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Business Perspectives for Freight Transportation Management – The SYNCHRO-NET Project

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Abstract. Nowadays, the effects of globalization impacted on the international trade that is growing faster. To confirm this trend, the volume of world trade continued to grow in the 2015, according to the estimates provided by the World Trade Organization. In this context, the challenge for transportation is to overcome the complexities related to higher service quality, time-sensitive delivery, the increasing distances and the vulnerability of the supply chain. To these issues are added those concerning the economical end environmental sustainability of the logistics operations. In fulfillment of the Horizon 2020 programme, different projects and research efforts are addressed to de-stressing the supply chain, introducing ICT-based solutions (e.g., e-Freight tools) and slow steaming concepts. The paper presents the SYNCHRO-modal supply chain eco-NET (SYNCHRO-NET) project, which has the aim to demonstrate the effectiveness of slow streaming combined with the synchro-modality, to reduce the externalities of the supply chain (i.e., costs and emissions) and to improve the reliability, the sustainability and the optimization planning process. This project takes into account the results obtained by the previous successful projects in the same field, but introduces a further layer of innovation that extends the current state-of-the-art. In fact, the SYNCHRO-NET implementation is not strictly focused on the ICT solution, but it combines operational models with a business perspective and includes a stakeholder-driven approach.

Keywords: Business model, operational model, survey, synchro-modal supply chain.

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1 Introduction

In the recent decades, globalization and urbanization together with the progress in management principles (e.g., Just In Time solutions), have restructured the global supply chain, increasing the relevance of an efficient freight transportation management. Moreover, the international trade is still registering a positive growth. In fact, according to the estimates provided by the World Trade Organization (WTO), the volume of world trade continued to grow in the 2015, recording the 2.7% as measured by the average of exports and imports, and they are expected to grow by the 2020 as population and economic dynamics increase (WTO, 2016). Thus, this context is characterized by the movement of high volumes of freight, on-time deliveries and high service quality level required by the customers. In fact, according to Halim et al. (2016) logistics service providers respond to the tension between transport demand and transport supply by dynamically adapting their services and strategies, ensuring that producer, product, and client service level requirements are met. They make strategic decisions about the selection of the right modes of transport, the location of distribution centers, and the connections between distribution center locations and modes of transport, in an effort to continuously reduce generalized logistics cost. Moreover, the transportation industry has to face with different challenges as bottlenecks and negative externalities generated by the logistics activities (e.g., traffic and congestion, environmental pollution due to the emissions generated, etc). Considering these issues, different stakeholders, such as companies operating in the transportation industry and local administrations, are readily activated in order to develop solutions and implement new business models with the aim to make logistics activities more sustainable in terms of economical efforts and environmental impact. In this direction, focusing on the long-haul shipment, new concepts as the slow steaming and the synchro-modality are attracting the researchers' attention. In particular, the slow steaming is subjected to widespread studies and projects as it is both a cost saver, given the increase of fuel price, and environmentally friendly (Lee et al., 2015). On the one hand, about the first aspect, Bonney (2010) and Lee et al. (2015) state that considering a fuel price of about $500 per ton, a slow steaming strategy leads to a costs saving of about 5-7% for the carriers. On the other hand, relating to the environmental benefits, Cariou (2011) provides a quantitative estimation of the reduction in emissions generated by the slow steaming. In particular, the author states that reducing a vessels speed by 10%, the

emissions decrease by at least 10-15%. Although these benefits of slow steaming, there is a skepticism from the end-users of logistics services due to the perception of longer transit times as consequent to the adoption of slow steaming strategies, which combined to the waiting time caused by port congestion, make the overall supply chain less agile and reliable, and more costly. This paper contributes to the literature concerned the issues above discussed, presenting a research project funded by the Horizon 2020 Programme of the European Commission, called SYNCHRO-modal supply chain eco-NET (SYNCHRO-NET), addressed the topic of the Mobility for Growth Horizon 2020 call "De-stressing the supply chain". The SYNCHRO-NET project is led by a consortium that brings together an industry-driven group of companies, research institutes and universities, among which the Politecnico di Torino, who has the leadership of the scientific part of the research project. SYNCHRO-NET involves top stakeholders and partners from 10 countries and 20 organizations and aims to demonstrate how a powerful and innovative SYNCHRO-modal supply chain eco-NET can catalyze the uptake of the slow steaming concept and synchro-modality, guaranteeing cost-effective robust solutions that de-stress the supply chain to reduce emissions and costs for logistics operations, while simultaneously increasing reliability and service levels for logistics users (SYNCHRO-NET, 2016). The purpose of this paper is to discuss the novelties of the SYNCHRO-NET project, which improves the current state-of-the-art along different axes:

- Holistic approach. The SYNCHRO-NET project not includes only innovations strictly related to the technical solution but, to our knowledge, it could be considered a pioneer in its type of approach, based on a comprehensive vision covering all relevant aspects, both technical and managerial. Concerning this second aspect, one of the main challenge faced is to make SYNCHRO-NET a commercially viable solution that allows both providers and users to get profit, according to a win-win strategy.

- Methodology innovation. The SYNCHRO-NET project is based on a stakeholder-driven iterative approach, supported by the adoption of a lean business methodology named "GUEST" and developed by a pool of researchers of the Politecnico di Torino (Perboli and Gentile, 2015). It allows to consider the stakeholders requirements from the early phases of the project development. Knowing these requirements, it is possible to drive in the right direction, the implementation of

a business model fitting the stakeholders needs and then, to define the operational model in a proper way. The consequent benefit is the higher market acceptance of SYNCHRO-NET output promoting and enhancing new collaborative business models.

- Technical innovation. SYNCHRO-NET aims to provide a cloud-based eco-net of advanced optimization, simulation and decision support modules, which enable slow steaming strategies and a complex synchro-modal supply chain to be planned and optimized effectively, both at the strategic level and in real time. Through this solution, the different stakeholders are capable to:
  - quickly analyze and calculate the impacts and benefits of slow/smart steaming and synchro-modality on the whole supply chain;
  - easily implement the preferred slow steaming strategy and corresponding synchro-modal operations to actually achieve the projected benefits (i.e., reduced emissions, de-stressed supply chain, lower costs and increased customer service).

The paper is organized as follows. In the Section 2 we introduce a brief description of the GUEST methodology adopted. In the Section 3 we discuss the state-of-the art concerning the previous European projects addressing the slow steaming and synchro-modality fields. In the Section 4 we describe the needs of a large set of stakeholders by analyzing a survey and presenting some results emerged. Then, in the Sections 5 and 6 are shown respectively the value proposition canvas and the business model obtained considering the information gathered in the survey. Finally, some conclusions are discussed in the Section 7.

2 Methodology

As introduced in the Section 1, we adopt the GUEST Methodology, developed by Perboli and Gentile (2015). It is a lean business methodology extending the work done by Osterwalder and Pigneur (2010) and all the Lean Startup movement, adapting their results to the environment of a Multi-Actor Complex System (MACS), as those of freight transportation. GUEST is the acronym of the five consecutive steps of the methodology, which have the following meaning:

- Go. A full description of the company profile, its current behavior and business development status, its environment, the external actors in the system and their interactions.
- Uniform. The knowledge of the system must be assessed in a standard way, in order to obtain a shared vision of the MACS. In particular, in this phase the governance and the business models are explicitly described by means of the Business Model Canvas (Osterwalder and Pigneur, 2010) and the Value Proposition Canvas (Osterwalder and Pigneur, 2014).
- Evaluate. The governance and the business models are assessed in a series of actions. The full structure of the costs and of the revenues is explicitly described in order to evaluate the goals of the initiative. Moreover, a series of problems and opportunities are identified as well as the actions able to manage them and the KPI to measure the effectiveness of the actions.
- Solve. Given the specific problems and the actions highlighted to cope with them, a list of operational models is proposed.
- Test. The actions are actually implemented in case studies and their performance are evaluated. Moreover, the findings of the actions are released according to the Results Dissemination Plan.

With particular regard to the application of GUEST to SYNCHRO-NET, at the current stage of the project development, the five steps were declined as follows:

- Go. In this phase a preliminary analysis of the stakeholders requirements is conducted administering a survey described in its components, in the Section 4. The aim is to gather information about the stakeholders profiles by means of the knowledge of their needs.
- Uniform. For the two main relevant previous projects in the supply chain optimization and slow steaming fields, a Value Proposition Canvas is derived (Section 3). Then, a deep analysis and comparison of the different canvas are performed, bringing out the main similarities and differences with the SYNCHRO-NET project. The Value Proposition Canvas is a tool proposed by Osterwalder and Pigneur (2014),

with the aim to support the definition of the value proposition that fits the needs and wants of each stakeholders involved in the project. This tool is composed by two main blocks: the stakeholder profile and the value map, which are below described, following the reading order of the canvas. The first building block describes the stakeholder in a more structured way, individuating its jobs, as the activities that it explains in its work or life; its pains, as the bad outcomes, risks and obstacles related to the jobs and finally, its gains, as the outcomes or benefits that wants to achieve from its activities. The value map defines the value proposition that a company has to offer to each stakeholder according to its profile composition. It is articulated in product and services around which the proposition is created, pain relievers and gain creators that describe how the bundle of product and services respectively reduce the pains or create vantages for actors. The fit between the two parts occurs when the solution of the project generate pain relievers and gain creators that combine with one or more of the most important jobs, pains and gains for the stakeholder. For more details about the building blocks of the Value Proposition Canvas, see Osterwalder and Pigneur (2014).

- Evaluate. Given the outcomes of the two previous phases Go and Uniform, the Value Proposition Canvas and the Business Model Canvas of the SYNCHRO-NET project are shown. (Sections 5 and 6). The Business Model Canvas is the other tool proposed by Osterwalder and Pigneur (2010). In this application, it allows to demonstrate how the SYNCHRO-NET project and its solution creates and delivers value to the different stakeholders and how captures value in return. This tool is read out from the center (i.e., the value proposition), then the right side illustrates the characteristics to which the business must strive to work and finally, the left side composed by the resources, activities and partnerships needed to implement the provisions.

3 State-of-the-art

SYNCHRO-NET is not the first project addressed on the realization of a powerful and innovative synchro-modal supply chain. In fact, in the domain of the supply chain optimization and slow steaming, there are other

important reference projects as "European Framework for safe, efficient and environmentally- friendly ship operations" (FLAGSHIP) (FLAGSHIP, 2016), "European e-freight capabilities for co-modal transport" (e-Freight) (e-Freight, 2016), "e-Maritime Strategic Framework and Simulation based Validation" (e-Mar) (e-Mar, 2016) and "Consistently Optimized Resilient Secure Global Supply-Chains" (CORE) (CORE, 2016). The purpose of this section is to present a comparative analysis between these projects and SYNCHRO-NET, in order to show similarities or discrepancies and to bring out the innovative nature of this last project. In particular, we decide to adopt a more comprehensive approach considering the technical aspects of the solutions proposed by these projects and the analysis from a managerial point of view. Our decision is based on the need of looking the state-of-the-art with a holistic vision that just technical and optimization point of views cannot give us. Moreover, according to the managerial perspective, we analyze the previous project highlighting the value proposition that they offer to the different stakeholders involved, by means of the Value Proposition Canvas, presented in the Section 2. At the current situation, some of the previous projects are not completed though funding are terminated. Thus, due to the unavailability of all the deliverables in the respective official web pages, there is a lack of information about some of these projects. For this reason, we present in detail the analysis of the two completed and successful projects that are more similar and relevant with SYNCHRO-NET: e-Freight and e-Mar.

e-Freight project. The European e-Freight capabilities for Co-modal transport (e-Freight) initiative is a research and development project co-funded by the European Commission under the 7th Framework Programme and it is conducted from the 2010 to the 2013, by a team of 30 partners from 14 EU member states and Norway, with the aim to contribute to the goals of the Freight Transport Logistics Action Plan and the Intelligent Transport System (ITS) Action Plan. As shown by the Value Proposition Canvas illustrated in Figure 1, the different stakeholders involved are:

- Compliance officers, which review and evaluate the compliance issues and monitor the respect of the current regulations.
- Port authorities, responsible of the efficient use of the infrastructures, supporting the transport users, providing them information about the available infrastructure and the timings.

- Customs, which provides different services related to the security of the transportation flow.
- Transport users (i.e., Freight carriers, Logistics service providers and Shippers), which manage the cargo at a more operative level.

Each stakeholder is affected by specific pains, shown in detail in the canvas (Figure 1), which are grouped in the following main issues:

- Intra-European trade is complicated due to the disconnections and vulnerability of the logistic chains.
- Safety and security particularly in establishing efficient collaboration between authorities and transportation stakeholders to improve the development of capabilities for proactive and remedial measures to protect the environment as well as the security of freight transport networks.
- Unharmonized and inefficient freight information exchange in the context of multimodal transport.

These issues are addressed in the e-Freight project that has the aim to overcome them proposing an "Intelligent Cargo" solution that makes goods self-aware, context-aware and location-aware as well as connected to a wide range of information services, creating an automated freight transportation management process. This solution is the basis of the project value proposition that is composed by the following benefits for the stakeholders:

- Vision of a paperless and standard framework for the freight transport process where an electronic flow of information is linked to the physical flow of goods, making leaner the freight information exchange, considering all the modes.
- Simplification and harmonization of the regulatory requirements.
- "Single Window" (single access point) for administrative procedures in all modes.
- Introduction of an Information highways for co-modality assisting transport operators to establish a common end-to-end transportation processes including regulations compliance and intelligent monitoring.
- Improvement of the efficiency of the whole supply chain considering both the economical and the environmental impacts.

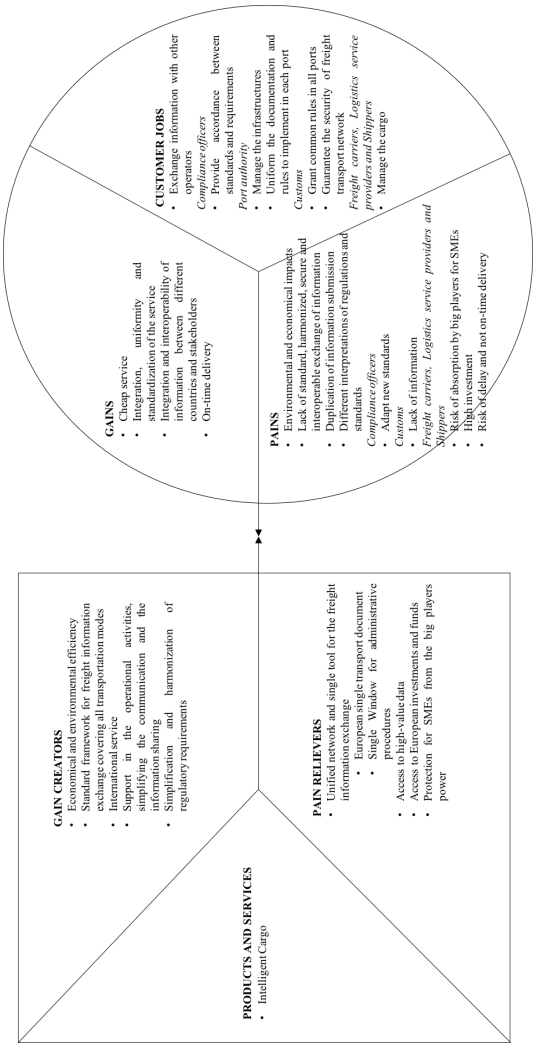


Figure 1: Value Proposition Canvas of the e-Freight project

e-Mar project. The e-Maritime Strategic Framework and Simulation based Validation (e-Mar) project is a research initiative led from the 2012 to the 2014 by a pool of 28 participants that addressed the topic "Upgraded maritime transport information management" as a part of the 7th Framework Programme promoted by the European Commission. The aim of this project is to support the development of sustainable maritime transport in Europe, through the definition of a framework that will be based on the latest information, communication, and surveillance technologies (e-Mar, 2016). As shown by Value Proposition Canvas illustrated in the Figure 2, the major stakeholders beneficiaries of the e-Mar outcomes are:

- Freight forwarders.
- Freight integrators, shipping agent and multimodal transport operators.
- Infrastructures managers and port authorities.

These stakeholders are affected by several pains, which are already addressed by the e-Freight project as above discussed and mainly related to the different interpretation of regulation and standards, and the lack of interoperability and harmonization of the information exchange process. Basing on the efforts and the results of the previous initiatives as e-Freight, the e-Mar projects aims to provide an ICT-based infrastructure, whose main pillars are:

- the eMAR Optimisation System (EOS), which provides to the maritime stakeholders, a tool for the optimal planning and scheduling of their operations, considering the real-time data.
- SafeSeaNet, Port Community System (PCS) and Port Single Window (PSW), facilities that allow the improvement of the exchange information process in a more secure and harmonized way, through standardized information and documents.

This e-Mar platform represents the basis of the value proposition of the e-Mar project, with consequent different benefits in terms of:

- Simplification and automation of information exchanges between administrations and maritime operators to achieve quantum improvements in maritime safety, security, customs control, environmental protection and cost savings for logistics operator.

- Facilitation of commercial transactions (e-Mar, 2016).

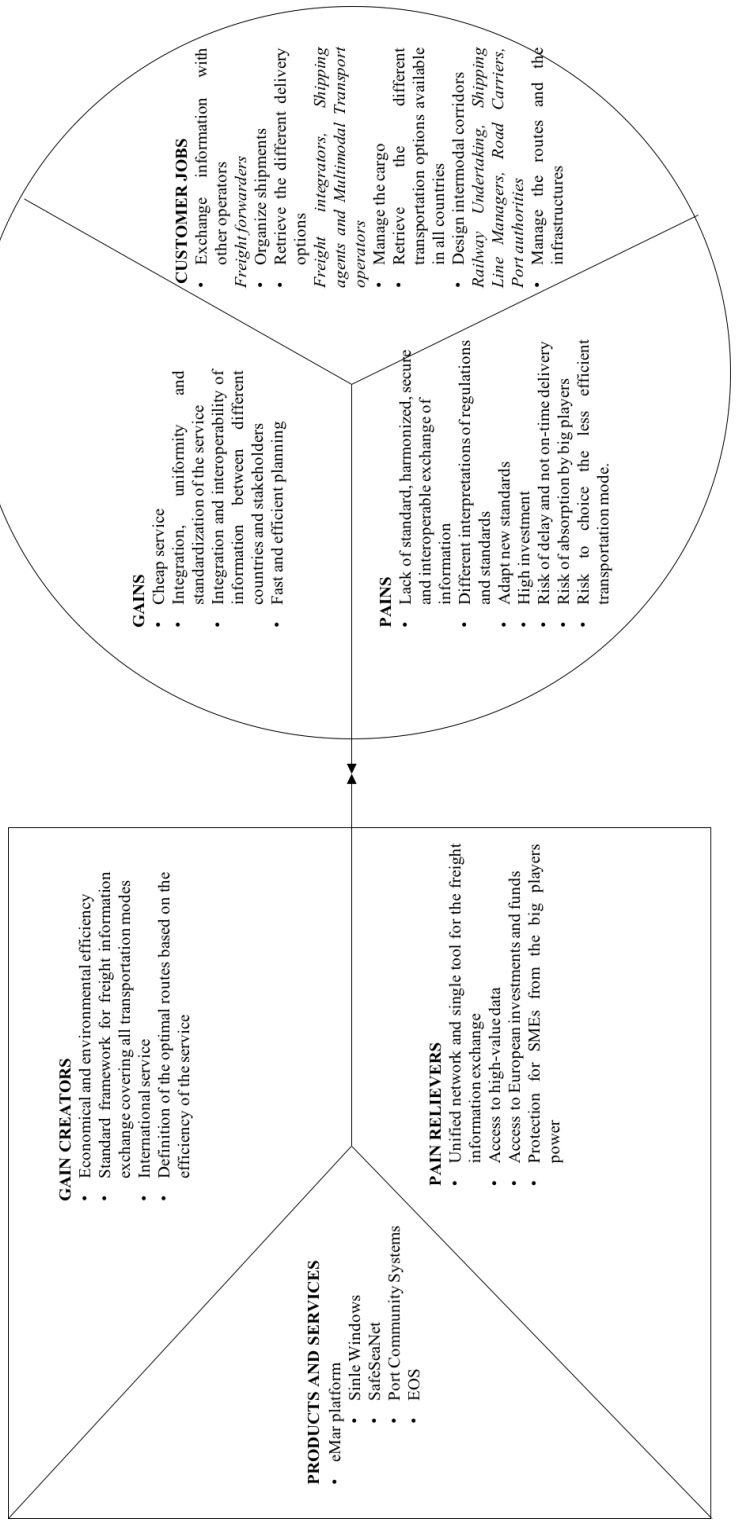


Figure 2: Value Proposition Canvas of the e-Mar project

The SYNCHRO-NET project takes into account the lessons learned, the knowledge base and the solutions provided by the successful research projects such as e-Mar and e-Freight, including some of their technical features and contributions to maximize the benefits obtained from the ever-increasing availability of real-time transport and logistics data. For example, the initial optimization module in e-Freight forms a starting point for SYNCHRO-NET and the synchro-modal and slow steaming concepts are already been explored by different reference projects. In particular, the Table 1 resumes the value propositions of the previous projects and provides a brief comparative analysis between them and SYNCHRO-NET.

As shown, the SYNCHRO-NET project presents similarities (e.g., the supply chain optimization and slow steaming domains) with e-Freight and e-Mar that represent the starting point due to their experience gained with surveys and pilots developments. These similarities are due to the willingness of the European Commission and the SYNCHRO-NET Consortium to integrate the different projects in a larger framework for freight delivery. Moreover, it adds a further layer of innovation that extends the current state-of-the-art in different way. First, according to a recent study of the EU-funded logistics research projects, the standardization and the cooperation between the actors involved, appear as common lacking aspects to innovation in logistics field (Roso et al., 2013). The first issue is already been faced by past projects. While, to overcome the issue related to the cooperation, the SYNCHRO-NET project proposes an holistic approach covering all relevant aspects, not restricted to ICT ones, and guaranteeing new forms of collaboration introducing innovative business collaborative models across Europe. In particular, SYNCHRO-NET adopts a stakeholder-driven iterative methodology (illustrated in Figure 3), where the stakeholders, industry end users requirements drive the development of first prototypes tested in business case demonstrators and the resulting feedback are used to refine and enhance subsequent prototypes. The second outcome is the integration of a commercial and business perspective in the SYNCHRO-NET project.

This approach push the adoption process of the innovation, guaranteeing the user acceptance, captivating industry-driven entities and empowering authorities to open European networks to a new form of collaboration. Moreover, considering the stakeholders requirements and needs at an early stage of the development, allows to anticipate issues increasing the probability of the research project success. Observing the Table 1, it emerges the absence of a commercial perspective of the previous European projects, already affected

Table 1: Comparative analysis between the previous projects and SYNCHRO-NET

	e-Freight	**e-Mar**
Value Proposition	Intelligent Cargo that makes goods self-aware, context-aware and location-aware and connected	e-Maritime platform for easier information exchange and e-Maritime services
Similarities with SYNCHRO-NET	Synchro-modal system to manage the freight transportation in EU Supply chain optimization and slow steaming fields Paperless freight solution Single Window concept	Supply chain optimization and slow steaming fields Paperless freight solution Single Window concept
Differences with SYNCHRO-NET	No commercial and business perspective	

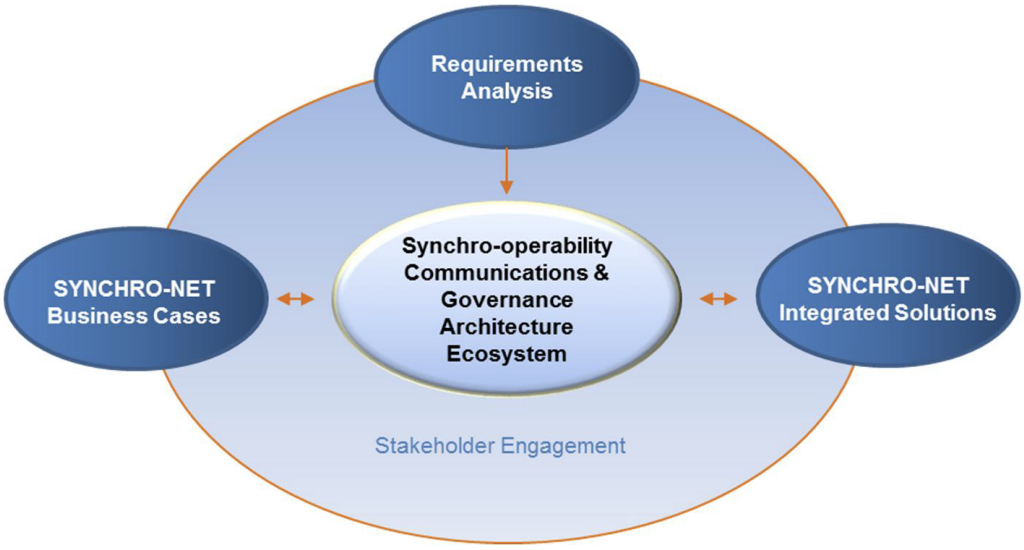


Figure 3: Methodology adopted

by financial barriers as emerged by the study of Roso et al. (2013). This issue represents a limit to the concrete realization and implementation in the market of the solution proposed by the projects, which commonly finish at the end date of the project or at the end of the funding. For this reason, the SYNCHRO-NET project is addressed to create a sustainable and feasible solution, in economical terms, during the time. In fact, the anticipation of the business and managerial aspects in the research and development activities of the project, represents a value added for SYNCHRO-NET. Combined with the above mentioned collaborative business models, it aims to guarantee the long-term practicability, sustainability and industry and public wide endorsement of the project results. In order to reach these innovative goals, SYNCHRO-NET introduces a revolutionary methodology in the European projects field. In fact, it adopts a stakeholders-driven approach, described in the Section 4. This is composed by a preliminary analysis of the stakeholders requirements by means of a survey, whose results allowed to prepare the Value Proposition Canvas and the Business Model Canvas, according to Osterwalder and Pigneur (2010, 2014) and finally, to transit from the business model, which represent the project *"as is"*, to the operational model from a *"to be"* perspective, obtaining a more comprehensive vision of the project domain.

4 Stakeholders needs and desiderata analysis

Several partners of the project and particularly, the Politecnico di Torino and the London Economics University, have elaborated in the beginning of the 2016, a survey administered by e-mail to a wide range of about 300 potential stakeholders by the members of the consortium. The aim of this survey is to figure out the main current and future needs perceived by the actors involved in the logistics industry, investigating their level of interest and enthusiasm about the solution proposed by the SYNCHRO-NET project. The structure of the questionnaire is composed by different parts:

- Details about the respondent and its organization. In the firsts two sections, some generic information are required to the respondent, about itself (e.g., name, job title) and its organization (e.g., organization category).
- Supply/Logistics chain. This section gathers, by means of a Likert scale, information about the logistics needs that the respondent organization meets and its perception of challenges faced (e.g., uncertainty in the supply chain leads to over-stock key products, or pressure to reduce the company's environmental impact, etc). In particular, respondents had to rate on a scale from 1 to 5 their level of agreement with four statements. A low score (1- not at all accurate or 2 - not accurate), implies disagreement. A value of 3 would imply uncertainty. On the contrary, the values of 4 (accurate) or 5 (extremely accurate) represent the respondent's agreement with a certain concept. The four statements are:
  - I am under constant pressure to reduce my company's environmental impact but the logistics chain is too hard to manage.
  - I believe there are better, lower cost, lower emission transport options available but I do not have time to find them.
  - I over-stock key products due to uncertainties in the supply chain.
  - I do not risk using rail movements for high priority shipments because I am not confident they will arrive on time.
- Intermodal freight logistics research projects. This part of the survey has the aim to investigate on the respondent's awareness about projects on synchro-modality.

- Assessing the role of inter-modal logistics solutions and Future needs. Through a Likert scale, the respondent has to assess the importance of two lists of respectively current and future needs, including 18 factors as reliability, timeliness, sustainability, etc. For each of the factors, the stakeholders assigned a score ranging from 1 - not at all important, to 5 - extremely important.
- Final thoughts and Solutions to logistics problems. These two sections offer to the respondent the opportunity to present any logistics problems perceived, which are not included in the previous lists and to propose solutions and express further views on the topic.
- Further participation. Through this section, the respondent can make itself available to be contacted in order to provide further input and to participate at the process of development of SYNCHRO-NET.

4.1 Results

The survey reached totally 193 responses, whose about 164 of theme are complete and thus, relevant for the analysis. More in detail, these stakeholders involved in the project are:

- Logistics operators. They manage the freight, picking up it on ships, trains and trucks and moving it across long distances. In particular, they are responsible of the safety and the efficiency of the delivery.
- Firms. They are the companies that will use the platform to coordinate the transportations of its goods (both for final products and raw materials) across Europe, benefiting from a better planning of the delivery process.
- Public authorities. They are responsible of the maintenance of public infrastructure, and they impose regulations and requirements to the other actors.
- Port authorities. They can be both public or private authorities with the aim to manage the port and related activities.
- Research institutions. Mainly universities and researchers working in projects, bringing innovations, know-how and research efforts, in order to improve the current system.

Table 2: List of stakeholders involved in the survey with the respective percentage

Stakeholders	**% of Participation**
Logistics operators	65.2
Firms	15.2
Public authorities	8.5
Port authorities	3.0
Research institutions	3.0
Trade associations	2.4
Others	2.4

- Trade associations. They are organizations founded and funded by businesses that operate in a specific industry.

As shown in the Table 2, about the 65.2% of the stakeholders are classified as logistic operators, followed by firms (15.2%), and public authorities (8.5%). Only the 2.4% of the respondents are not classified in the above mentioned categories.

Challenges in meeting current logistics needs. Focusing on the fourth question "Supply/Logistics Chain" of the questionnaire, concerning the perception of the current logistics needs, the stacked bar chart, shown in Figure 4, highlights the distribution of responses, where the red shades imply disagreement and the green ones imply agreement with the statements.

The results concerning the answers to each statements shown the following aspects:

- Only a fifth of respondents considered the statement *"I am under constant pressure to reduce environmental impacts, but the logistics chain is too hard to manage"* as accurate or extremely accurate. There is therefore substantial disagreement on this aspect.

- About the 30% of respondents agreed that although there are better, low cost and lower emission transport options, they do not have time to find them.

- A quarter of the stakeholders admit that they overstock due to uncertainty in the supply chain. However, more than half of respondents

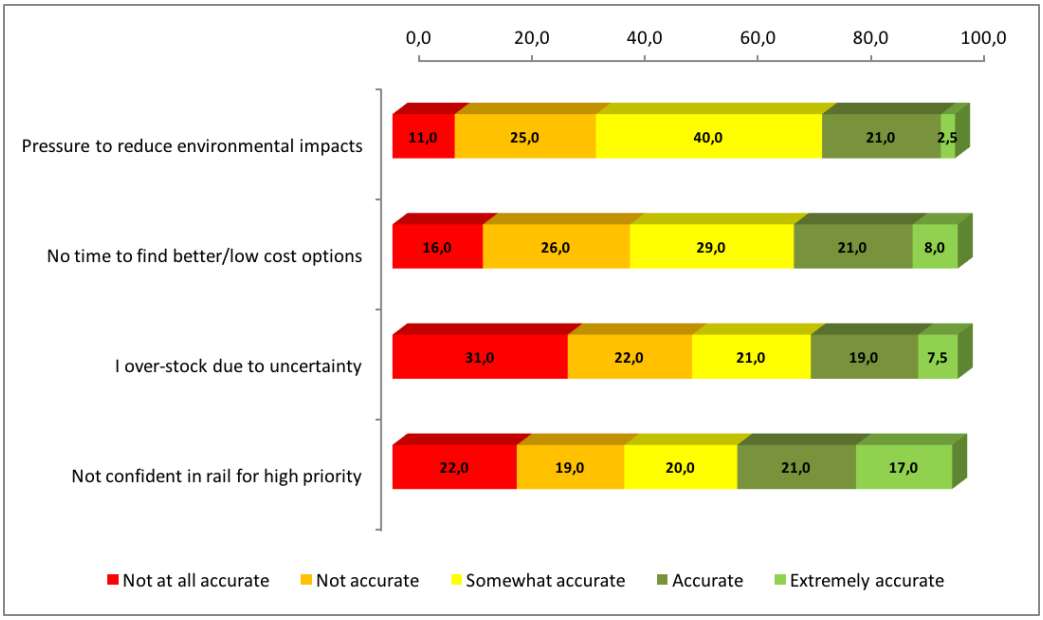


Figure 4: Meeting the current logistics needs

disagree with the statement.

- A striking finding is the low confidence in the use of rail: 38% (or 17% +21%) of respondents do not risk using rail for high priority shipments because they are not confident that they will arrive on time.

Analyzing these results according to the type of stakeholders respondent (Figure 5) it emerges that logistic operators state that it is possible to optimize the operations, moving toward more efficient (in terms of costs and emissions) transport options. Anyway, they do not have enough time to analyze these options (or they do not have enough incentives from the management). Furthermore, logistics operators do not trust on railway transport systems, particularly when they are under time constraints. The same distrust on railway systems emerges strongly from the firms involved in the survey, and is confirmed by the trade associations, which represents the needs (or the pains) of different types of operators. Public and port authorities are mainly affected by pressures to reduce environmental impact, but they find hard to manage the logistic chain in order to cope with these requirements. Despite they cover only the 2.4% of the total respondents, an interesting outcome from the trade associations is that usually firms over-stock key products to

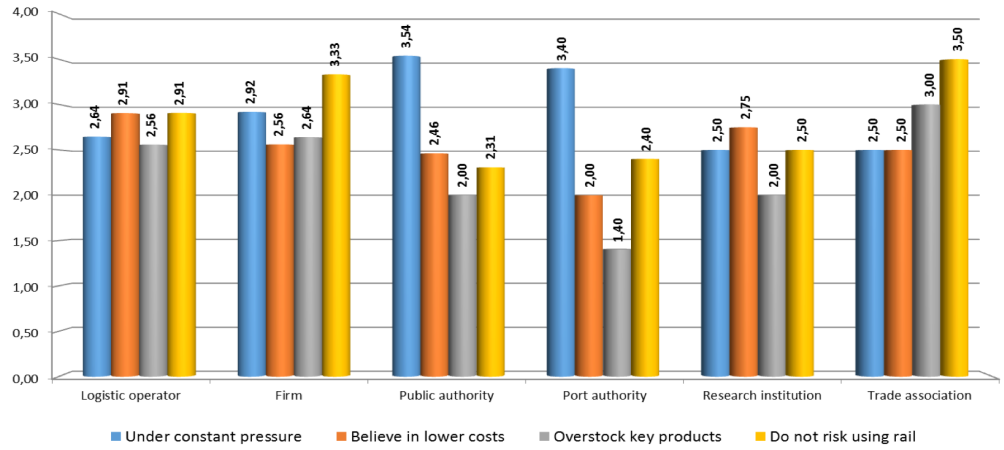


Figure 5: Current logistics needs perception by type of stakeholders

reduce the impacts of the uncertainties in the supply chain (the reduction of the supply chain uncertainties is one of the objectives of SYNCHRO-NET project). Going in order, the following points will report the aspects that mainly affect the different types of stakeholders:

- Logistic operators believe that there are better, lower cost, lower emission transport options available but they do not have time to find them.
- Firms have an average situation, with mayor focus about the effectiveness of the rail transport system and to reduce company's environmental impact.
- Public and port authorities are strongly under constant pressure to reduce the environmental impact but they find too hard to manage the logistics chain.
- Research institutions believe in better, lower cost, lower emission transport options available but they do not have time to find them.
- For trade associations, as a resume of more professional and activities, the most affecting aspects are the distrust in the rail system and the over-stock key products due to uncertainties in the supply chain.

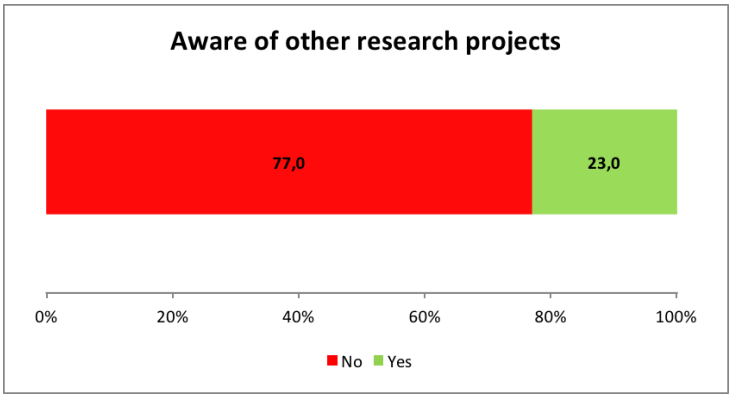


Figure 6: Awareness of other Intermodal Freight Logistics Research Projects

Awareness of other research projects into intermodal freight logistics solutions. The Figure 6 shows a low awareness about other research projects on intermodal freight logistics solutions. In particular, the 77% of the respondents ignores their existence, while less than a quarter of the total (23%) knows other research projects, whose the most frequently mentioned ones are the following:

- TENT-T.
- B2MOS.
- Ifreightmed.
- MOS4MOS.

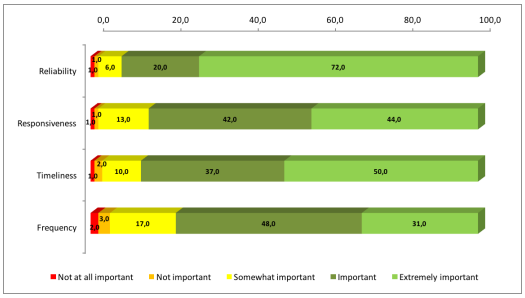
Assessing the role of intermodal logistics solutions for current and future needs. To make easier and clearer the presentation of the results obtained in the two questions of the fourth part of the survey, concerning the meeting between the intermodal logistics solution and current and future needs, the 18 factors above mentioned are grouped in four categories:

- Time and reliability factors.
- Costs and sustainability factors.
- Management and risk factors.

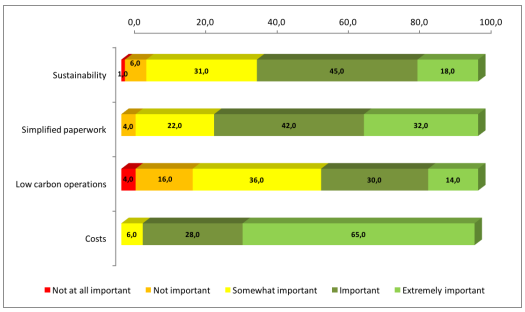
- Customer, quality and other factors.

Focusing on the current logistics needs, the results of the first category of factors are shown in the Figure 7a. In particular, the main one considered relevant in meeting the logistics needs of organizations is the reliability. In fact, more than the 70% of respondents consider it extremely important and an additional 20% as important. Follows the timeliness with more than the 87% of respondents including both the extremely important and important assignment. Although defined as relevant by the majority of the sample, responsiveness and frequency factors are less considered by the respondents. As illustrated in Figure 7b, the category related to costs and sustainability factors gathered more fragmented opinions. In particular, a negligible percentage of respondents (less than the 1%) considers not relevant the cost factor, while the 65% of them recognize costs as extremely important and the 28% as important. On the contrary, to sustainability and low carbon are assigned little values of importance, respectively the 18% and the 14% of consensus. Looking at the management and risks category, (Figure 7c) all these factors are considered relevant by the stakeholder, gathering percentages of importance (including both the extremely important and the important items) higher than the 60%, except the routing flexibility with the 54%. In particular, the charts show that the 84% of respondents consider the consistent transit times extremely important or important, followed by the liability for the carrier with the 74% and the trust and coordination between managers with the 72%. Moreover, risk management and container tracking are assigned a slightly lower prominence: 68% of respondents consider these aspects as important. Finally, concerning the last category of factors, the results shown in the Figure 7d highlight as, after the reliability and costs, meeting the customers demand is one of the most relevant factors in meeting current logistics needs, with the 90% of consensus. Door to door services are also recognized as important or extremely important by a great part of respondents (73%), followed by customer claims settlement (67%).

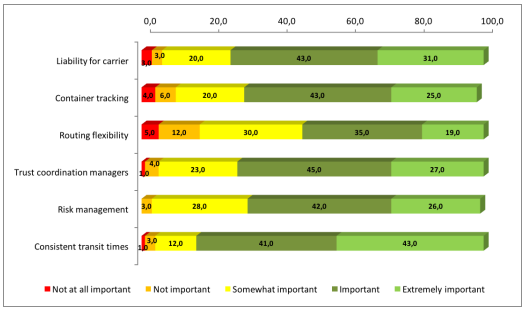
The trends observed from the assessment of the role of intermodal logistics solutions for current needs remain similar, considering the future logistics needs, as shown in Figure 8. The main future needs that are perceived as relevant with a more that 90% of agree (both extremely important and important), are costs (96%), reliability (95%), meeting the customers demand (94%), timeliness (91%) and finally, responsiveness (90%). Moreover, the risk management is considered more important in a long-time period. In



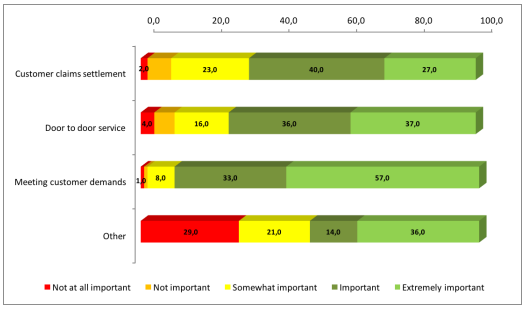
(a) *Time and reliability factors relevant to meet current logistics needs.*



(b) *Cost and sustainability factors relevant to meet current logistics needs.*



(c) *Management and risk related factors relevant to meet current logistics needs.*



(d) *Customer and quality related factors relevant to meet current logistics needs.*

Figure 7: The role of intermodal logistics solutions for current logistics needs

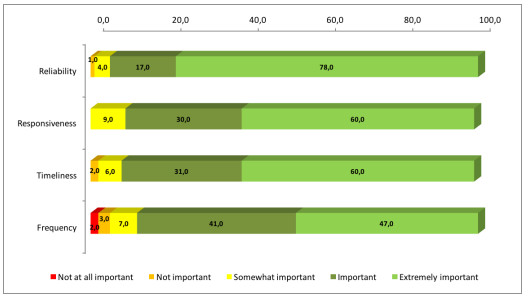
fact, while in the currents needs assessment, it was deemed extremely important by the 26% of the respondents and important by the 42%, in this area, the consensus increases to the 95% (17% important and 78% extremely important). Concerning the future needs less perceived by the respondents, answers confirm the previous responses on the current logistics needs, decreeing the routing flexibility, and low carbon operations the less relevant needs (respectively with the 71% and 75% of agree), although to a lesser extent (before 44% and 54%) observing a positive perspective due to the higher increases related to these two above mentioned needs and sustainability.

Respondents were also asked to specify other important factors affecting current and logistics needs. Among the responses, some frequently mentioned items were:

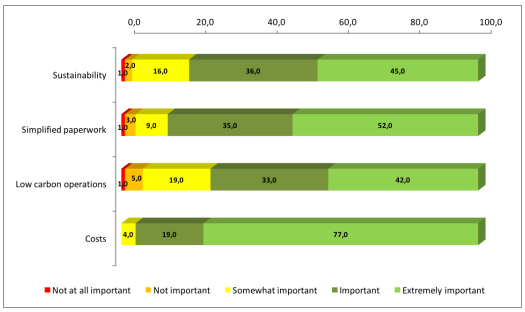
- Compliance with regulation and standards, particularly for pharmaceutical products.
- Traceability/ lead time.
- Communication/information flows and forecasting.

Assessment of logistics needs, challenges and solutions perceived by each stakeholders. In order to add another level of detail to the analysis concerning the role of intermodal logistics solutions for current and future needs, for each stakeholder, it is represented the actual situation and the expected one, considering all the potential needs. Through these categories, the survey is trying to evaluate as more aspect as possible and to get a global vision of the real situation of the organizations and the future situation. Moreover, concerning the fifth part of the survey, this paragraph includes a discussion of the current problems and challenges perceived in the logistics sector and the identification of some possible solutions provided by each stakeholder.

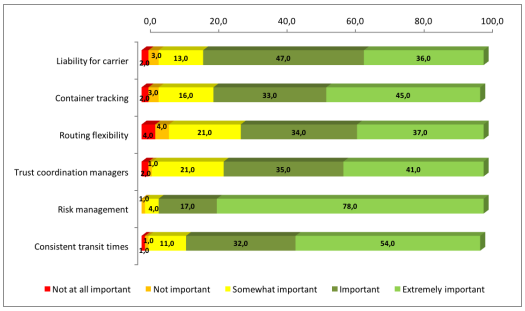
Logistics operators. With an average increase of the 7.4%, logistic operators have a positive outlook of the actual market situation. In particular, for the expectation related to low-carbon operations the increase is 25%. This category is in direct relation with sustainability, with an expected growth of 15.1%, while cost efficiency, one of the main goals for logistic operators, records the maximum importance, with an average expected value of 4.81 (increased by 2.7% from the actual average value).



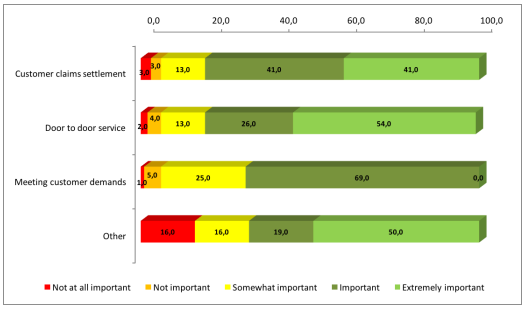
(a) *Time and reliability factors relevant to meet current logistics needs.*



(b) *Cost and sustainability factors relevant to meet current logistics needs.*



(c) *Management and risk related factors relevant to meet current logistics needs.*



(d) *Customer and quality related factors relevant to meet current logistics needs.*

Figure 8: The role of intermodal logistics solutions for future logistics needs

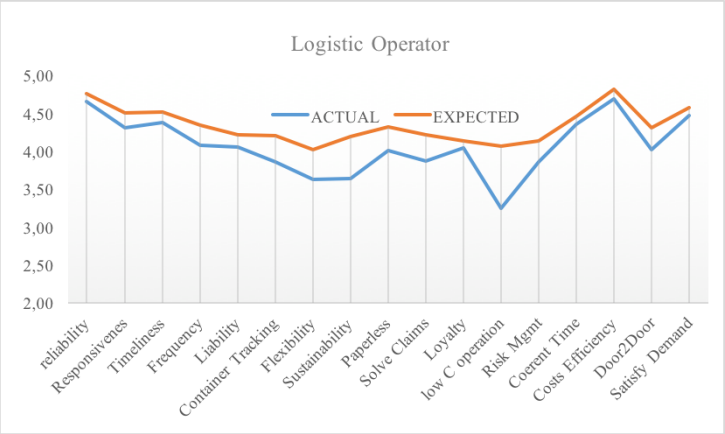


Figure 9: Actual and expected situations for logistics operators.

The mains logistics problems which present a challenge for logistic operators in their current or future operations are:

- Lack of information from the Internet. Logistics operators gather and use all the information from the Internet, but many carriers does not have a proper web site where to find full details.
- Managing the information coming from field to improve responsiveness and service level.
- Regarding multi-modal platform: speed and reliability of the transportation if put in context of the service capabilities required to an express courier to e-competitive.

Concerning the solutions for the previously mentioned logistics problems, logistics operators state that mobile applications, both cloud and web connected, can provide a certain scope of services and platforms to some itinerant services and business models. Some of them are applications for tablets.

Firms. Also for the firms, the results illustrated in Figure 10 show a positive outlook about the future logistic needs. In particular, the higher relevance is referred to low carbon operations (with an increase in expectation of 26.8%), Sustainability (17.3%), and routing flexibility (16.3%). Moreover, the main priorities for the firms are timeless (with an average value of 4.92) and the cost efficiency (4.83), both in the actual and in the expected situation.

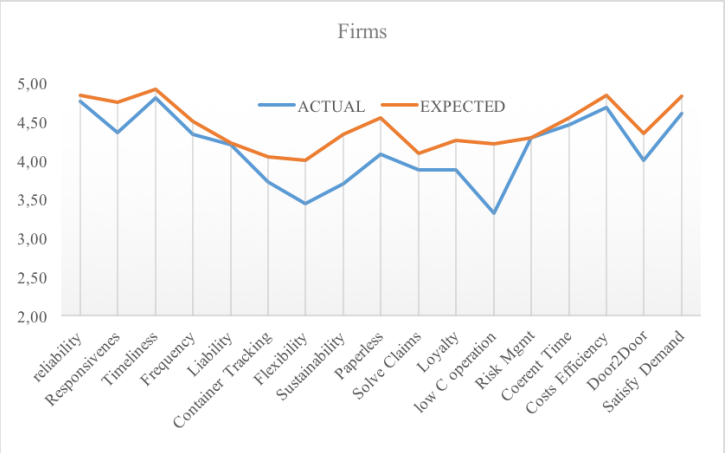


Figure 10: Actual and expected situations for firms.

The main logistics problems, which present a challenge for the firms are:

- Fluctuation of the transport market between industrial and fresh produce sector.
- Stocking model in the current warehouse does not reflect anymore the company needs. Consequently, transport and internal activities are impacted.
- Reliability, flexibility, costs, forecasting, etc.

The main solution provided by the firms, in order to address these problems, is the centralized distribution center. In fact, having all products in a single place allows to meet the customers wants of faster deliveries.

Public authorities. The aim of public authorities is to administrate different aspects of public life, such as all branches of the executive power of a state, province, municipality etc. Therefore, their interest is focused mainly in routing flexibility (with an increase in expectation of 19.4%), low carbon operations (18.2%), consistent transit times (19%), container tracking (16.7%), door to door service (16.7%), liability for carriers (14.3%), and timeliness (14%). In general, results (Figure 11) show for public authorities an average increase of 11.6% between actual and expected values. Finally, public authorities assign a high value to reliability, responsiveness, sustainability, cost efficiency, and meeting customer demands.

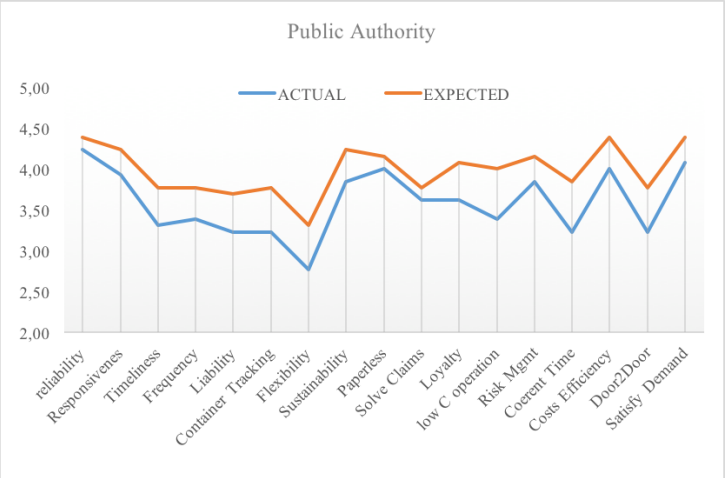


Figure 11: Actual and expected situations for public authorities.

The relevant logistics problems, which present a challenge to their current or future operations, are:

- Single window implementation.
- Supply chain management.

The mainly potential solution proposed are:

- Flexibility of laboral market, regarding to dockworkers.
- Increase storage area and higher turnover for goods.

Port authorities. The graph illustrated in Figure 12, highlights that also in this case the trend is positive for quite all the categories, with the exception of cost efficiency (with a decrease of 4.2%). A general increasing trend is showed by other aspects, with an average increase of 8.8% and best increases referred to low carbon operations (20%), timeliness (15.8%), simplified paperwork/documentation (15%), and risk management (14.3%). The higher values are assigned to reliability, sustainability, and meeting customer demands.

The only logistics problem perceived by port authorities is to improve railway status and conditions, by means of an expansion and the building of rail infrastructure (e.g., for deep-sea connections), according to the high

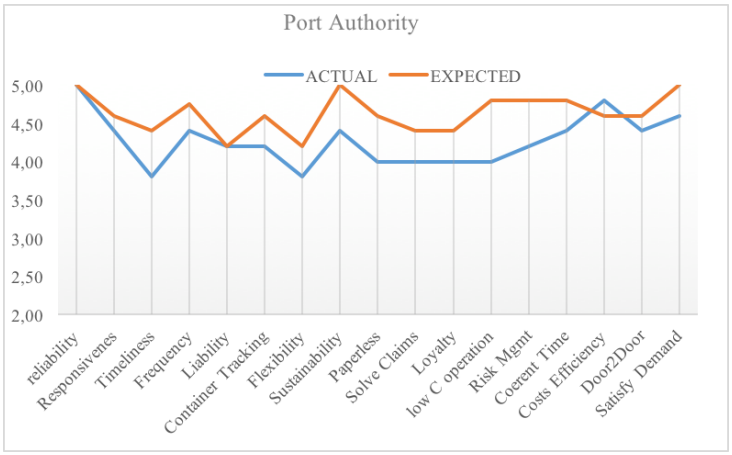


Figure 12: Actual and expected situations for port authorities.

increase in expectation related to low carbon operations.

Research institutions.

Compared with the other actors, the research institutions play a different role and thus, they have in general a different outlook (see Figure 13). Generally, research institutions show the lower increase in expectations, with an average value of 5.6% and decreases related to cost efficiency (-21.6%) and frequency (-14.3%). On the contrary, the main increases are related to customer claims settlements (27.3%), consistent transit times (27.3%), and meeting customer demands (23.1%).

Regarding the main logistic problem, research institutions answer that there are still a lot of open problems in the domain of real-time coordination for synchro-modal logistics. However, they do not provide solutions.

Trade associations. As shown in Figure 14, trade associations give particular relevance to two logistics needs: frequency and routing flexibility. Concerning the first item, a positive outlook increase of 28.6% occurs, representing the perspective to create a bigger and connected market. While, regarding the routing flexibility, it has the maximum expectation growing (36.4%), linked with the societal need to be faster and dynamic. The paperless category is the highest priority in both case (actual and expected) with an average value of 5. In any case, trade associations represent only the 2.4% of the respondents and therefore, it is not possible to provide an

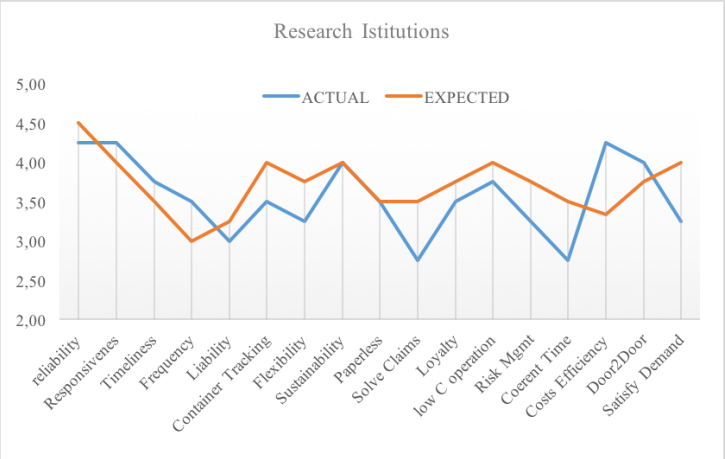


Figure 13: Actual and expected situations for research institutes.

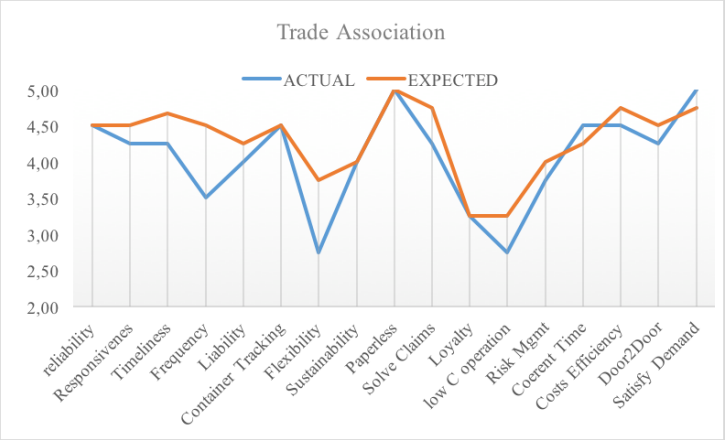


Figure 14: Actual and expected situations for trade associations.

accurate analysis.

5 Value Proposition of the SYNCHRO-NET project

The aim of this section is to analyze the value propositions that the SYNCHRO-NET project offers to the main stakeholders involved (i.e., logistic operators,

firms, public authorities, and port authorities), which fit their needs and requirements emerged by the survey conducted. The tool used is the Value Proposition Canvas (Osterwalder and Pigneur, 2014), described in Section 2. In particular, for each actor we provide a brief description of jobs, pains and gains, in order to identify which ones are common for two or more actors and which ones are specific. These information are then summarized in a graphical way, in the Value Proposition Canvas for the SYNCHRO-NET project illustrated in Figure 15. The jobs, pains and gains for each type of stakeholder are described in the Table 3. As emerged in this table, each type of actor has different jobs, with some common objectives. In fact, both public and port authorities want to increase the control on the freight flows, in their areas, with the aim to better allocate resources and prevent bottlenecks. The increased control on the freight flows could help firms to have a better control on the delivery process, thus making the delivery times more reliable. Moreover, the optimized management processes for port authorities could help logistic operators to better plan their activities, retrieving available storage spaces in ports and terminals, and being able to choose the optimal transport solutions given time, cost and risk constraints. Regarding customer gains, we can identify a set of commonalities related to increasing efficiency, quality, and awareness about environmental issues. For logistic operators and firms, an increase in the efficiency means an optimization in the resource usage and in the planning of the activities. As a consequence, the quality perception by final users will increase in terms of service reliability. For public and port authorities increasing the efficiency means an optimization of the infrastructure usage, with positive consequences for the quality of the service provided. Environmental issues are usually seen as constraints by the different types of actors involved in the process, being imposed by national and European regulations, but they can also be exploited to obtain a positive return on image. Finally, logistic operators and port authorities can provide better conditions for workers through an increase in the efficiency and an optimized planning of the activities. Even for the customer pains it is possible to identify a set of commonalities, mainly related to the absence of a single tool to plan the activities, with consequent difficulties on retrieving information about different transport modes. The absence of a single tool leads also to difficulties in the traceability of the deliveries, making delivery times not trustable, and in the management of the externalities.

The resulting value proposition of the SYNCHRO-NET project consists of a single platform, in which all the actors involved in the supply chain can

Table 3: Jobs, pains and gains of each stakeholder involved in the SYNCHRO-NET project

Stakeholder jobs	
Logistics operators	Retrieve available storage space in ports and terminals Retrieve the optimal transport modes in order to satisfy objectives (cost, time, risk, etc)
Firms	Plan and monitor the delivery process
Public authorities	Monitor the freight flows to prevent bottlenecks
Port authorities	Monitor the freight flows in the port area Optimize the management processes, keeping into account infrastructures, facilities and personnel availability
Stakeholder gains	
Logistics operators	Increase the efficiency Increase the quality of the service provided Increase the awareness about environmental issues Reduce empty trips Provide better conditions for workers
Firms	Increase the efficiency Increase the quality of the service provided Increase the awareness about environmental issues Increase the service reliability (trustable delivery times) Have a single tool to monitor the delivery process Reduce uncertainty through inter-modal solutions
Public authorities	Increase the efficiency (in terms of infrastructure usage) Increase the quality of the service provided (in terms of infrastructure usage) Increase the awareness about environmental issues (reduce the pollution) Optimize the freight flow in order to reduce congestion
Port authorities	Increase the efficiency (in terms of infrastructure usage) Increase the quality of the service provided (in terms of infrastructure usage) Increase the awareness about environmental issues (reduce the pollution) Anticipate/control uncertainties through a better planning of the activities Provide better conditions for workers
Stakeholder pains	
Logistics operators	Difficulties on retrieving information about availabilities and timetables Manage the externalities Uncertainty about custom operations Wasted time for infrastructures/facilities/personnel unavailability in ports and terminals
Firms	Difficulties on retrieving information about availabilities and timetables Manage the externalities Uncertainty about custom operations Difficulty in the monitoring process Delivery time not trustable
Public authorities	Manage the externalities Lack of control in infrastructures usage
Port authorities	Manage the externalities Uncertainty about custom operations Temporary lacks of infrastructures/facilities/personnel

interact in order to optimize and synchronize the operations. One of the main benefits of planning and monitoring all the supply chain with a single tool is the increase of the communication and information exchange among the different actors, with a consequent increase in the service provided in terms of quality and reliability. Moreover, the increase in service reliability means for the firms more trustable delivery times, allowing a reduction of safety stocks. An optimized, long term planning process of the supply chain lead to a better planning in resources usage for logistic operators and port authorities, allowing better working conditions for workers. For public authorities, an optimized planning and monitoring process lead to a better control of infrastructure usage, preventing road/rail congestion and bottlenecks. The synchronization between different transport modes can be used to foster the ones with lower emissions (e.g., railway), in order to reduce the impact on the environment, fulfilling European directives on greenhouse gas (GHG) emissions and gaining a return on image for firms and logistic operators. Moreover, an optimized synchronization between different transport modes could be used to foster the adoption of slow steaming strategies for ships and trucks, even in this case with a positive impact on environment.

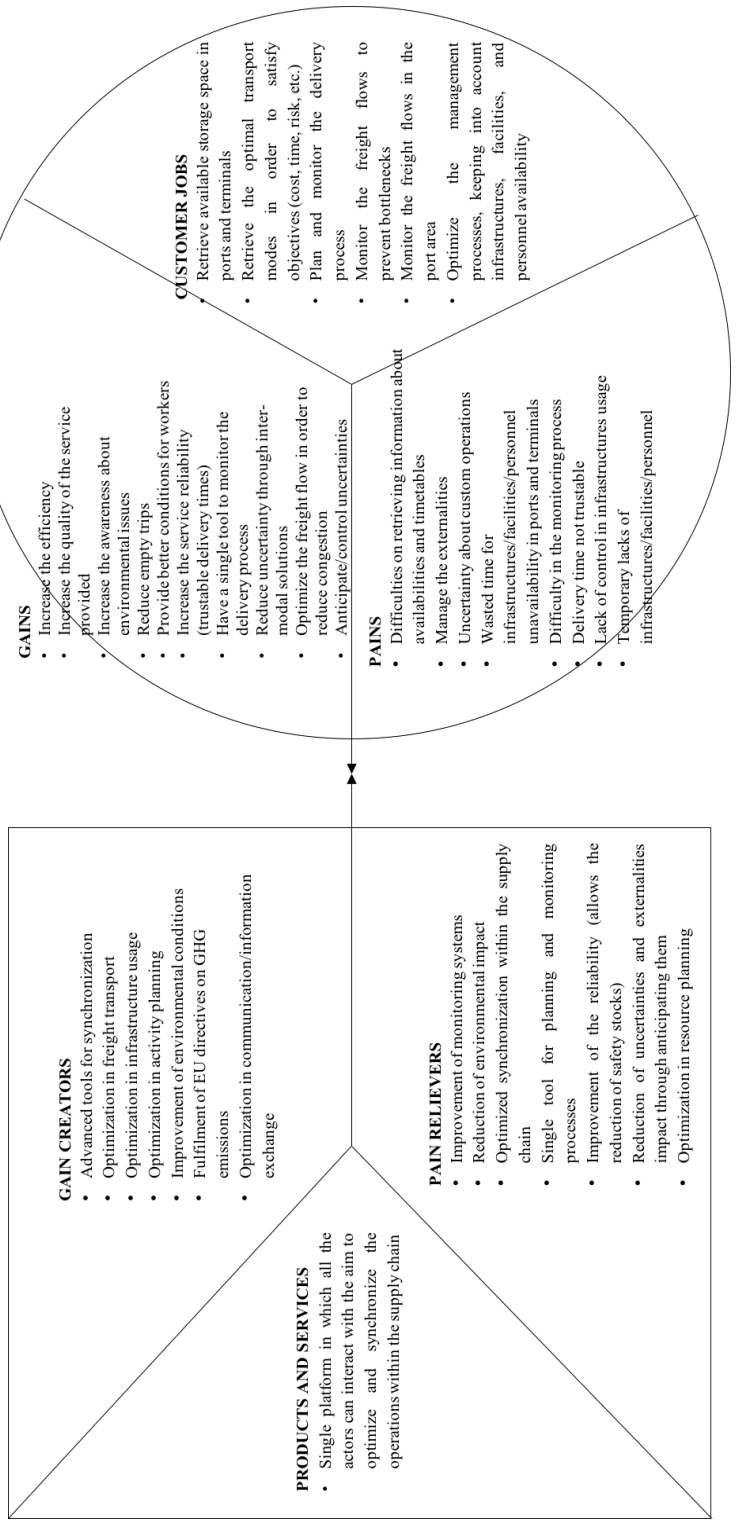


Figure 15: Value Proposition Canvas of the SYNCHRO-NET project

6 Business Model of the SYNCHRO-NET project

As discussed in the Section 3, the innovative feature of the SYNCHRO-NET project is its business-oriented perspective. In this direction, the Business Model Canvas shown in Figure 16, is presented in this section with emphasis to each of its building block, following described. The customer segments are identifiable in the stakeholders of the project, emerged from the survey (see the Subsection 4.1), to whom is addressed the value proposition defined in the Section 5. In order to reach these stakeholders and communicate with them, the SYNCHRO-NET project involves different types of channels including:

- Platform/website. Single tool to communicate and interfacing with all the partners and stakeholders of the project. It represents the main source of information, providing multi-modal map, timetable and data.
- Community newsletter. It is a common direct channel of information sent to the members in order to ensure their constant updating about services.
- Events and exploitation. They are required to build a community and to increase the awareness and knowledge of services offered by the SYNCHRO-NET solution. It is also relevant to guarantee the better understanding of the emerging needs and improvements, according to the stakeholder-driven framework adopted in the project.
- Dissemination. This type of activity combined with the exploitation is used for raising the interest levels to the critical mass required for the self-perpetuating of the project. It is composed by contributions to the literature, both for initial awareness activity and for later dissemination of results, identifying journals, and conferences in transportation, logistics and slow steaming fields.
- Customer Relationships Management system (CRM). It is required to manage business relationships, data and information associated to the partners and stakeholders.
- Marketing activities. Marketing efforts are oriented to making the full solution available for the commercial implementation, achieving an

enough number of co-workers to develop the platform and a reference in the freight transportation industry.

Once the stakeholder are reached, they are involved in relationships mainly oriented to the cooperation and collaboration, with the aim to obtain mutual benefits. In particular, these relationships can be grouped in the following categories:

- Community membership and Information sharing among members. The Community represents a powerful tool for the communication and the exploitation of results and thus, for the co-creation of value for the stakeholders and final users. Moreover, the Community can interact through a SYNCHRO-NET web portal, which provides information, training material, discussion groups, networking opportunities for participants.

- Business development. It is a process needed in order to guarantee the successful of the project and the adoption of the platform by the co-workers and stakeholders.

According to the innovation character of the SYNCHRO-NET project that, with its holistic vision, includes also a business perspective as above discussed, the block of the revenue streams plays an important role for the future commercialization and self-perpetuating of the project solution in a long term. In particular, the main revenue streams identified are the following:

- Membership fees. The interaction in the Community can be composed by different levels depending on the needs of the participants. Thus, several types of members as the "Contributors" or the "Champion" had to pay subscription fees, one-off licenses and consulting fees to the SYNCHRO-NET consortium, in order to access to advanced training programmes or services.

- Revenues from green certifications for third supply chains. They are composed by incoming received from the CO2 savings and the carbon credits trading.

- Support for the green assessment. It consists of the revenues for supporting third parts campaigns to implement a sustainable transportation.

- Licenses for platform use. They are represented by the incomes for use of the platform and the related professional tools, realized for the business market.

The most important assets required to make the SYNCHRO-NET business model work are:

- SYNCHRO-NET platform. This single tools is the main key resource due to its relevant role in realizing the project and guaranteeing the usability of the services in the long term.
- Human resources. They are the members of the Consortium that automatically become SYNCHRO-NET partners and they have commercial and voting interests, but also all the potential participant of the Community, which are at the same time sources of information.
- Sales unit. It is composed by the personnel directly involved in the realization, improvement and commercialization of the project solution.
- Research and Development (R&D) unit. It represent a fundamental key resource to maintain SYNCHRO-NET in a competitive and useful position in the market and to increase its value added improving its knowledge content.
- Freight transportation data and multi-modal maps.

The key activities required for the implementation of the value proposition and to build a unique framework, can be identified in the follows ones:

- Information gathering, concerning the freight transportation and its environment, in order to implement a solution taking into account the specific policies, rules, constraints and methods for the freight management of each county involved and to create a sustainable freight transportation system.
- Information sharing. It is the most important activity to achieve a common tool useful for all the partners.
- Planning of freight deliveries. This key activities concerns all the operations needed to provide the real-time planning of the routes and synchro-modal logistics optimization.

- Externalities management. It involves the activities related to the management of risks and externalities, and the rearrangement of the previous solutions when they occur.
- Green certification. This activity plays a key role for the community members, providing them a sort of certification concerning the eco-sustainability of their logistics operations and the green assessment.
- Business development. As already stated, it is needed a business support useful both to gain new members and to disseminate platform developments among existing members, to guarantee the sustainable success of the project in the long term.
- Customer Relationships Management (CRM). It includes all the activities to communicate, assist and take care of the existing members.
- Big data and analytics management. It includes the collection of information by the SYNCHRO-NET platform, which can be used for further developments and researches.
- Cloud and ICT management. This activities concerns the management and maintenance of the technical environment, in which the SYNCHRO-NET platform works, in order to guarantee the right performance of the different functionalities.

Concerning the key partnerships of the SYNCHRO-NET business model, the stakeholders are at the same time, both users of the project solution and partners. Moreover, besides them there are also other key partners involved in the project to guarantee the usability of the services and the efficiency of the logistics and transportation activities, as:

- Shipping companies. They perform regular transportation of goods overseas.
- Terminal operators. They ensure the safety and the efficient movement of goods in the terminals.
- Technological partners. They are responsible of the maintenance and the updating of the technology, providing also support to the parts in the long term.

Finally, to implement the project and to operate the relative business model, the main costs on which SYNCHRO-NET incurs are those related to the key resources and key activities, as the costs for the maintenance of the platform and the optimization tools, the personnel costs, the expenditures for the business development, R&D and marketing activities. Moreover, the cost structure includes also the efforts for the implementation of incentive mechanisms, in order to increase the interest of potential users and thus, to reach the critical mass.

Figure 16: Business model canvas of SYNCHRO-NET project

7 Conclusion

In this paper, the project SYNCHRO-NET funded under the 7th Framework Programme for Research proposed by the European Commission, has been analyzed from a managerial perspective. This project arises in the destressing of the supply chain field. The most important output of SYNCHRO-NET will be the demonstration that slow steaming, coupled with synchromodal logistics optimization delivers amazing benefits to all stakeholders in the supply chain: massive reduction in emissions for shipping and land-based transport due to modal shift to greener modes and optimized planning processes leading to reduced empty kilometers for trucks and fewer wasted repositioning movements (SYNCHRO-NET, 2016). After a first analysis of the state-of-the-art in the domain of the supply chain optimization and slow steaming, we focused the discussion on the innovative approach adopted by SYNCHRO-NET than the previous projects. In fact, given the lack of a business orientation, which interests the research initiatives conducted in the past, the main challenge introduced by SYNCHRO-NET is addressed to the increase of the acceptance across all the stakeholders, guaranteeing the success of new business collaborative models. For this reason, the approach is not restricted to pure technical aspects. On the contrary, it is based on a holistic vision and an innovative stakeholder-driven component, integrating both business and operational models and including the stakeholders requirements in the early stage of project development process. Thus, we presented the implementation of this stakeholder-driven methodology adopted, in order to conduct an assessment of the requirements by means of a survey. Based upon its results, we discussed the value proposition and the business model of the project using the canvas provided by Osterwalder and Pigneur (2010, 2014). From this approach, what has emerged is the high value of knowing the stakeholders requirements, in order to develop a solution that meets their needs, guaranteeing the reaching of the critical mass. Thus, this strategic fit, together with the integration of the operative models with a managerial perspective, provided by the business model, allows to ensure the acceptance in the market and the economical sustainability of the project, making it self-perpetuating in the long run.

Acknowledgments

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