TRANSNATIONAL TOOLBOX FOR FOSTERING COORDINATED MULTIMODAL FREIGHT TRANSPORT THROUGH ICT IN CE

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1. Executive summary

This document includes the Transnational Toolbox for fostering coordinated multimodal freight transport through ICT systems in CE.

Considering the desktop research made in WPT1 and the results obtained in WPT2 through the execution of the pilot actions, the deliverable takes in consideration the goals of the strategy and wish list in specific tasks, KPIs, time line, identification of financial resources and potential solutions to be adopted in ports until the year 2030.

The COMODALCE project aims at developing multimodality in CE Ports as strategic nodes and hubs for the whole Region by setting up strategies, a transnational multimodal cooperation network and a joint action plan to improve hinterland intermodal connections through the experiences of ICT solutions developed within the project, pushing in particular for an increase of rail freight transport, moving the freights from road to railway.

At the same time, the development of port's hinterland and hubs will not be possible without the parallel increase of new infrastructures, linking in a better way the maritime logistics and the continental logistic centres. In this way, COMODALCE project's activities were focused on evaluating possible ICT solutions to overcome the lacks in digitization of logistic and administrative operations. To combine the solutions identified through the pilot actions, the Transnational Toolbox has been developed focusing on possible ICT solutions in the (inter)ports, as indicative tools tested in real life, which provided useful information for the long-term plans and for local logistics in general.

Actually, a lack of cooperation in digitally sharing information among relevant actors and stakeholders, as well as poor infrastructures affecting links between ports and hinterland, are significant limits to operative efficiency. The project partners have identified the most relevant type of freights to deploy the tests operated within pilot activities, especially considering those resources with the highest rate of growth in the last decade. For the purposes of COMODALCE, the transnational toolbox has concentrated on the analysis of the real-life situations and possible solutions to be developed in the near future.

The Toolbox was focused on the optimization of ICT and operative processes for multimodal railway transport of freights that are mainly involving the project partners' logistics. The experiences obtained through the development of pilot actions in COMODALCE and analysis of the situation at the container terminals and railway stations in ports, has brought the basic concepts for the Transnational Toolbox to be additionally upgraded in the near future. The lessons learnt in other COMODALCE pilots have produced some concrete results allowing to prepare a feasible Transnational Toolbox and to take proper measures in terms of ICT tools solutions at multimodal level for railway transport and for a concrete improved connection between ports and the hinterland.

The focus on the digitization at port's terminals can help to streamline the processes and to optimize the operational procedures in order to reduce losses of time and to upgrade the existing systems and digital equipment at terminals. As said, the main focus for COMODALCE purposes was on the upgrade of existing tools in the ports and terminals as well as on the optimization of the railway transport of goods from/to the ports (priority given to the railway transport but includes the whole multimodal system).

Live sharing of information, unification of platforms and working systems, digital planning are only few of the measures planned to be adopted in the near future, in order to improve port's services and to face the growth of freight's volumes, keeping in mind that without having a larger view of the local logistics (for example at CE level), all these interventions will not represent optimal solutions. Last but not the least, until the national infrastructure is not improved and modernized, solutions will have limited impact on the improvement of multimodality. At this regard, the main efforts have to be spent for the construction of

modern railway tracks, which have a crucial role for better links between ports and the hinterland on the TEN-T network.

2. The strategies linked to pilot actions

There are many obstacles to the development of multimodality in ports and to the development of the connections between the ports and the hinterland. Even if there was mentioned a lack of infrastructure, there is a need also of operational improvement in ports' logistics and administration.

It is fundamental to focus on ports' logistics, while considering that they represent the link between the Motorways of the Sea and the EU Core Network corridors. Through the decades the ports strengthened their role of logistics basis in terms of import and export, for many of the countries gravitating in their vicinity. The (inter)ports represent the main logistic solution for national markets, as well as for neighbouring countries' markets.

The statistics about transport modes and types of cargoes are showing that in general, the main growth in terms of volumes of cargo has been experienced for containers, where the main transport mode is represented by the railway for around the 60 % of the freights. The plans for the future are dedicated mainly to multimodality, which includes both, an improvement of digitization and an organizational effort, to handle the increasing volumes of freight, mainly depending on the Transocean routes, not only for a specific market, but for the whole CENTRAL EUROPE region. It goes by itself that having even bigger and bigger volumes of freights, the actual situation cannot be faceable for eternity. In fact, the works done in the (inter)ports, both for the work's organization and for the upgrade of existing ICT systems, will not serve when the port's capacities will be fully occupied, but the local solutions will have to be adopted in parallel with the upgrade and construction of new infrastructures also at national level, because it's notorious that most of the freights transported through ports are concluding their trips in other countries, therefore, the necessity of new ICT tools and upgrades of infrastructures is inevitable.

At CE level, the view at a larger scale doesn't change the fact that the growth of volumes of cargo in the last decade is mainly due to the fact that the relationships with Far East countries are seeing a quick development in terms of technologies but also in terms of logistic operations. Even bigger vessels in the Mediterranean region are linking the Far East with CE through the ports in the Mediterranean, both in import and export operations. The routes are consolidating their schedules and always new solutions for services are proposed. Keeping in mind the focus on development of multimodality through ICT solutions, still remains the lack in infrastructures, which are in many cases obsolete and inadequate. If at the beginning the multimodal routes were just testing links, now when all the connections are consolidated and working on daily or weekly basis, the planned growth of volumes is putting under pressure the (inter)ports' logistic system, which require implementations by the end of 2030 in most of the crucial nodes in the CE region.

The solutions tested through the COMODALCE's pilot actions were extremely important for the further planning of investments in the near future as well as for preparation of an efficient Transnational Toolbox for fostering multimodality in CE.

2.1. Pilot actions within COMODALCE

To link the investments at national level, the interventions at digital level in the ports are necessary to improve the use of multimodality for the transport of goods through CE countries. At this regard, many important steps were implemented in terms of automation of processes as well as in terms of optimization of data transfer, to increase of operative processes. At the same time, infrastructural improvements in

ports, are also confirming the intentions of (inter)ports as nodes to increase the digital transformation by the end of 2030. The ICT tools for the development of ports' digital systems, will be also accompanied by additional and modern equipment, which will work optimally thanks to the upgrades of the IT systems, like those for the planning of yards and digitization of information regarding the freights arriving/leaving the ports by train or by truck – in this sense, for example the purchase of OCR systems like those in Slovenia and Hungary, will help providing all the information about wagons and containers for the whole stakeholders' community and not only for ports' operators.

2.1.1. The solutions experienced in Slovenia

Of the total cargo handled in the port of Koper, approximately 60% is transported by rail. The collaboration between a port and a railway operator in the COMODALCE project helped in finding useful and optimal solutions for multimodal freight transport, which were tested through the installation of an OCR gate integrated with Port's Community System (PCS) and ICT solution from a railway operator.

Luka Koper

The development of an automatic scanning system for containers and wagons represents a concrete step towards the digitization of processes in the port. It is part of the port's Strategic Business Plan, which also envisages the development of the larger area (including the hinterland) by the year 2030, when Luka Koper will have a modern container terminal with a capacity of more than 2 million container units - TEU. With this document, Luka Koper has a clear development strategy, through which it can reasonably expect stable growth in the long term by reaching:

- A technologically modern and efficient railway system allowing to better link the port of Koper and the Slovenian/EU rail network;
- An increase of the level of traffic safety;
- Shorter travel times;
- Reduced environmental impacts and risks to the environment;
- An additionally increase of the proportions of cargo transported by rail;
- An increase of the use of environmentally friendly modes of transport;
- An increased digitization of processes, through the use of useful ICT tools, which allow to optimize some operational activities.

Even if the success, growth and development of port activity is measured in the long term, some important improvements in the field of digitization of the information accompanying the cargo, were already identified for the short period. The OCR gate and its integration with the PCS was necessary and represented a concrete step towards the digitization of processes, linking the port with its hinterland through the multimodal transport.

Table-research and analysis process foreseen in the WPT1, allowed Luka Koper and Adria kombi to jointly start the development of ad-hoc solutions for the railway transport of cargo with containers in the port of Koper. The solutions studied during the technical meetings with stakeholders were initially concentrated on the proper location for the introduction of the new digital technology. The best position was identified in front of Container Terminal's gate, where the exchange between tracks 1F and 25C for inbound and outbound train is allowed.

Figure 1: identified location for the positioning of the OCR system in the port of Koper (Source: Luka Koper's archive)

The solution chosen for the pilot action aimed to install an OCR scanning system in the port of Koper at the entrance of the container terminal, for the scanning of wagons and containers transported through railway in the port of Koper. The system is able to scan the trains with containers at terminal's gate and provides all the data codes and videos through a detection system which scans the wagons/containers in real time, saving all the information on a local server. The implemented solution shows images about detected serial numbers, status of the wagons and containers (including eventual damages) and records images also for later disputes with forwarders, owners of the containers etc. The system consists in an installation of a double portal over two railway tracks in front of the container terminal.

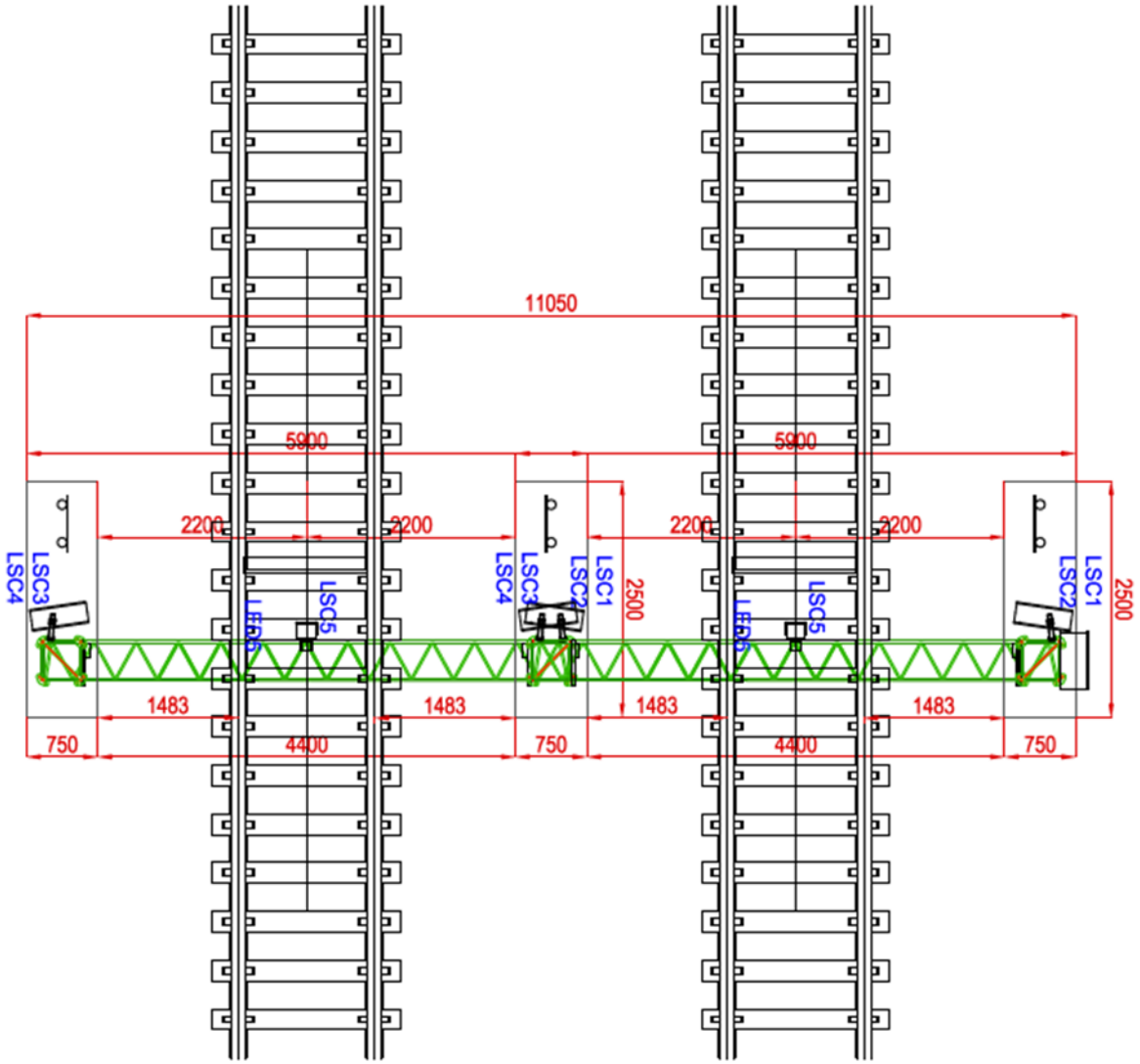

Figure 2: design of the OCR system in the port of Koper (Source: Luka Koper's archive)

It mounts an equipment composed by video cameras with high resolution capacity and with lighting system for the detection of serial numbers and damages in every type of atmospheric conditions and for 24 hours a day. In addition to this, the high capacity of the video card and of the storage disks installed, allows the servers to record the trains passing inbound and outbound of the Container Terminal in a high resolution for many weeks, before archiving the data.

While purchasing the equipment, some works for the construction of foundations took more time than expected but the works were successfully completed by the end of the year and additional integrations of the software provided by Adria Kombi were completed at the beginning of 2022. Actually, the equipment is fully installed as seen below:

Figure 3: installed OCR system in the port of Koper (Source: Luka Koper's archive)

The installed equipment allows the Port's Community System (PCS) to efficiently follow the operational processes at the railway which serves the Container Terminal and digitally fulfils the expectations of the stakeholders involved in the development processes. Here below a view of the recorded container on the wagon:

Figure 4: view of the scan of the OCR system in the port of Koper (Source: Luka Koper's archive)

The system allows also to see the above container from four different sides. The Investment I2 was successfully completed by the end of 2021 and handed over for use at the beginning of 2022, when all the data flows were tested by the involved stakeholders. Actually, the system is fully in use at the Container Terminal and implementations are foreseen in next years.

The system was integrated with the ICT tool provided by Adria Kombi as per its pilot action and served for the further improvement of the system before its entering in production. It brought the expected functionalities for all the users of the system, which meant live purchase of data and permanent saving of data for later analysis or checks.

Adria Kombi

The pilot action of Adria Kombi is linked with the one in Luka Koper, focused on the installation of an OCR scanning system at the container terminal to scan rail wagons and containers transported through the Port

of Koper. The system is installed and scans the trains with containers at the terminal's gate and provides all data through a video detection of the wagons and of the containers.

Through a data comparison between a dataset the port gets from intermodal operators, and data gained from the scanning facility, a check of data accuracy is ensured as well as the status of the unit. Afterwards, Adria Kombi as pilot action partner sends the information about trains in advance to Luka Koper's System. Here below a scheme of Adria kombi's links with other systems:

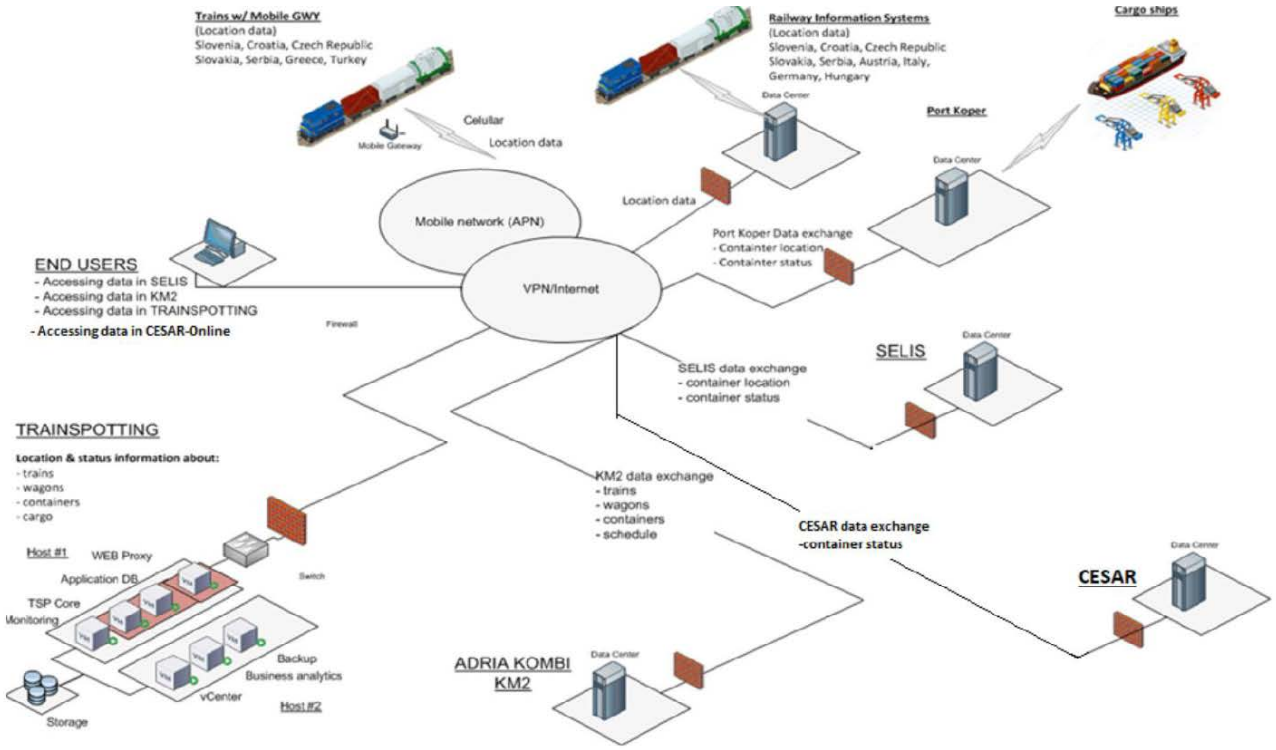

Figure 5: scheme of the links Adria Kombi has with other systems (Source: Adria kombi's archive)

Even if the picture can seem complex for understanding, it's clear that it shows how the intermodal operator has connections to various systems that are run in intermodal transport chain, such as shipping lines, terminal operator, partner intermodal operators, railway companies, railway infrastructure managers and clients.

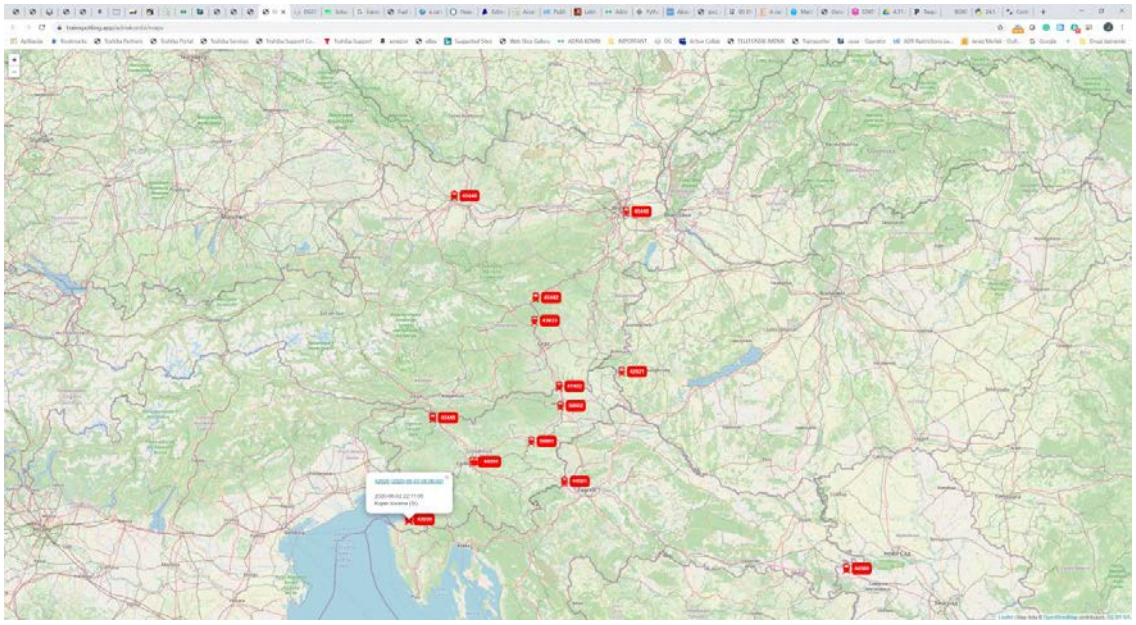

Figure 6: actual train positions approaching port of Koper (Source: Adria kombi archive)

Based on that system architecture, Adria Kombi has vital information about each unit before it arrives in the port, either from sea or from land.

The ICT solution adopted by Adria kombi for the multimodal transport from / to the port of Koper allows to have a complete view about actual positions of trains wherever they are. In the specific, the above picture shows for example the location of trains in approach to the Port Koper. Each train will get unloaded and loaded for departure at the same time-window inside CT. Plan of loadings and actual loading will not always match, but having the data in the system, can help in near future.

2.1.2. The solutions experienced in Italy

All Italian partners working in WP2 of the COMODALCE project have strategies and concepts developed, to reach the overall as well as individual aims. It is common to all, that the currently established procedures are not in line with current standards and in one or another case do not match with the expectations from stakeholders.

Port of Trieste

The Port Network Authority of the Eastern Adriatic Sea (PNAEAS) has invested in paperless processing of documentation for trains, developing a dedicated module to manage the procedures concerning the railway traffic in the Port Community System, PCS, “Sinfomar”. This activity led to the realization of a standardised electronic version of the train manifest, called CH30 in the Port of Trieste. Following the same path, currently PNAEAS aims at standardising the waybill, in electronic format, avoiding paper-based documents. This new format of the waybill has to be completely integrated with the current CH30 document.

Therefore, the pilot action, defined in the COMODALCE project, focused on this topic. It started from the definition of the new processes to electronically transmit, together with the CH30, the waybill for trains leaving the Port of Trieste and, on the other hand, to electronically acquire the waybill data concerning trains arriving at the Port of Trieste to automatically generate the CH30 document.

MMTA CH30 PF - TRENO IN ARRIVO

spedizione: BUD.TRS 20NS106 agente: T.O. DELTA S.P.A. treno nr.: 42181 di data: 30/03/2020 ora: 18:00

allibramento Sinfomar 2414238 dal 29/03/2020 in arrivo da: Budapest diretto a: TRIESTE MARINE TERMINAL

Pos.	Vagone	Targa n. container	Merce	Semirimorchio/Container			Sigilli	UNDG	Tipo documento	Numero documento doganale	Nr. Sinfomar
				Massa	Tara	M. lorda					
1	335645762501	CNTR : CAIU4799047	sanitary pads	4.934	3.800	8.734	H008761, W729181		EX	EX: 20HU811020270E1511	2414260
		CNTR : EISU3966750	goods	21.113	2.200	23.313	7152737,		EX	EX: 20HU611040270FE2F4	2414254
		CNTR : FCIU5991509	tetra recart	7.356	2.200	9.556	006932,		EX	EX: 20HU101220270EA648	2414244
2	335645762725	CNTR : EITU3001160	goods	21.113	2.200	23.313	7152739,		EX	EX: 20HU611040271107A07	2414250
		CNTR : MEDU7155964	parts	4.080	3.800	7.880	KLW237809, BK821424		T1/MRN	T1/MRN: 20HU317000170EA076	2414253
		CNTR : FTAU1171775	plastics	2.259	2.200	4.459	000041,		EX	EX: 20HU82106027101765	2414263
3	378049758444	CNTR : MSCU7710335	WOODPULP	26.540	3.800	30.340	036765,		EX	EX: 20CZ6100002PL20II0 NON CHIUDERE	2414251
		CNTR : TEMU6556630	WOODPULP	28.600	3.800	32.400	036751,		EX	EX: 20CZ6100002BK6Q806 NON CHIUDERE	2414256

Figure 7: Example of CH30 document generated in Sinfomar – train arriving from Budapest (Source: PNAEAS archive)

The new component was developed inside the PCS Sinfomar and the following requirements were requested for the implementation: the utilisation of public and open data/metadata format; utilisation of open interfaces that are public, documented and free to be extended; utilisation of interoperability standards and cooperation protocols; conformity to the EU Regulation (UE) 2016/679 – General Data Protection Regulation, GDPR, for the protection of personal data.

This new component focused on the evolution of the CH30 document. In addition to this, the generation of the electronic waybill had to be integrated with the other modules of the PCS in order to use the data already stored in the system. Furthermore, it manages the following data: number of identification of the waybill, date of the document, track number, sender, consignee, place of delivery, departure/arrival train station. Moreover, in the waybill, the list of wagons with the details of the transported goods is added.

In the pilot action, PNAEAS has foreseen two different phases: the first one is related to the realisation and implementation of the module in Sinfomar and the second one concerned the roll-out of the module and its first maintenance in order to guarantee the complete working of all the functionalities of the new module. The first phase was realised exploiting the synergy with another project, named "SMARTLOGI – Logistica transfrontaliera sostenibile e intelligente", co-financed by the Interreg Italy-Austria Programme.

The results were integrated also with the action carried out by the COMODALCE's PP10 - Mahart Container Center Ltd. Some discussions and activities already started and the xml and xsd structure of the CH30 in use have already been shared to plan the development of the interoperability between the PCS and the system in use at Mahart Container Center.

ZAILOG Verona and Port of La Spezia

Both partners collaborating in COMODALCE, representing respectively Italian regions Veneto and Liguria, work extremely close together for the pilot case which consisted in the implementation of an ICT solution linking the freight village of Verona, La Spezia and Rostock. In the specific, ZAILOG provided the implementation of an ICT integrated platform for the management of the rail freight corridor La Spezia –

Verona – Rostock. This cross-border logistics fast Corridor Information Pipeline (namely CIP) represents one of the terrestrial extensions of the ICT systems already supporting the ports involved (e.g., in the case of La Spezia, APNet).

At the beginning, the studies made about corridors potential showed concrete traffic volumes from la Spezia to Verona and further implementations of the railway transport on the corridor until Northern Europe are expected in next years. After the completion of market analysis, the identification of the requirements for the implementation of the ICT tool along the corridor La Spezia – Verona started and actually is under development.

2019
DESTINAZIONI
IMPORT FULL TEUS

VENETO	TOTALE		RAIL	
	TEU	TONS	TEU	TONS
Verona	18.205	178.845	3.020	45.879
Padova	12.200	110.559	7.310	68.546
Vicenza	5.234	56.921	0	0
Treviso	4.381	28.297	0	0
Venezia	2.470	18.233	0	0
Rovigo	269	3.031	0	0
Belluno	174	1.053	0	0
	TOTALE		RAIL	
	TEU	TONS	TEU	TONS
	42.933	396.939	10.330	114.425

TRENTINO AA	TOTALE		RAIL	
	TEU	TONS	TEU	TONS
Bolzano	651	4.327	0	0
Trento	7	67	0	0
	TOTALE		RAIL	
	TEU	TONS	TEU	TONS
	658	4.394	0	0

FRIULI VG	TOTALE		RAIL	
	TEU	TONS	TEU	TONS
Trieste	545	4.820	0	0
Udine	98	794	0	0
Padova	133	1360	0	0
Gorizia	88	556	0	0
	TOTALE		RAIL	
	TEU	TONS	TEU	TONS
	864	7.530	0	0

2019
PROVENIENZE
EXPORT FULL TEUS

VENETO	TOTALE		RAIL	
	TEU	TONS	TEU	TONS
Verona	27.537	331.529	10.174	17.363
Padova	56.848	606.113	49.704	529.381
Vicenza	7.240	66.279	0	0
Treviso	6.453	58.108	0	0
Venezia	3.887	38.313	0	0
Rovigo	504	5.064	0	0
Belluno	262	1.313	0	0
	TOTALE		RAIL	
	TEU	TONS	TEU	TONS
	102.731	1.106.719	59.878	546.744

TRENTINO AA	TOTALE		RAIL	
	TEU	TONS	TEU	TONS
Bolzano	1.186	15.168	0	0
Trento	316	3.515	0	0
	TOTALE		RAIL	
	TEU	TONS	TEU	TONS
	1.502	18.683	0	0

FRIULI VG	TOTALE		RAIL	
	TEU	TONS	TEU	TONS
Trieste	1.013	9.181	0	0
Udine	1.279	10.422	0	0
Padova	1137	10343	0	0
Gorizia	180	1569	0	0
	TOTALE		RAIL	
	TEU	TONS	TEU	TONS
	3.609	31.515	0	0

Figure 8: some results of the market analysis done for Verona – La Spezia (Source: ZAILOG archive)

2.1.3. The solutions experienced in Poland

BCT

The project partner which mainly developed ICT solutions for fostering multimodality in the northern regions of the CE was the Baltic Container Terminal (BCT). The BCT's pilot action consisted in the

development of a modular responsive web application accessible via internet for intermodal operations community with functionality and data privileges control. The application extended its functionality to the email notification system which allows to react on specific / urgent / actions and it's fully translated - currently in 2 languages Polish/English. A responsive framework allows users to work independently from devices such as desktop/laptops computers, tablets and phones. The integration module allows connecting external systems used by intermodal community with platforms to improve the process and reduce the need for manual work in the system.

To better understand the complexity of th system, here below are indicated some types of technology used in the pilot action, for the development of the ICT tool:

- Postgres SQL database - powerful, open-source object-relational database, strong reputation for reliability, feature robustness, and performance;

- Java Spring - flexible libraries and trusted by developers, flexible and comprehensive set of extensions and 3rd party libraries give big possibilities, Spring puts on security and it deals with security issues quickly and responsibly;

- Hibernate - object-relational mapping tool for the Java programming language. It provides a framework for mapping an object-oriented domain model to a relational database. Hibernate handles object-relational impedance mismatch problems by replacing direct, persistent database accesses with high-level object handling functions;

- FreeMarker - template engine to generate output HTML, web pages, e-mails, etc., it is simple specialized language;

- Bootstrap - open source toolkit for developing with HTML, CSS, and JS. It's a responsive grid system with powerful plugins built on jQuery;

- Json - open standard file format, data interchange format, lightweight;

- Apache with Tomact - open-source implementation of the Java Servlet, Tomcat provides a "pure Java" HTTP web server environment in which Java code can run.

In addition to the mentioned ICT tools and software components, different support technology tools and platforms like Netbeans, Github or Docker were in use during the development and implementation. The schematic below representation shows the structure of the linking process sustained for the success of the development of the ICT tool at BCT:

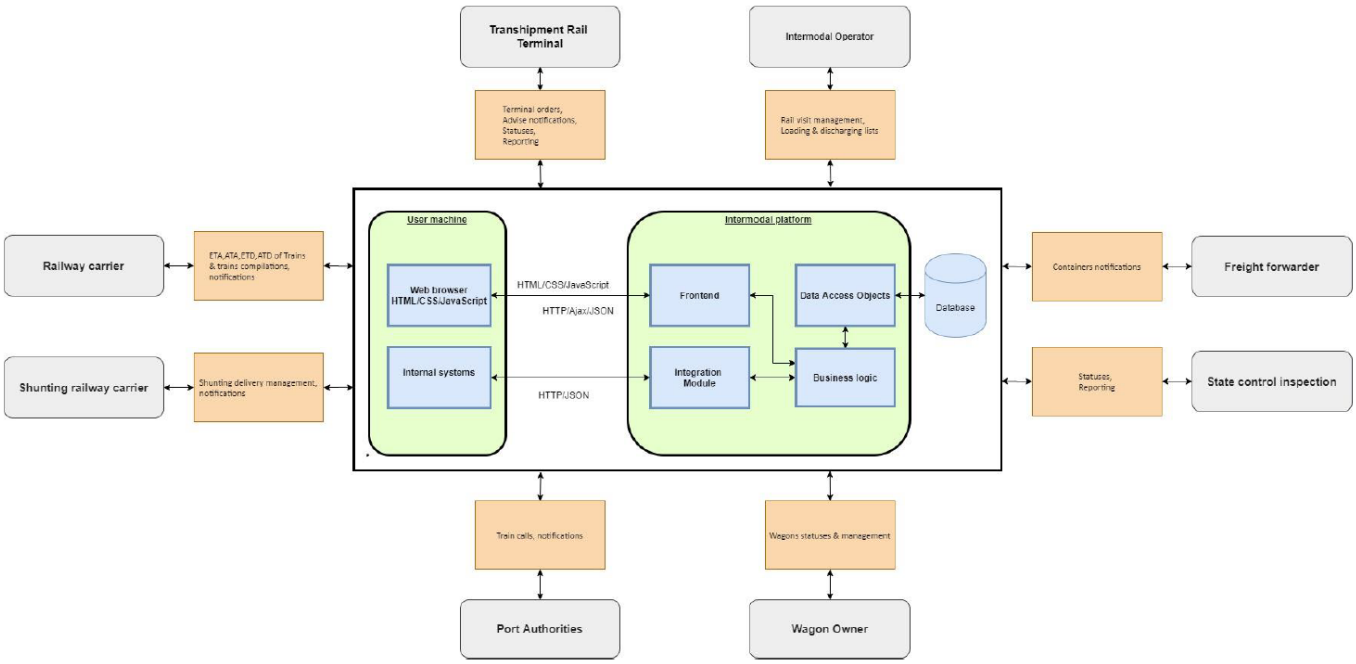

Figure 9: structure of the developing process of the ICT tool at BCT (Source: BCT archive)

Port of GDYNIA

On the Polish side there was also the preparation of pre-feasibility studies for "*the improvement of the port railway traffic management system and port's integration with its hinterland as part of the technical and organizational improvement of railway access to the Port of Gdynia*".

The issues related to the growth of containers' volumes in Slovenia, was detected in Poland as well. Due to the increasing volumes (TEU) in the port handled by intermodal technology, as well as grossing share of railway operations connecting port with its hinterland, ITS instruments ought to be utilised in order to optimize the traffic flow and boost port's competitiveness in the Baltic region.

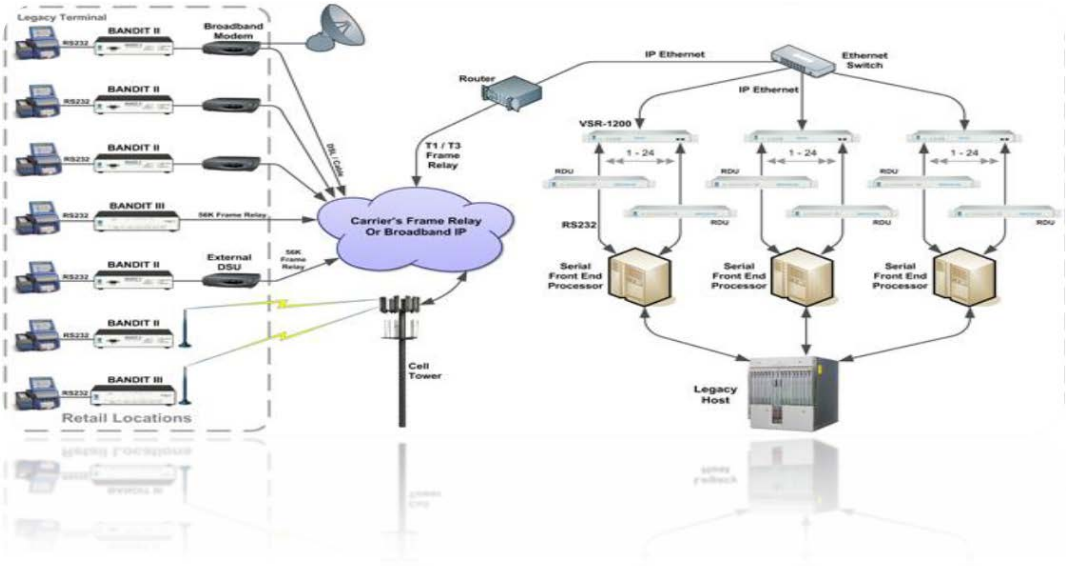

Figure 10: graphic overview about the basic idea of the ICT tool to be used in Gdynia (Source: Port of Gdynia)

In practice, the essential scope of the pilot action was the adaptation of port's IT system to the system implemented by the PKP PLK at Local Control Center of Gdynia Port Station. This solution allows a remote management and supervision of the railway traffic by means of IT systems.

The feasibility study proposed by the Port of Gdynia provides recommendations of new functionalities to the existing IT systems in the port for the enhanced exchange of information with the port users community, including Baltic Container Terminal, which is one of the COMODALCE project partners.

The pre-feasibility study proposes some concrete solutions like: provision of up-to-date traffic information, traffic management on terminal approach railways, possible improvements in information exchange among hinterland terminal/railway operator/port terminal/port authority;

What was also very useful for the better understanding of the potential solutions to be used at the port of Gdynia, also a collection of best practices in the EU ports was prepared, putting a specific attention on the implementation of the IT rail traffic management systems and the integration of ports with the hinterland.

2.1.4. The solutions experienced in Hungary

There were two pilot actions developed in Hungary. The MAHART Container Terminal experienced similar solutions to those that were developed in Slovenia (Koper). On the other side, RSOE in Budapest developed a container loading ICT solution and in addition to this, there was completed an analysis of the Container List data, in order to harmonize it with a friendly format for the whole logistic chain.

MAHART Container Terminal

The pilot activities in MAHART consisted in three separate steps which jointly provided a full picture of the ICT development at its Container Terminal. At the beginning there were identified weaknesses and needs for the terminal which ended in an upgrade of their IT platform as to enable one-to-one data exchange with the Port of Trieste on inbound/outbound trains, to reduce entry/exit time. The development of the IT platform consisted in an electronic data interchange, as well as an agreement about the data specification and data format to be exchanged with stakeholders. Furthermore a process to upload received data in the terminal system was developed.

In a later phase the plans of MAHART were also including a gate for scanning data and identification of characters on containers and wagons, but the COMODALCE project co-financed the software for characters' identification. In the specific, building the gate itself was co-financed by MCC. The contribution from the COMODALCE project was used to develop client operation software that enables character identification, automated upload / download possibilities and comparison with data that is in the system. In th specific, the MAHART ICT tool offers the following solutions:

- Scan and identification of inbound container numbers;
- Scan and identification of inbound wagon numbers;
- Scan and identification of inbound IMDG labels, IMO numbers;
- Compare obtained data with the data previously registered in the system by EDI;
- Alert messaging in case of discrepancies;
- Manual work is needed only in case of the data in the system does not correspond to the data scanned

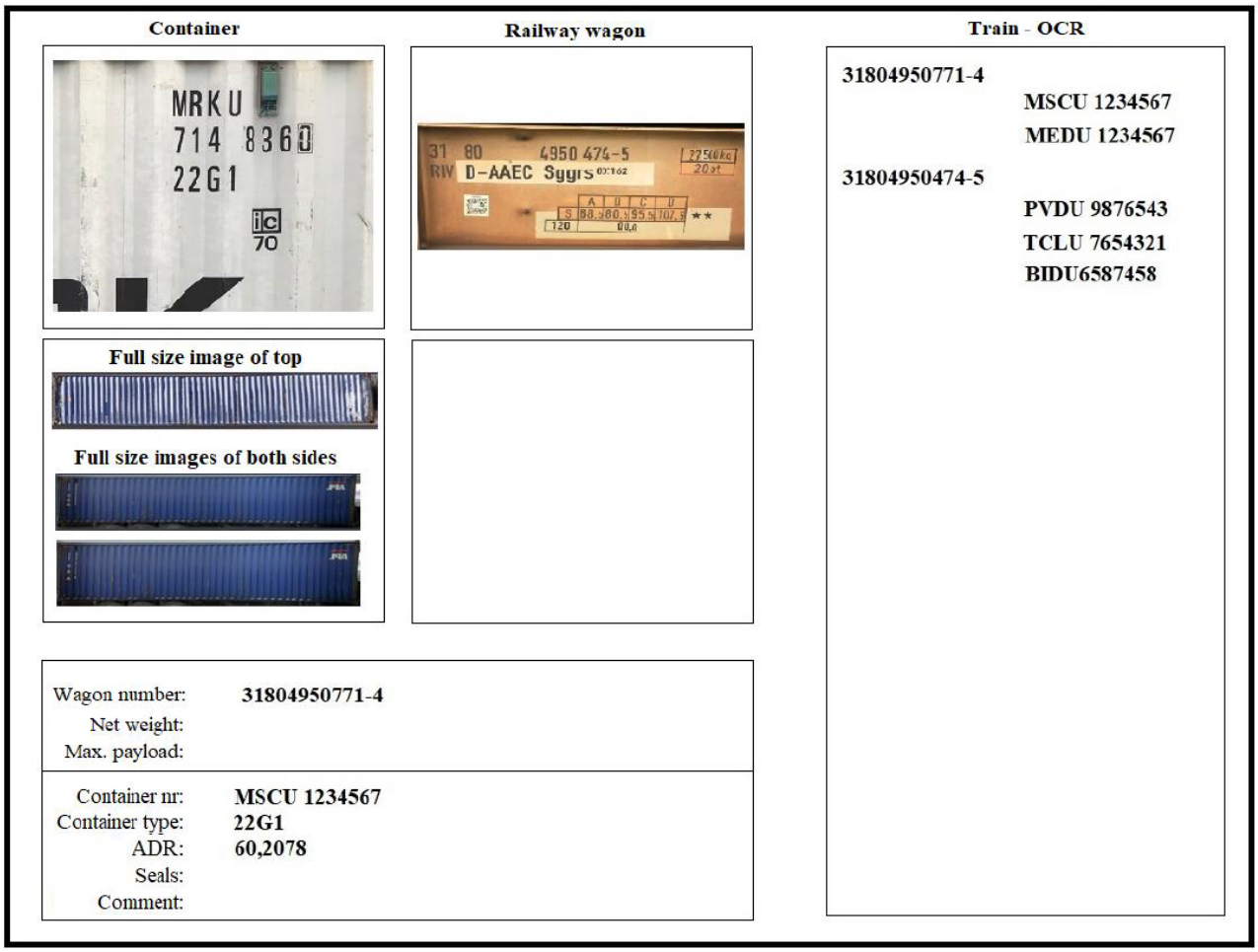

Figure 11: print screens of the ICT solution used at MAHART Container Terminal (Source: MAHART archive)

RSOE Budapest

The solution proposed in the COMODALCE project by RSOE is dedicated to the inland waterway transport and also in this case it needed the cooperation and contribution of MCC.

Initially there was no harmonised river container loading plan available at the inland ports in Hungary, neither in Europe. Each carrier, shipmaster is using its own format to inform the terminal about container loading. In order to harmonise and overcome this problem with unharmonized container loading plans for rivers, RSOE in cooperation with MCC, developed a suitable ICT tool as project's pilot activity for the Danube River.

After the completion of an analysis about available solutions for such a lack, the development of a software tool was specified more in detail and developed. The main achievements of the ICT tool are:

- electronic web interface input possibility for shipmasters / shipping agents to provide the container loading plan to terminal operators;
- harmonised electronic Container Loading Plan output (PDF);
- investigation about opportunities of how to integrate this software solution into the national port information system (KIR)

In addition to this ICT tool, the RSOE in Budapest contributed to the harmonisation of the container list of inland waterways for the Danube with the list solution adopted on other European inland waterways.

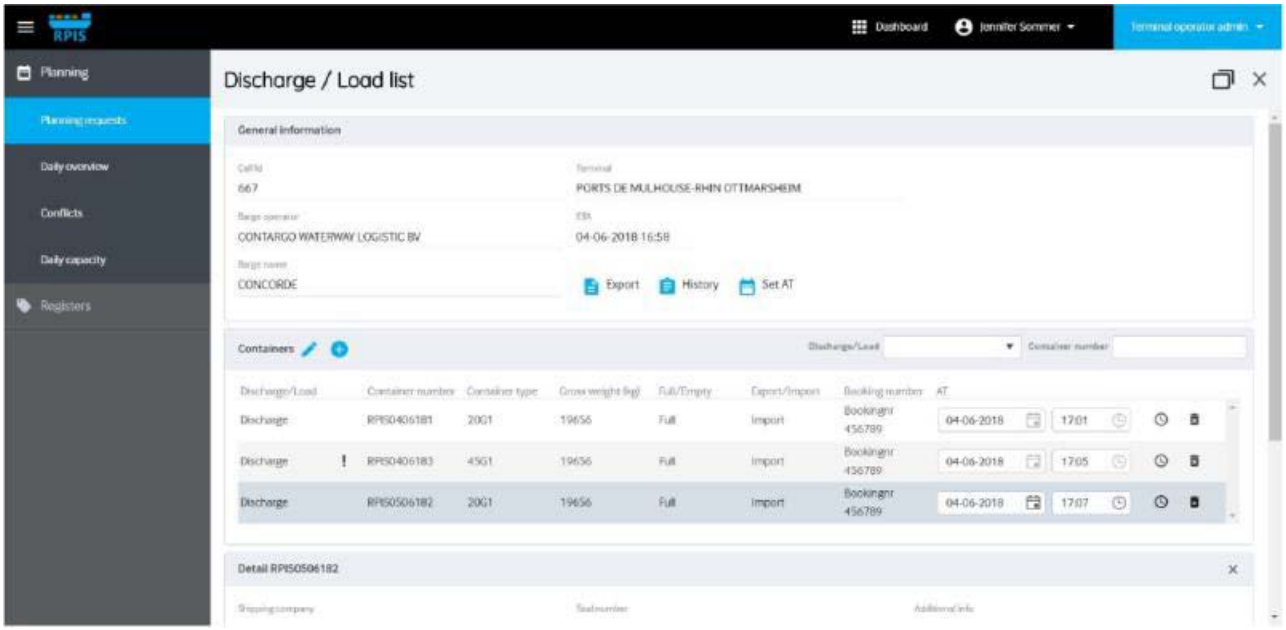

Figure 12: RPIS Loading List (Source: RPIS project / HPC)

After a comprehensive and deep analysis of data formats used by the Upper Rhine Ports, an amended data format for container loading list was developed in close cooperation with MCC to be used in daily business on the Danube River region as well.

3. Identification of transnational coordinated actions

3.1. What was achieved through COMODALCE

Many useful solutions were tested and developed through the COMODALCE project, before entering in production. The ICT tools identified can be transferred to other (inter)ports in CE for the adoption of similar standards helping the development of multimodality, as well as the increase of better links between these (inter)ports and their hinterland.

COMODALCE's project partners provided also some useful information in WPT3, while describing the potential measures to be adopted in next years in order to help increasing the use of multimodal transport and specially the railway transport for freights in CE. The potential Actions / Measures for a further development of ICT tools introduced through COMODALCE has been provided by each project partner and basically classified per period's length until years 2025, 2027 and 2030. The list of proposed actions is summarized in the table below, with estimated values per each line of the wish list:

	ACTION/MEASURE	ESTIMATED COST	TIME HORIZON
TRIESTE	Upgrade the gate control access for the ports of Trieste and Monfalcone	200.000 euros	2027
	Activation of PCS services in Monfalcone – evaluation survey	0 euros	2025
	Upgrade of the PCS app	80.000 euros	2025
	Evaluation study to implement the "security by design" paradigm	35.000 euros	2024
	Extension of the web service implemented in COMODALCE project to other dry ports	10.000 euros/site	2023
	Introduction of API technology to further extend the service implemented in COMODALCE	80.000 euros	2028
	ICT assessment of the systems of the port of Monfalcone	50.000 euros	2028
KOPER	Interoperability with other systems in the port's area	1.000.000 euros	2025
	Installation of scanning solutions also for trucks, integrated with port's PCS	500.000 euros	2027
	Development of user interface for the whole system	150.000 euros	2030
VERONA	Development of the Freight Village Community System	2.000.000 euros	2025
	Digitalization of the last mile connection	500.000 euros	2024
	Interoperability of the ICT systems of the players operating in the intermodal chain	550.000 euros	2025
	Implementation of an OCR portal	600.000 euros	2025

LA SPEZIA	Development of the Port Community System	2.000.000,00	2024
	Last mile digitalization	450.000,00	2023
	Interoperability of IT platforms and systems	450.000,00	2024
	Digitalization of port gates	1.000.000,00	2024
	Digital Twin	70.000,00	2023
	Drones	130.000,00	2023
	Blockchain	350.000,00	2024
	New technologies and 5G infrastructure	6.500.000,00	2024
BCT	Interoperability with all railway undertakings using the port of Gdynia	150.000 euros	2025
	Including major inland terminals to INCOS platform	47.000 euros	2027
	Integration of INCOS with Polski PCS as national level tool	155.000 euros	2030
PORTS OF HUNGARY	Automatization, Industry 4.0 port solution pilot	400 000 - 1 000 000 EUR	2026 (36 Months project)
	Port Blockchain pilot	250 000 - 500 000 EUR	2026 (36 Months project)
	Enhancing port communication with road transport in KIR national system	200 000 EUR	2025 (36 Months project)
	Masterplan and pilot for Danube Ports Information System	1 000 000 - 3 000 000 EUR	2026 (48 Months project)
	Danube Ports Information System implementation	4 000 000 - 10 000 000 EUR	2030 (48 Months project)
MAHART	Develop Terminal Operation System (TOS) in order to receive and process data received	200.000 EUR	2025
	Define, structure and standardize communication file together with Port of Trieste, in order to use electronic data interchange and communicate data with them.	20.000 EUR	2025
	Select and maintain the OCR gate software, customise to the local needs and implement it in MCC	25.000 EUR	2030
ROSTOCK	Establishment of an IT-operations control system for the intermodal terminal operator	150.000 euros	2024
	Installation and integration of a train-scanning-solution into the operations control system of the intermodal terminal operator	200.000 euros up to 650.000 euros (depending on solution)	2025
	Development of an external user interface in form of a terminal information and handling system	50.000 euros	2025

3.2. Possible solutions until year 2030

There are several proposals for further development of the ICT solutions tested through pilot actions in the COMODALCE project, which are achievable with different time schedules. Having more than 30 views of future implementations, we can group all of them in three main categories:

- Development of PCS through modular solutions allowing to integrate the system with new ICT tools from different software providers;
- Digitization of processes through the purchase of scanning equipment which is able to provide and share instantly the data about wagons and containers;
- Unification of interfaces of the systems of different stakeholders under common standards all over CE, for a unique model to be used for the same processes and types of data to be shared through the same logistic chain.

In addition to these, there are also proposals related to both digitization of processes and safe & security in (inter)ports. Many of the project partners collaborating in COMODALCE, were also developing ICT solutions in other EU projects, with specific focus on traffic flows or traceability within ports areas, like:

- the introduction of drones for the digital recognition of faces, cargo, trucks etc.: with the ICT solutions tested through COMODALCE, in was proven that a digital integration of different systems can be feasible, and more systems linked all together can offer a complete traceability in port's areas;
- 5G technologies in ports: the enormous quantity of data actually transferred between the stakeholders involved in the logistic chain in ports can become easily available to all, by introducing the 5G communication system. As said, some of the COMODALCE partners are involved also in other projects and one of these is the 5G-LOGINNOV project, where the introduction of the new generation technology is going to be tested, showing the potentials of 5G in logistics;
- Blockchain: the system, which is actually more popular for markets linked by the payment method through virtual bit coins, can allow the (inter)ports to have safe and secure transfer of data just-in-time without prejudice to the quantity of data transferred or to the type of data shared between the stakeholders.

So, what is expected by the end of 2030? For sure, there is need in Europe about standardization of processes related to the multimodal transport, between different countries. The new ICT tools that are going to be provided for the railway transport in (inter)ports areas, are going to be accompanied by modular solutions which will allow the users to find the expected solution, still through different providers, but focusing on a system like the connect-and-go, where just small integrations will be requested. At the same time, the scanning systems will help to increase the digitization processes, by speeding up operational procedures, as well as by storing the acquired data on clouds or storage devices with high graphic resolutions, for later analysis or for the detection of damages and dangerous cargoes.

The lack of opportunities for integration of systems will be the main challenge in next few years, which will lead to further collaborations between stakeholders in order to harmonize the cargo plans, the lists for loading, the data transfer etc.

Conclusion

Actually, the solutions provided through the COMODALCE project allow to reduce many operative estimated times in line with the on-going digitization processes in EU.

It has to be highlighted, that not only the external stakeholders will benefit from the introduction of such solutions, co-financed by the COMODALCE project through the Activity WPT2, but also the potential later users all over Europe will be allowed to indirectly benefit from these solutions as a safer and more secure working process, where the digitization is able to speed up operational processes and at the same time to reduce the potential human errors. Not only. Some of them can reduce the possibility of accidents involving employees and offer safer working conditions. Such improvement has not been yet quantified from the social point of view, but a reduction of absence of employees due to illness is reflected for sure also in a reduction of payments of sick leave.

From the technical point of view, the terminal operators, as well as railway operators and all the other logistic operators involved are enthusiastic about the innovation, supporting with great efforts the testing periods. The developed ICT tools can represent the basis for the concrete development of the full digitization of the operative processes related to the multimodal transport of containers and of their manipulation within (inter)ports' area, by the end of 2030. It can happen through the integration of the scanning railway systems with the with the systems mounted on cranes, reachstakers etc. which can offer a complete traceability of the freights within port's areas. In parallel, the harmonization of port's PCS with others in line with EU regulations and directives can offer a large-scale traceability system, with less probabilities for errors, damages and delays.

It's already proved that the ICT tools proposed through COMODALCE's pilot actions can be integrated with other video/data systems in the ports which can provide a traceability of each container, truck and wagon in port's area. In addition to this, the systems can be easily integrated by others for trucks and trains. This further step, which links PCS system through the ICT solutions for multimodality in suburban areas, is foreseen within the pilot activities planned in the newly submitted EU project named ACCESSMILE. The evaluation process is ongoing within the Interreg CE Programme.