigure, is key to success in dealing with unforeseen and dynamic contexts e.g. when competition is rising, pandemics disturbances supply chains or long term relationships with partners structurally changes. The theory offers the idea of platform growth in three stages on the basis of liquidity (Choudary, 2015) that is further conceptualized as maturity growth of OEs in the OEMF.

Finally, the maturity growth theory (Paulk et al., 1993) is supportive in understanding the present position of OEs and their potential development path towards structural improvements in sustainable multimodal transport services. Sustainability issues like climate change in the transport and logistics system can trigger new policies and directives (e.g. new green climate deal) (see e.g. Geels, 2011; Smith, Stirling & Berkhout, 2005), which in turn spark off new technological innovations (e.g. OEs offering CO_2 free transport). The theory argues that an initial reaction of traditional established actors and incumbents is to perceive change as difficult to manage risks, hence resist to safeguard their interests.

The OEMF claims that the maturity of practices of an OE at different transition stages is determined by the OE's capability to grow to a higher performance level (internal factor), given severe competition levels in a dynamic market (external factor). Lessons on such transitions can be learned when the best performance in practices from OEs in different industries are considered to indicate the highest maturity level. In the OEMF, these practices are organized in three key process areas (KPA), namely the (i) market related KPA (aimed at taking strategic decisions), (ii) the operational KPA (coordinating operations for implementing strategic decisions inside/outside firms) and (iii) technical KPA (related to process automation for tighter integration of users system to the OE and service organization for users). Each KPA is operationalized in the OEMF through a limited set of related practices and KPIs (key performance indicators).

Next, the OEMF focuses on understanding the nature and performance of these OE process areas and practices, assesses their maturity, and expresses this in terms of three different levels:
i) *Maturity level 1 (*create - processes are adhoc): OEs strive to perform three subprocesses i.e. 'organizing liquidity' (e.g. bringing shippers and intermodal service providers on the exchange), 'organizing matching quality' (e.g. enabling relevant offers for shippers), 'building trust' (e.g. guaranteeing that proposed benefits are delivered in a safe and reliable manner),

ii) *Maturity level 2* (curate – standardized processes, systematic monitoring): In addition to level 1, OEs aim to excel in the subprocess of 'ensuring balance' (in consumption on two sides: enabling shippers always to find relevant offers).

iii) *Maturity level 3* (cultivation - processes are automated, controlled and subject of innovation): OEs in addition to level 2 aim to excel in i.e. 'stimulating innovation').

A highly mature OE is theoretically assumed to perform all practices at level 3. The hypothesis is that when OEs in the freight transport market in each of their practices matures towards this highest level, it will be successful in accelerating rail freight transport growth, since this modality is then structurally integrated into multimodal transport services.

Figure 2 summarizes the OEMF, with the three KPAs and their description in the first two columns. For measuring each practice in a KPA (third column) of an OE, a generic KPI (column 4) is suggested as a guideline. Finally, related to the KPI, a general assessment criterion at each maturity level (columns five to seven) is presented.

				Maturity level 1 - CREATE	Maturity level 2 - CURATE	Maturity level 3 - CULTIVATE
Key Process Area	**Description**	**Practices**	**Key Performance Indicatior (Example)**	***Organizing Liquidity, Organizing Matching Quality, Building Trust***	***Ensuring Balance***	***Stimulating Innovation***
Market related Practices	Strategic practices for making choices on strategy, market focus, products and the management of current and potential resources	Strategic Management	Benefits offered	No standard product definition.	Product defined with broader market focus	Multiple products traded, each with clear market focus. Product optimized over multiple modes
		Product & Service definition	Transaction cost			
		Subscription & product /service definition	Frequency of rebates/ incentives			
		Market & Stakeholder management	Participants on both sides of exchange	Adhoc or no value added services	Value added services formalised, monitored and controlled	Value added services optimized for customer efficiency
		Market rules	Frauds complaints			
		Design of Algorithm	Time: publish price signals			
		Integration of adjacent markets	Investments			
		Organization development	Budget			
Operational Practices	Practices for process and policy standardization. Aiming at continuously optimizing these for higher efficiency	Communication	Individualized feedbacks	Adhoc, Processes and policies are not clearly defined and communicated	Processes, policies are defined, standardized, monitored and controlled for operational activities	Processes and policies are standardized, automated and optimized. Goals are controlled; communicated externally, internally
		Registration	Time for certification			
		Operationalizing Auctions	No. of finalized transactions			
		Clearing & Settlements	Delay/failure in payments			
		Data analytics and information sharing	Progress of implementation	If at all, few and far apart performance indicators	Analytics processes within each sub process are standardized.	Automated dashboards. Analytics utilised for process optimization
		Training &education	Time spent in training			
Technical Practices	Practices regarding supporting and technical operations e.g. data- availability, security and integrity. Optimizing interface with participant's and partner's ICT systems	Service Organization	Issues closed	Manual systems in place, inconsistencies possible	Data integrity, accuracy enables monitoring and tracking for improvement of services	Systems are completely integrated and interact with each other
		Process Automation	% integration with partners, participants			Data security is ensured. Data is 24X7 available and real time

Figure 2: Online Exchange Maturity Framework, Jain (2020)

3. State of competition in the European freight transport industry

The analyses on the influence of external drivers on freight OE's in Europe, revealed two prominent business models (Jain et al., 2020). The (i) freight transport exchanges (FTE) that as marketplaces take responsibility for the matching of two sides (service demand and service provision) but do not guarantee the physical transport delivery (although offer value added services e.g. for track and trace) and (ii) the since 2015 emerging digital freight forwarders (DFF) that, next to their matching service, also organize and execute physical transport service, fully or partially, as finalized transaction on their platform. Referring to the OEMF, the DFF appears to represent a transition stage of OEs in their attempts to better deal with challenges resulting from the current freight market conditions. Combinations and variations of the two business models could also be observed by the end of 2020. This development indicates that competition in the market is ongoing in interaction with evolving market conditions, in which OEs strive to distinguish their business models from others in order to compete. A discussion on these models is also slowly finding its way in literature (Mikl et al., 2020).

Figure 3 below shows the trend in the unrestricted OE's of freight transport over the period 1985-2020. Multimodal OEs (often profit based start-ups), especially DFFs (since 2015) in the global freight transport market, appear to outgrow multimodal FTEs in number. Some DFFs in this context hire transport assets, possibly to ensure reliable services. Such hiring of dedicated services has seen a downturn in a number of cases (Lennane, 2020) due to changing market conditions in the pandemic times, indicating that OEs are constantly reconfiguring their business models as a response to the market requirements. Services related to Amazon appear to be common. FTEs in air transport can also be observed. Such multimodal OEs usually focus on e.g. ocean, air and road services for overseas transport, also integrating rail services within the EU. Their matching mechanisms include price discovery.

Competition is clearly observed to be rising in road based OEs, both in FTEs and DFFs. The latter, also profit based start-ups, organize matching (with differing automation levels) based on price.

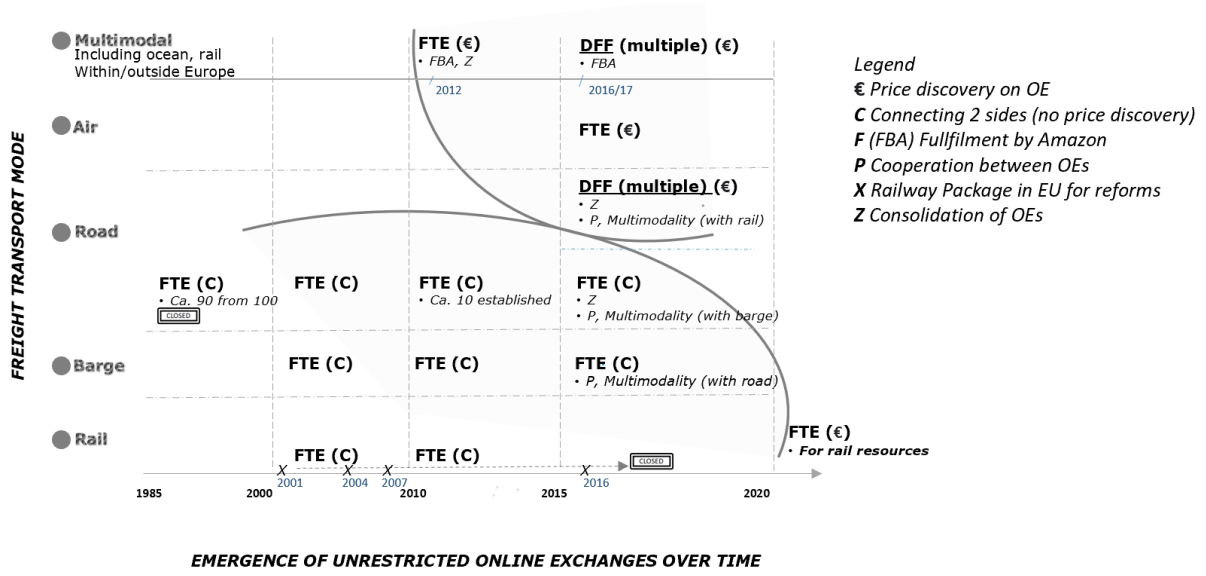

Figure 3: Trends observed in freight transport online exchanges (FTE, DFF) active in Europe. Author's depiction

Cooperation in Europe, e.g. between road FTEs (without price discovery) and consolidations through acquisitions by DFFs (of other DFFs and FTEs), aimed at expanding the covered geographical network, could also be observed. Such patterns can be linked to strategic practices of platforms in mature industries (Jain et al, 2019). A barge and road FTE are now also linked. Past rail FTEs did not succeed, a new FTE that uses price mechanism has emerged for leasing rail freight resources.

On the whole, DFFs appears to be ahead in integrating rail in their services for larger multimodal supply chains overseas and across Europe. They are increasingly communicating their service offerings, including goals on CO_2 emissions. The private and consortia OEs belonging to incumbents are also active in this regard. Since the goals of the Green climate deal became more concrete towards the end of 2020, also in road transport a burst of activities can be observed to organize multimodal transport. Interviews in this research project and newsletters indicate that, in response to the transport demand of global customers, also road based DFFs become relevant for rail.

Although OEs (especially in road) increasingly mention the number of offers, the users of their platforms, and the amount of CO_2 emissions reduced, it appears very difficult (e.g. for potential customers) to find more transparency regarding e.g. the volume of freight demanded and transported, the number of rail operators (only a market power or multiple rail operators) and road operators

participating or the price indications of specific services. In this respect, platforms of other mature industries appear to be more transparent.

All these signals indicate that due to the two drivers of change, competition in OEs in the freight transport industry seems to accelerate. However this is not yet clearly visible in terms of an increase of rail freight. Hence, where the aforementioned analyses offer interesting insights on trends in the development of OEs, the lack details on choices OEs (should) make to move to a higher level of performance in multimodality using rail. An in-depth case study was needed on the stakeholders' views on the development and requirements regarding OE's practices (as defined in the OEMF in Figure 2). This is because a case study approach enables exploring the views of stakeholders in a real-world setting (Jacobsen, 2002; Järvensivu & Törnroos, 2010) when less knowledge on this is available from other sources. This materialized in a collaboration of selected stakeholders including an OE with the aim to agree on a match between specific cross border transport demands and the services offered using rail. Next in section 4 the case study approach is briefly discussed.

4. Case study approach

Using an earlier analysed sample of the operating unrestricted OEs, a real life case study with a from that sample selected OE at maturity level 2 that offers physical delivery of transport was considered acceptable, as none could be found at overall maturity level 3. At level 2, trust from demand and supply on the exchange, a critical level of liquidity (required to be successful in matching demand and supply) and a continuity in the consumption of OE's services on both sides could be assumed. This matching is based on the quality of data supplied from each side on the OE. Developments can relate to either including rail in services or increasing its volume on the OE. One of the invited OEs agreed to the invitation to participate in the case study.

There is no single way of building a case: a variety of rail freight transport cases in multimodal transport chains are possible. Operational choices depend on various choices e.g. the geographical positions of countries and their trade relations that dynamically influence the transport flows. Further, complexities relate to the number of stakeholders within and external to the OE's ecosystem. Figure 4 shows a high level overview of stakeholders. Those directly influencing the development of the platforms are investors, board members, service providers (ICT, financial services, logistics services), regulators and policy makers (Kramarz, 2021). Others (e.g. NGOs, interest groups, public authorities) are outside the ecosystem, but can indirectly influence the platform. Stakeholder types participating in the case study are shown on the right and will be discussed briefly in section 5.

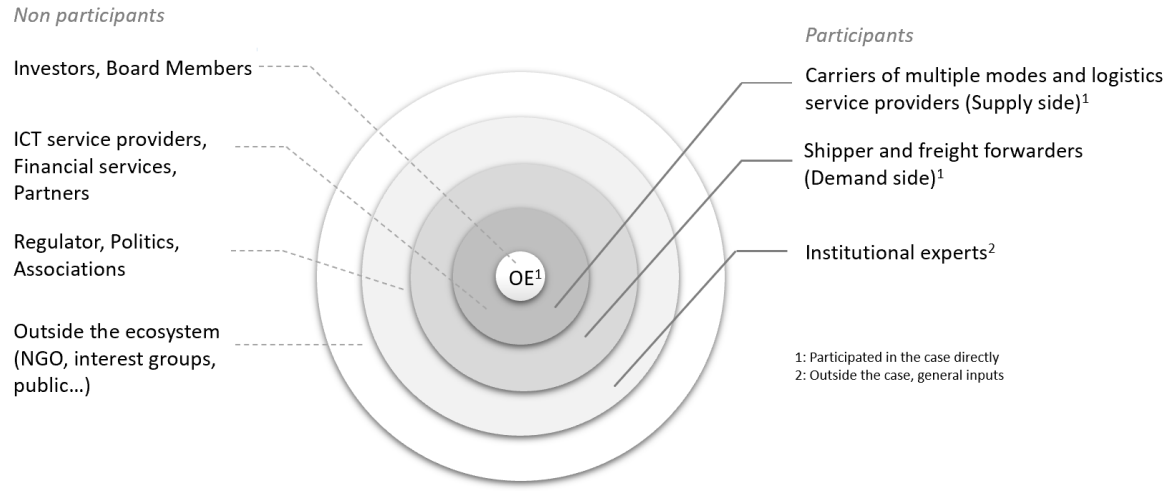

Figure 4: Stakeholders in a platform's ecosystem (general view, left). Stakeholders participating in the real life case study (right). Author's depiction

The participating firms for investigating the functioning of the OE on the basis of the transport demand at hand were selected on various criteria, including involvement in the intermodal/multimodal (including rail) transport business using standardized containers, with businesses set up in neighbouring countries in the EU. Moreover, the firms and the OE were not acquainted to each other, because that increased the change for 'fresh' opinions on the OE's role. The focus was on rail and road transport in a cross-border context that are considered favourable for rail in terms of distance, having a potential for modal shift for containers from road to rail (EUROSTAT, 2018 and 2020). Further details are provided in section 5.

Data collection methods used in the case study were meetings with (recorded) observations, semi-structured interviews (in line with the OEMF and earlier findings regarding regulation and technological innovation in research) with open ended questions. Analytical methods used were, document and website analyses, time series and quantitative analysis, aimed at triangulation and snowballing to build the relevant narrative for the case. Live meetings and workshops due to pandemic restrictions were not possible, hence took place online.

5. Results

Essential case study data for understanding the results is first presented. Due to confidentiality reasons no names/information of the OE and interviewees related to participating firms can be mentioned that links them to their identity.

A first case with a demand of a transport customer for cross border freight between 900 and 1600 km showed that road transport prices on selected routes were very low compared to rail, hence not competitive on OE. For the second case offering a modal shift potential, no interested shipper could be found. The third case provided a workable setting.

In this case, the aim is to test the organisation of a regular transport of a couple of hundred standardized containers per year, and notably try to understand whether economic benefits, efficiency in monitoring the transport and opportunities of new freight business for the empty containers returning on rail, were possible. Aim is also to study the changes in the business model the shipper had to make to adopt the exchange. The cross border rail transport distance was ca. 750 km. For the pre-haulage (40 km) and post-haulage (up to 330 km) on road that in some cases included cross border transport, the shipper had its own arrangements. The shipper, due to its long term relationship with the rail transport firm, received a special volume based price for the transport demand, when the demand is booked under certain conditions.

The analyses involved testing the organization for the shipper's transport demand in both directions on the OE for a) only rail transport, and b) replacing post haulage on road by rail with return load wherever possible. Offers were made on the OE by intermodal service providers that showed potential of reducing CO_2 emissions. From the offer selected regarding b), the price for some destinations (including cross border transport) was in a comparable range to the current price paid by the shipper, and appeared competitive to the shipper when also the efficiency using the OE was taken into account (also for a)). However, the difference for one cross-border destination (ca. 330 Km) was 1.5 higher than the current price paid by the shipper.

Next, the views collected in interviews with all stakeholders were used to answer the research questions related to the two earlier mentioned research aims to understand (i) the preferred business models, benefits/risks and value addition/challenges perceived by the stakeholders regarding platforms in general and the selected platform in the case in particular, and (ii) their requirements towards specified strategic practices that shape the role of the platform in the next decade in favour of the growth of rail freight in multimodal transport.

The selected OE, shipper (demand side) and three service providers (supply side) provided relevant information to perform the two intended analyses. The two research aims were further discussed with five experts from policies on rail (1), regulation in transportation and platforms (1), and (intermodal) freight transport (rail, intermodal and modal shift, maturity model in logistics and transport) (3). The discussions with these experts were more generic than focused on the selected OE.

For readability's sake first the answer of stakeholders directly participating in the case study (shipper, service providers, selected OE) are presented, followed by those of the experts. For data protection reasons, only selected observations are discussed. The focus is on highlighting similarities and differences in opinions.

Views on general business model of platforms and of the OE in the case study

Key views of involved stakeholders are as follows.

(i)Stakeholders appear to take risks in testing different OEs in pursuit of business growth and finding more efficiency. Their openness to who operates OEs (independent operator, consortia or incumbent freight forwarders) is expressed as "as long as they offer economic and environmental benefits, the operator does not matter".

(ii)Views differ between stakeholders who have not yet adopted the OE and those who have. From those who haven't one view on single mode road OE's (FTE, DFF) is that these are "of low relevance" for rail. "These focus on piecemeal transport, hence are not suited for cases requiring time consuming operations." Another view on road and on multimodal OEs, was "we have booked [container transport] sometimes". "We would love to give shippers [better transport] service though OEs", but till now "we did not succeed." Suitability of FTE's as a "marketplace" was not considered aligned to the need of existing users. Regarding the selected OE, the opinion of a stakeholder was "that it gives the [market] the right understanding of its business model".

(iii)The OE, highlighting its own business model, took a more mature view that "business models evolve with market conditions", where reconfigurations support creating trust in markets.

The experts provide diverging opinions e.g. "the operator of such an OE can be an unrestricted", "public or commercial" party. Others stated that a "platform is not always a solution", whereas one argued that "there will be a platform in 2030 but the business model cannot be predicted today".

The *role* of an OE in this regard appears to be to understand the market mood, implying systematically considering (the need for) reconfigurations and communication to the market and its stakeholders (existing and potential) on their business models, in order to be perceived as attractive. This continuous process aims to create and maintain trust at all times as dynamics in the market is high and competition increases.

Views on benefits and risks

The views differ between stakeholders who have not yet adopted the OE and those who have.

(i) A stakeholder (not yet using OE) regarding benefits stated that, "people start using platforms like [OE] to save money and compare it with their current situation before booking via [OE]". Another stated: what is the "benefit [from OE] and .. how much". Thus the need is for assessing whether the benefits over the risk taken by sharing business critical details in adopting an OE are big enough. Such risks (e.g. for service providers) relate to sharing data on prices, for shipper on transport details. This view is expressed as a feeling of "loss of control", hence the question is "Can OE functions [on the platform] be performed only by the OE or is it also possible for the [stakeholders] to do so?"

(ii)Stakeholders using the OE perceive that "the industry is opening to transporting CO_2 free transport" and "working together with [OE] can contribute to sustainable multimodal transport". Their views on benefits relate to ".. improved transparency in the supply chain transport". Further, main risks perceived

are "usual business risks" e.g. "consequences of mergers and acquisitions", possible "influence of stakeholders", thereof "loss of confidential data".

(iii)OE also perceives such risks towards stakeholders and adopts its "responsibility to communicate actively" and "to improve perceptions" regarding "false impressions". OE's and existing user's ability to take risks to "make compromises" is what apparently leads them to benefit from each other.

The experts reason that perceiving risks "from competing price is genuine" and "the influence of Amazon can be a potential threat". Especially "traditional players perceive risks that the platforms will make freight what Uber made to Taxi". Hence "everyone becomes very strategic in deciding whether to work or not" with the OE. One stated that platforms "have known to exploit social conditions of their service providers, e.g. Uber". Other experts reformulate risks into potential benefits as "the down side of not joining a platform is empty freight train" hence "joining the platform could be a benefit" for rail freight and for the OE.

The *role* of the OE in this regard appears to clearly offer ways to each type of stakeholder in its ecosystem to assess their benefits and risks to make informed decisions about adopting the OE.

Views on value additions and challenges

A consolidated bird's eye perspective shows that the views are dependent on each stakeholder's own maturity level, notably in relation to digitalization of their internal processes.

(i)Views of existing OE users focus on "simplifying complexity" and "booking efficiency". Other views relate to "planning to connect ICT systems" (i.e. systems not yet interfaced).

(ii)Being hindered by the complexity of the rail system today, the value addition according to most stakeholders is "the visibility, and fast and efficient transport organization for [their] transport customers", and further the offering of "better prices and faster solutions than the current system".

(iv)Challenges in transport demand as experienced by those not using the OE relates to the "fragmented" platform market due to which "not sufficient (volume) demand for rail freight is available".

(v)The OE considers its *role* in "matching environmental and social conditions in transport demand" as a value addition. This through the "ability to develop new functionalities" at high speed for "customers and partners".

The experts mention the major challenge that, since "rail transport is complex", "the involvement of the infrastructure operator is undermined in the use of such platforms". Clarifying "entry points, track access charges, intermodal connections, list of terminals…" in this context can add value.

All stakeholders agree on the *role* of platforms in simplifying/reducing complexity by "creating one unique language that all understand e.g. what is a standard product/unit", so that offers can be better understood by the market.

Next, the similarities and differences in views of the stakeholders (mainly shipper, OE and in selected practices the service providers) are highlighted on requirements towards strategic practices in the next decade for stimulating the growth of the rail freight share in multimodal transport.

Requirements regarding strategic practices of the OE

Strategic Management: The stakeholders agree that the *role* of the OE is to continuously establish alignment of goals to optimize the benefits (economic, environment and social) for its stakeholders within the given regulatory framework. Transition requirements towards a next maturity level of the OE relates to (i) increasing the capability to include environmental and social benefits in the service offers, and (ii) increasingly stimulate the demand for rail freight transport so that stakeholders in the market perceive these as their own needs.

(i)OE expressed that "attempts to offer environmental benefit are already made today". "By 2025 a clear environmental benefit is possible". Today "social benefits are realized by complying with e.g. present local regulations". However "current practical conditions do not always facilitate" further steps to be taken, but these are "possibly feasible in 2030". Other stakeholders agreed to this view, suggesting that the OE should explicitly offer users a "want more CO_2 reduction" option by means of which they can contribute to climate related projects.

(ii)The stakeholders agreed that it is the *role* of the platform to "stimulate demand so that markets sees rail transport as need". Opinions differed between "already offering CO_2 free transport" (by the selected OE and existing users) and potential users: "developing such a practice may take 5-10 years. Acceleration in rail freight requires a push to speed actions, i.e. OE must continuously develop the skills to do it", until 2025 and 2030. Stakeholders agreed that "first there is a need for a change in perception that rail is expensive and slow in action".

Product and service definition: The stakeholders agree that the *role* of the OE is to continuously offer products and services, each with a clear market focus that caters to single and multimodal transport. Further optimize value added services for customer efficiency, social and environmental benefits.

(i)Stakeholders in general agree to managing ongoing requirements for covering rail related complexities of different cases to reduce transaction costs for stakeholders on the OE. Simplicity in platform usage by standardizing the booking process is key for covering the multiple cases. Visibility (of offers, price, real time events) and flexibility for transport customers to intervene (e.g. in case of delays in transport), in the OE's handling of customer specific exceptions (e.g. in booking system) is key to gaining market trust. Value added services e.g. insurance, customs clearance etc. in this regard should be available ("these usually work").

Views on transition requirements considered relevant to mention here.

(i)Stakeholders agree that the requirement towards "improving speed, by reducing transport delays: cross border custom, technical & operational issues", cannot be fully achieved by 2030 through the OE as "rail organization is complex and domain knowhow is scarce." Another view was that "the OE cannot directly impact these issues, but can push actions in this direction. Regulators and rail operators need to act here". The transition requirement in this regard was towards efficiency/ease in booking, illustrated by: "Today, for booking one container by rail freight .. one needs contacts ….each booking generates 100 E-Mails.".

(ii)Stakeholders agree on the requirement for "free online calculators to assess benefits from OE's services" for the market. The OEs expresses that this is already possible "for registered users", and possibly in 2025 for public users. Other stakeholders see a pressing need for "the possibility of finding prices", while another observed that "most rate calculators [on platforms in the market] show a high price". From an earlier interviews, one view on CO_2 emissions calculation was that "the calculation must be standardized, e.g. in rail passenger transport the CO_2 emission is stated on the ticket".

(iv)The key expectation from stakeholders towards the *role* of platforms appears to be that "the OE can support in simplifying the access to the [rail freight] system. For someone who does not deal with such transport concepts on a regular basis, this is helpful to solve challenges regarding e.g. whom should I contact to get my freight on rail."

Subscription and product/service pricing: The stakeholders agree that the *role* of the OE is to automate and optimize the process towards balancing and actively consuming rail related product/services.

(i)There is agreement on the requirement that "simplified subscription model for [accessing] rail service fast" could be in place by 2025. Further discussions did not take place in this regard.

Market and stakeholder management: The stakeholders agree that the *role* of the OE is to optimize processes and policies for increasing and retaining satisfaction, hence contribute to trust of market actors in the OE.

(i)OE agreed to the transition requirement that it should have strategic partnerships with service providers (e.g. rail)", stating that this "requires technical and domain knowledge as rail systems and processes are/have been made complex. [It] requires time". Improvements are feasible by 2025 and others agree to this timeline. The idea is that OEs should have different mechanisms and channels to manage and reach participants and service partners to manage the expectations, needs and importantly risks perceived in an ongoing fashion.

(ii)A difference of opinion exists regarding the requirement towards "regularly meeting with political, regulatory and standardization agencies for solving issues arising in multimodal transport". OE agreed this to be possible by 2025. Another stakeholder did not see such a need.

Market rules: Stakeholders agree that the *role* of the OE is to align mechanisms to standardise market rules (e.g. transport related), platform rules (e.g. making OE a safe place to interact) and regulatory requirements (e.g. local regulations). Interestingly, issues from stakeholders on bias and neutrality of the OE were not raised.

(i)A transition requirement to which stakeholders agree is to "implement services with other OEs for continuous monitoring of credentials (e.g. service provider to check credentials, EU database for road carriers)". The OE assumes this to be feasible by 2025.

Design of algorithms: The stakeholders differ in their views on the *role* of the OE in involving shareholders, key participants in the design and automation of algorithms to meet interests of demand and supply side in matching and pricing, and to create trust.

Three transition requirements in this regard are

(i) stakeholders agree to the requirement to "communicate market signals" based on matching. The OE expresses that "different signals (e.g. critical transport information for market) are already communicated" but assumes that communicating also other signals will be realized by 2025. Others wish an "immediate implementation" stating that "this is the biggest need and expectation from the platforms. They have all the information from all the stakeholders who provide data, despite the fact that risks are involved. If the platform does not use that data, what is the point of taking the risk?"

(ii) Regarding "integration of environmental and social conditions in the matching algorithm", the OE perceives this "possible after 2030". Another stakeholder expresses a clear priority as "I do not care for other matching conditions before it starts functioning for logistics operation (implying finding a relevant match based on price offers for current business)". Another view was that "in future, shippers will book based on costs and CO_2 emissions."

(iii) All stakeholders disagreed that OE should "include rail and road users for discussions regarding improving OE's pricing mechanism" to create trust and prove that no bias in intermediation exists. OE saw its *role* in taking away misperceptions.

Integration of adjacent markets: The stakeholders agree that the *role* of the OE is to continuously optimize products/services for creating positive network effects for its stakeholders.

(i)The stakeholders agree on the transition requirement that a "project oriented growth in new markets/expansion is useful, e.g. cooperate with DFFs and FTEs to create more volume for rail on the platform". Moreover, "this is an ongoing process (for 2025/2030), depending on emerging situations, demands and chances".

Organization development: The stakeholders agree that the *role* of the OE is to continually optimize capabilities development of its (intellectual, technical and human) resources for stimulating innovation in the multimodal freight transport industry.

(i)All stakeholders agree to the transition requirement on "further rail knowledge development", although this is "time consuming". A next level on this can and should be reached by 2025.

(ii)Based on this, stakeholders agree to the transition requirement that the OE should "suggest fact based initiatives for rail at EU and state level, on new policies and priority in infrastructure development". OE assumes such activities to be possible on a regular basis by 2030, Other views are that the OE should keep "actively talking to government, regulators, shippers, service providers, trying to create more value by sharing thoughts at the right place, to the right people and at the right time". Another opinion was that "stakeholders are willing to pay for such related new information as it is valuable and brings actors in markets forward". There is agreement that such activities should take place on a regular basis by 2025.

View of experts on role of other actors in creating favourable conditions for transition to the next maturity level

Selected stakeholder views (experts and case study participants) on roles and actions required from other actors (mainly OE, rail operators and policy makers) in the OE's ecosystem were considered relevant, and are therefore highlighted here. Selected actions are highlighted that could push evolutionary progress. These are presented without differentiating between roles of actors in policy making, e.g. regarding creating directives or regulations (at EU and state level). The timeline (2025 or 2030) towards the actions was not clear, showing a need for future research in this regard.

(i)The stakeholders agree that the role of policy makers is to push competitiveness of OEs "by ensuring data sharing, pushing new technological innovation, [and facilitating] competition" as "digitalization in freight forwarding is still low. Their business (using rail) is profit oriented: forwarders are not interested in creating transparency."

(ii)They agree that a push in rail freight competitiveness is required "since rail freight transport shares the same infrastructure as the rail passenger transport, with latter having a higher priority", thus flexibility and the "ability of rail freight to react in real time. E.g. last minute changes are not possible today". Another view was "getting infrastructure projects sanctioned takes a long time". In addition, "rail as an environment friendly mode requires faster train paths". The upside is that "shippers are interested in rail transport...". Another stakeholder observed "that collusive behaviour of incumbents" e.g. in cross border block trains on essential freight corridors (Smith, 2021, "Freight cartel") can be a hinderance. Further "the influence of Amazon (not yet found in literature) can be a potential threat to the future of rail." E.g. when they acquire intermodal logistics capabilities and offer these commercially in the market.

(iii)Few but relevant views regarding harmonization of rules and regulations relate to standardization in cross border processes for digitalization, automation and transparency. "This is an ongoing topic for policy makers as seen in GSM-R, ECTS, ERMTS ….".

(iii)The majority of stakeholders see a need for action from policy makers in providing more (economic) incentives to actors, to use and offer reliable as well as environment friendly multimodal transport products and services. Others stated that "Promoting rail for shippers could be helpful". A pressing need from all stakeholders was felt towards policy makers for "translating emissions/congestion into the infrastructural (use) conditions for all modes" in order to create a more level playing field for rail freight transport services. The urgency for "a change in mindset" was emphasized on "the present assumption that rail prices should be as low as road."

(v)Service providers also see the need for a mind shift in rail operators. One stakeholder observed "that there is scope of improvement with the help of digitalization for all participating partners in the

transport. There are many partners involved in the operations, each entity focussing on its own responsibilities. E.g. shipping company, terminal operator, forwarder, supply chain operators to interface this. There is scope of cost reduction here."

(iv)Repeated views regarding "proper training and education for railways" were highlighted. Expressed as "In contrast, such trainings are easier for trucks."

6. Conclusions and discussion

This section draws conclusions on the presented study regarding the role of online exchanges (OEs) platforms towards rail freight growth in the EU. Further, selected issues regarding the role of policy makers are discussed.

Two major drivers for change, the (de)regulation (e.g. towards single market policy, green climate deal) and the technological innovation (e.g. on OEs), appear to have nudged competition in freight transport OEs in Europe regarding multimodal services, especially for using rail and reducing CO_2 emissions. Based on these insights an in-depth case study was undertaken to collect views of selected stakeholders on the role of OEs in the EU rail freight market.

Although it should be underlined that lessons from a single case study cannot be generalized as such, they do provide relevant food for thought. The case study showed that the stakeholder's requirement for transition are induced by short-term challenges from present market conditions (i.e. what needs to be solved by 2025 first?). The need is expressed to increase efficiency and flexibility in rail freight transport services by i) simplifying complexity (notably in cross-border processes) ii) standardizing transport booking (deal with demand variety), iii) increasing visibility of rail (price based) service offers/demand, iv) increasing transparency in transport operations (for timely intervention), and finally vi) improving favourable conditions (notably infrastructure and level playing field in pricing). Several of these potential improvements refer to more clarity on the exchange of different types of data and this basically relates to who should provide what data, to whom, for what purpose etc. Here, OEs can play a significant role. This view is presented in Figure 5 below.

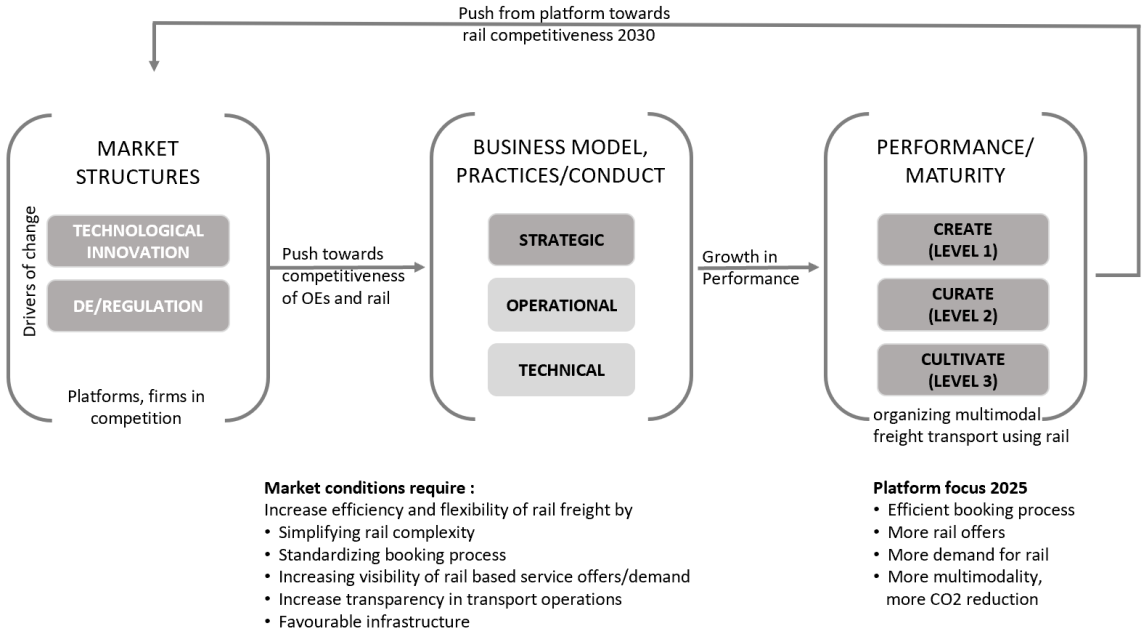

Figure 5: Summary of stakeholder views on transition requirements towards OEs. Author's depiction

Key findings on experienced problems are:

(i)though demand for rail freight transport exists, stakeholders on supply/demand sides struggle to find an OE (or OEs) that offers rail freight services suitable to their needs.

(*ii)the speed of innovation on OEs to increase the level of standardization for booking of transport services is slowed by rail complexity (variety of demands). Moreover, low levels of digitalization and stakeholders' willingness to share data (i.e. different levels of integration with the OE's system) leads to a low visibility of rail related service offers on OEs.*

(iii)New users have no means to benchmark OEs. They need to understand whether benefits from OEs (e.g. better prices, efficiency gains, sufficient transport volume, flexible service) structurally outweighs the risks they perceive for their individual businesses (e.g. sharing data on prices, shifting to new business relations, handing over control in business to OE).

(iv) Existing users and OEs are in practice increasingly focus on creating transparency in supply chains for CO_2 free multimodal transport using rail. OEs in this respect are largely dependent on data from various actors in the transport chain (e.g. terminals, suppliers, infrastructure operators).

The key conclusions from the case study on pressing transition requirements towards strategic practices of OEs (to clearly improve in the coming years, and to consolidate in the longer run) are:

(a)*Strategic management: OEs need to communicate their transition path towards multimodality using rail more clearly.*

(b)*Products and services: To push adoption of OEs faster, stakeholders need to compare OEs and standardized calculators (e.g. rates, emissions) can be helpful here. .*

(c)*Subscription and product/service pricing: OEs need to provide a fast access to rail offers/services.*

(d)*Market and stakeholder management: OEs need to address risks perceived by stakeholders (new and existing) more systematically*

(d)Market rules: OEs need to make their platform a safe place to interact.

(e)Design of algorithms: OEs need to send regular price signals to boost the transparency, market competition and market trust in them.

(f)Integration of adjacent markets: OEs need to cooperate with other OEs to reduce fragmentation and create more volume for rail.

(g)Organization development; OEs need to develop the capability to better understand and manage the rail complexity (e.g. cross border challenges, access issues).

Given these conclusions, the question (based on practices) rises whether policy makers should offer guidelines on OEs for communicating performance data, for standardizing calculators (e.g. on CO2 emissions) and discouraging collusion between market powers that hinders new entrants to access rail markets? Regarding reducing complexity in rail, should policy makers nudge rail service providers for digitalizing their internal processes and sharing available rail capacity to platforms? Should they encourage OEs to play a consultative role e.g. regarding prioritization of infrastructure, or congestion issues in cross border rail freight? Finally push cooperation amongst OEs to create more volume for rail?

Two conditions appear to specifically need support from policy makers. They focus on the mindset of low rail prices, formulated as (i) "translating emissions/congestion into the infrastructural (use) conditions for rail or other modes" and related to this (ii) providing (economic) incentives to different actors for using rail (e.g. shippers). Both conditions may improve the ability of taking risks on the

demand side. The near future will show whether policy makers and market actors are jointly willing to take up these challenges.

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