Interreg

EUROPEAN UNION

Danube Transnational Programme

DIONYSUS

Integrating Danube Region into Smart & Sustainable Multi-modal & Intermodal Transport Chains

Inter-Connecting Danube & Sea Ports digital infrastructure through Robotic Process Automation. A multimodal approach.

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3 Abbreviations

Abbreviation	Explanation
RPA	Robotic Process Automation
MPAC	Constanta Maritime Port Administration
AI	Artificial Intelligence
EC	European Community (obsolete)
EMSWe	European Maritime Single Window Environment
EU	European Union
IWT	European Inland Waterway Transport Platform
RIS	River Information Services
RFD	Reporting Formalities Directive Directive 2010/65/EU
NSW	National Single Window
PCS	Port Community System - an electronic platform connecting the systems operated by the organizations and entities making up a seaport community. The Port Community System facilitates exchange of operational or administrative information between different actors in the port; it can also include systems for optimization of processes (e.g. “smart port” systems). The PCS can be operated and maintained either by a public, private or public/private organization.
ETA	Estimated time of arrival
ROI	Return On Investment
FMEA	Failure Mode Effect Analysis
API	Application Programming Interface

4 Executive Summary

This report has been elaborated within the framework of the project DYONISUS, work package D.T 2.4.3 **"Inter-Connecting Danube & Sea Ports digital infrastructure through Robotic Process Automation. A multimodal approach."**

The objective of the study which is to enable a faster and more sustainable communication between and inside the Danube Inland & Sea Ports workflows through digitalization boosted by Robotic Process Automation (RPA).

From the legal framework that regulates activities on the river in European Union, probably the most applicable principle for implementing an RPA is "**Once-only principle"** that states: "unless otherwise required by Union law, Member States shall ensure that the declarant is requested to provide the information pursuant to this Regulation **only once per port** call". An RPA solution for communication inside ports, but also between ports, will ensure applicability of this solution.

At European Union level, there are clear indications, that digitalization is a key component of any strategic direction. This will enable implementation of smart solutions like Artificial Intelligence and RPA.

The transportation sector will play a key role for EU economic development, but will also have challenges with regards to the European Green Deal and emissions reduction.

The new regulations in place (e.g. eFTI) are supporting the needs of the River and Maritime entities that were approached for the study.

The participating entities in the survey were not only Port Administration, but also Terminal operators, Shipping Owners and Shipping Agencies, Freight Forwarders and Other stakeholders.

The data collection process was also done via different channels like: On-site (Port Constanta) and Online interviews, Survey, Clarification meetings. The result of the study consider all means of data collection, but has as centre point the Survey run via a questionnaire sent to the participating entities.

The survey was sent to 30 entities and 9 answers were received back (low rate of answers is mainly due to the war that started in the region on February 24th).

The survey was structured in such a way that there will be minimum to no overlap to previous run surveys in Dionysus or other projects (e.g. Daphne). Besides some info related to Port identification details, the focus was on data flows communication inside and between ports. On top, Change Management

related questions were introduced to understand the very important impact on people and also ways to increase their competencies in the digital world. Several facts related to the survey:

- Out of ports that answered the questionnaire 78% were inland ports, 11% inland and seaport and only seaport 11%
- Regarding the ownership of the ports, 56% are public, 22% are public and private partnerships and 22% private ports
- IT literacy of ports employee had an overall score of 4, meaning above average
- In general, port employees are open to learning new IT related skills on an average level of 4 out of 5 score
- The processes that were most frequently nominated by ports as important to be analyzed are invoicing, transshipment, berth allocation, notice to enter/exit and issuing port access documents.

Robotic Process Automation (RPA) uses the software technologies to automatically handle computer tasks that are repetitive, rules driven, tedious for employees. Usually, back-office employees, spend up to 80 % of work hours filling in forms, making repetitive calculations, processing orders or such routine activities.

RPA is a very good solution for optimizing processes, and reducing durations, but cannot be implemented in all cases. There are clear criteria that are to be followed. In addition, in order to benefit from a rapid ROI, the best fit for RPA implementation are processes that passed through a **transformation initiative** using the **Lean Six Sigma methodology.**

Considering all the financial variables, we note that the implementation of an RPA solution will lead to consistent process improvements, productivity increase, reduce data deduplication, faster times in reacting to client needs etc.

The cost of the solution per process optimized varies:

- from about 10.000 Eur to about 30.000 Eur as one-time implementation cost.
- from about 400 Eur to 2.500 Eur as monthly subscription cost. The “Issuing port access documents process” that is specific to Port of Constanta and Maritime Danube Ports Administration has a higher cost, as the number of transactions is much higher.

IT literacy has improved over time, the results collected in this survey shows that there is an above average level of IT literacy of the people involved in port processes, hence there is a good platform of knowledge to move forward towards digitalization.

5 Introduction and scope of report

This report has been elaborated within the framework of the project DYONISUS, work package D.T 2.4.3 **"Inter-Connecting Danube & Sea Ports digital infrastructure through Robotic Process Automation. A multimodal approach."**

The objective of the study which is to enable a faster and more sustainable communication between and inside the Danube Inland & Sea Ports workflows through digitalization boosted by Robotic Process Automation (RPA).

RPA is the use of software to handle high-volume, repeatable tasks that previously required humans to perform. Various port operators continue to use their existing applications without having a satisfactory level of alignment to the new EC requirements in regard to data exchange, such as Directive 2010/65/EU with its recent revisions or the European Maritime Single Window Environment (EMSWe) initiative.

The study aims at leveraging port administration/authority attributes in order to trigger participative actions from the other Danube ports partners to summarize such existing applications and study the opportunity to make them "talk to each other"/exchange data through RPA. The study will go as far as gathering a list of used (digital) applications vs what processes could be digitalized and therefore generating more attraction/awareness to the project objectives.

The Robotic Process Automation for ports is a strategic approach/functionality, this ascending automation trend being introduced and developed during the recent years in order to improve port efficiency. As in the current programming period, important resources were allocated by EU to research innovation in the transport field, RPA being one of the studied technologies, it is proper to study how practically this could be introduced in the Dionysus Project area.

The study will analyse the processes which might be subject to automation in ports: equipment, equipment control systems, human-machine interactions, interactions with the port community and others. The RPA will impact also on the logistics chains and will improve their multimodal character. MPAC will be responsible for this study execution and validation with all PPs involved in A.T2.4.

5.1 Contracting authority /investor

The National Company "Maritime Ports Administration" S.A. Constanţa (MPAC)

5.2 Beneficiary of the study

The National Company "Maritime Ports Administration" S.A. Constanţa (MPAC)

6 Legislative framework overview

EU Directive 2010/65/UE on reporting procedure for ships, aims to standardize the administrative procedures applied in the maritime transport sector by using a simple procedure and streamlining reporting formalities. The Directive applies to the **reporting formalities applicable** in the field of shipping to ships arriving in and departing from ports located in the territory of the Member States.

REGULATION (EU) 2019/1239 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a European Maritime Single Window environment and repealing Directive 2010/65/EU establishes a framework for a technologically neutral and interoperable European Maritime Single Window environment ('EMSWe') with harmonised interfaces, to facilitate the electronic transmission of information in relation to reporting obligations for ships arriving at, staying in and departing from a Union port.

'European Maritime Single Window environment' ('EMSWe') means the legal and technical framework for the electronic transmission of information in relation to reporting obligations for port calls in the Union, which consists of a network of maritime National Single Windows with harmonised reporting interfaces and includes data exchanges via SafeSeaNet and other relevant systems as well as common services for user registry and access management, addressing, ship identification, location codes and information on dangerous and polluting goods and on health;

Obligations

Directive 2010/65/EU of the European Parliament and of the Council (3) requires Member States to accept the fulfilment of the reporting obligations of ships arriving in and departing from Union ports in electronic format and to ensure their transmission via a single window in order to facilitate and expedite maritime transport.

Both the European Parliament and the Council have frequently called for more interoperability and for more comprehensive, user-friendly communication and information flows, in order to improve the functioning of the internal market and to meet the needs of citizens and businesses.

Once-only principle

1. Without prejudice to Article 11(1), unless otherwise required by Union law, Member States shall ensure that the declarant is requested to provide the information pursuant to this Regulation **only once per port** call, and that the

relevant data elements of the EMSWe data set are made available and reused in accordance with paragraph 3 of this Article.

2. The Commission shall ensure that the ship identification information, particulars and exemptions that are provided through the maritime National Single Window are recorded in the EMSWe ship database referred to in Article 14 and are made available for any subsequent port calls within the Union.

3. Member States shall **ensure that the data elements of the EMSWe data set provided at departure from a port in the Union are made available to the declarant for the purpose of fulfilling the reporting** obligations at arrival to the next port in the Union, provided that the ship has not called at a port outside of the Union during that voyage. This paragraph shall not apply to information received pursuant to Regulation (EU) No 952/2013, unless the possibility of making such information available for such purpose is provided for in that Regulation.

TEN-T Regulation

The Trans-European Transport Network (TEN-T), based on EU Regulation No 1315/2013 and guidelines from the Council from 11 December 2013, aims to fund the construction and upgrade of transport corridors across EU member states to remove bottlenecks and promote sustainable and seamless transport in the EU area. The Core Network comprised in TEN-T is due to be completed by 2030 and it includes the most important connections (railway lines, roads, inland waterways, maritime shipping routes, ports, airports and railroad terminals), as well as linking the most important information and communication technology nodes (e.g. with solutions combining automation, telecommunication and technology such as RPA).

Complementing TEN-T Regulation there are several new strategies and important guidelines that the European Union has issued. Among them, the following have a direct impact in the River and Maritime transportation:

SUSTAINABLE AND SMART MOBILITY STRATEGY estimates transport by inland waterways and short sea shipping will increase by 25% by 2030 and by 50% by 2050. On top, another strategic milestone is that by 2030, rail and waterborne-based intermodal transport will be able to compete on equal footing with road-only transport. The strategy considers the fact that mobility and transport matters to us all, but there are certain **challenges** that are to be addressed in the next period:

- the most serious challenge facing the transport sector is to significantly reduce its emissions and become more sustainable. By 2050 the strategy can deliver a 90% reduction in the transport sector's emissions. The multimodal **Trans-European Transport Network** (TEN-T) is to be

equipped for sustainable and smart transport the success of the European Green Deal depends on our ability to make the transport system sustainable
- Digitalization will become an indispensable driver for the modernization of the entire system – **this is also where RPA automation fits in the whole transportation system, as possible solution.**
- it is crucial to ensure that the transport system is truly resilient against future crises, considering the past pandemic crisis just as an example

To improve the energy efficiency and reduce emissions of aircraft and vessels, EU must continue working closely with International Maritime Organisation (IMO), and needs to implement multimodal exchange of data, plus smart traffic management systems in all modes.

Hence Commission's programme NAIADES III to exploit this potential by renewing barge fleets and to improve access to financing, while ensuring full compliance with environmental policies, in particular with the Water Framework Directive and the Habitats Directive.

European Strategy for data

The strategy for data focuses on putting people first in developing technology, and aims at creating a single market for data that will ensure Europe's global competitiveness and data sovereignty. European strategy for data intends to:

- adopt legislative measures on data governance, access and reuse. For example, for business-to-government data sharing for the public interest;
- make data more widely available by opening up high-value publicly held datasets across the EU and allowing their reuse for free;
- invest in a European High Impact Project to develop data processing infrastructures, data sharing tools, architectures and governance mechanisms
- enable access to secure, fair and competitive cloud services by facilitating the set-up of a procurement marketplace for data processing services

Digital Transport and Logistics Forum (DTLF)

Aims to foster cooperation for the digitalisation of freight transport and logistics processes through electronic information exchange, DTLF aims to address the main themes of **digitisation of transport and logistics with the objective to move from paper to electronic documents**, through simplified procedures and integrated information exchanges across different sources.

The RPA implementation will clearly support the objectives of the DTLF in terms of paperless processes.

Electronic freight transport information (eFTI) is a new EU Regulation 2020/1056 entered into force in August 2020, and will become fully applicable as of **August 2025**.

The Regulation will constitute a big step forward in the digital transformation of freight transport in Europe, with important benefits to both operators and authorities:

- reduced administrative costs in transport and logistics
- improved overall efficiency of the logistics chain, facilitate the electronic exchange of information between the economic operators themselves;
- enforcement of freight transport rules in EU by ensuring the availability of more data of high and standardized quality that could be used for monitoring and statistical purposes, among others.

The eFTI Regulation will complement other EU initiatives supporting freight information exchanges in electronic format, in particular the European Maritime Single Window environment and the EU Single Window Environment for Customs.

GDPR Regulation

Regulation (EU) 2016/679 and Regulation (EC) No 45/2001 is an EU law with mandatory rules for how organizations and companies must use personal data in an integrity friendly way. It regulates the rules across the EU to protect and empower all EU individuals regarding the processing of their personal data and to hold organisations processing personal data of individuals in the EU accountable for their processing activities.

7 Introduction to survey analysis

7.1 Participating entities

The participating entities in the survey were selected from all areas of business involved in port activities:

1. **Port Administrations**
2. **Terminal operators**
3. **Shipping Owners** and **Shipping Agencies**
4. **Freight Forwarders**
5. **Other stakeholders**

With the Danube Port Administrations there have been several ways of collecting information:

1. **On-site (Port Constanta) and Online interviews**
2. **Survey document**
3. **Clarification online meetings**

Table 3. 1 List of ports and other authorities that received the survey

Port of Adony	Baja Public Port (Baja OKK Kft)
Public port of Bratislava	Port Terminal Ruse West
Port of Linz - LINZ AG Hafen	PORT BULMARKET - RUSE
Port Governance Agency, Republic of Serbia	Hungarian Federation of Danube Ports (HFIP)
Port of Constanta	AFDJ Galati
Centroport	APDM Galati
Ennshafen Port	Port of Giurgiu
Port of Burgas	Port Nikopol
Port of Vukovar	Drobeta Turnu Severin
MURFATLAR	Port of Giurgiulesti
Ruse-East	Izmail
Nikopol	Pro Danube Management (PDM)
Port Lom	Pro Danube Romania (PDR)
Freeport of Budapest	Romanian Ministry of Transport
Port of Dunavecse	IC Group Vienna

Due to the regional unrest, caused by the conflict started on February 24th 2022, the ports in the affected countries or in the close proximity of the war could not answer to the survey sent (e.g. ports in Ukraine were under Martial Law and were not allowed to send any information, at this time).

Table 3. 2: The list of entities the sent back the filled in survey:

Port of Adony
Public port of Bratislava
Port of Linz - LINZ AG Hafen
Port Governance Agency, Republic of Serbia
Port of Constanta
Centroport
Ennshafen Port
Port of Burgas
Port of Vukovar
APDM Galati

Preparing the survey included several interviews conducted with**:**

1. Port Administrations: Ennshafen Port, Public port of Bratislava, APDM Galati, Port of Constanta (including on-site process discovery)
2. Terminal operators (e.g. DP World, Comvex)
3. Shipping Owners and Shipping Agencies (e.g.: Phoenix Shipping, IST Logistic, Navlomar Maritim)
4. Freight Forwarders (e.g. TTS -Transport Trade Services)
5. Other stakeholders: Pro Danube Management (PDM)

7.2 Focus areas

We have evaluated for the Danube Port Administrations (Constanta Port being responsible for this work package and the largest Danube port) the information flow associated with port activities: flows between port operators, shipping owners and agencies, forwarding companies and the Port Authorities (statistics sent to the port authorities, billing activities for concessions / services, etc.)

We have evaluated the information flow between Danube ports, flows involving port authorities and economic operators (e.g. departures, ship arrivals, RIS-Reporting Information System, etc.)

The aim was to understand the possibility of automating repetitive activities, with high volume (intense activity) and digital inputs in the computer, so that they can be automated in the future using RPA.

8 Robotic Process Automation (RPA) technology

8.1 What is RPA - main concepts of Robotic Process Automation

Robotic Process Automation (RPA) uses the software technologies to automatically handle computer tasks that are repetitive, rules driven, tedious for employees. Usually, back-office employees, spend up to 80 % of work hours filling in forms, making repetitive calculations, processing orders or such routine activities.

RPA can perform any complex, rule-based work, can interact with any software application or website, in a precise, accurate and immune to boredom fashion.

> "RPA is an advanced form of business process automation that is able to record tasks performed by a human on their computer, then perform those same tasks without human intervention. Essentially, it is a virtual robot copycat."
>
> –Marcel Shaw, federal systems engineer at Ivanti.

RPA software will automate the activities or tasks previously performed by employees and when needed humans make judgmental calls, handle exceptions, and provide oversight. RPA can handle tasks completely from start to finish, and in other ways they can work hand-in-hand with human employees, as their digital assistants, for more efficient and effective work. But that's just the beginning, the newest advances have robots not only handling more complex functions, but also they're learning to make some of the decisions.

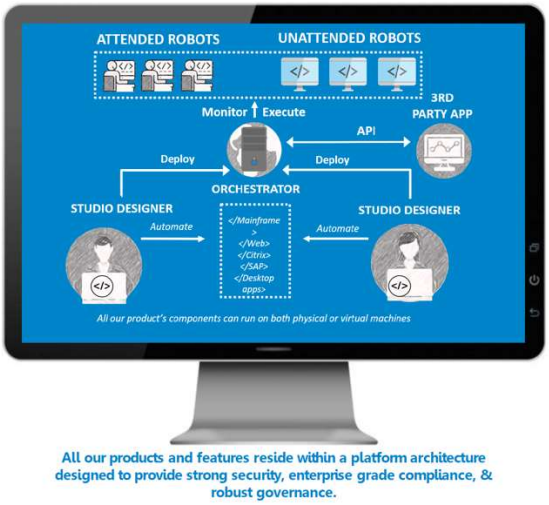
> "Put simply, the role of RPA is to automate repetitive tasks that were previously handled by humans. The software is programmed to do repetitive tasks across applications and systems. The software is taught a workflow with multiple steps and applications."
>
> –Antony Edwards, COO at Eggplant

RPA **isn't** a replacement for human workforce, it's ideal for tasks that require no human intervention, often referred to as **unattended**. Many tasks require a human connection, or at least in a portion of the process, such activities are known as **attended** tasks.

- **ATTENDED ROBOTIC PROCESS AUTOMATION**
  - Assists human operators.
  - Triggered manually and running locally.
  - Fit for manual, repetitive, rule-based activities, requires human intervention
- **UNATTENDED ROBOTIC PROCESS AUTOMATION**

- Doesn't require human intervention.
- Triggered and running remotely.
- Fit for manual, repetitive, rule-based back office activities NOT requiring human intervention.

Figure 8. 1 Attended vs. Unattended robots



High level setup for a Robotic Process Automation (source UiPath)

A human 'trains' the RPA in a fashion like recording a macro in Excel, recording each step and action in the process being automated.

Table 8. 1: Comparison between RPA recording and Excel Macro

RPA	Macros
Allows you to learn and enhance itself from the repetitive process.	Never learn anything for the repetitive process.
It can act Autonomously.	It cannot work autonomously.
It responds to external stimuli and reprograms itself.	It doesn't respond to external stimuli.
It offers Highly secured automation.	Security is not a high priority.

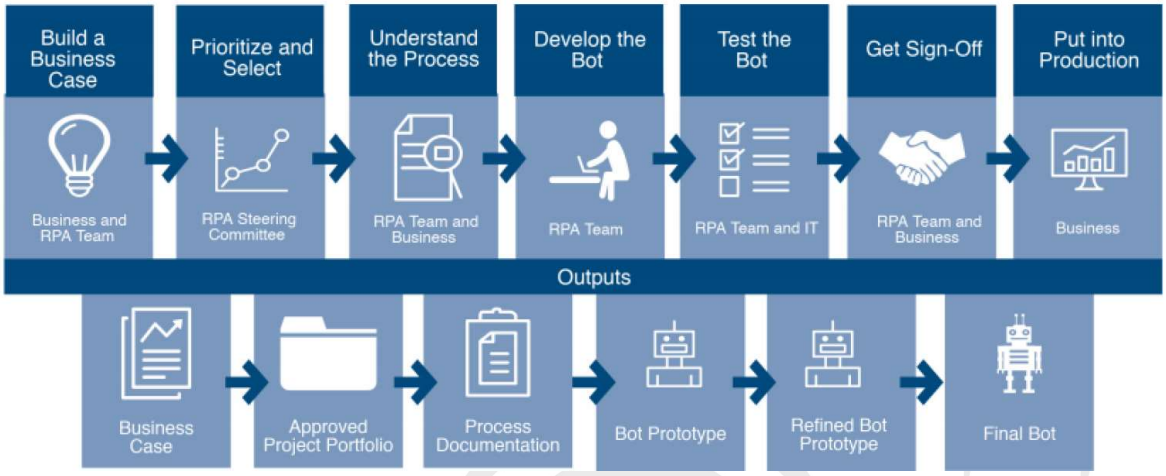
RPA can bring measurable improvements in customer satisfaction, by freeing up customer-facing personnel from filling forms and tabulations, as well as by reducing the opportunity for errors. It improves productivity, as software robots complete the same tasks faster, they work 24/7 don't need time off or sick leave, increases accuracy and resource utilization.

Studies on RPA and digital transformation shows that "more than three quarters (79%) of respondents are trying to automate complex existing/legacy processes with RPA" [19]. RPA bridges today's gaps, automating legacy application user interfaces, thus leading to many short-term benefits: increased process speed, reliable data manipulation, etc. With a long-term approach, organizations find more success using robotic automation as bridge between legacy systems APIs, thus simplifying legacy application and databases retirement and expediting automation "as a service", delivered from the cloud.

8.2 RPA Strategy and Methodology used in identifying suitable RPA processes for in scope ports

RPA can help just about every department in an organization improve efficiency, typically back office and the contact centre are the most obvious places where this kind of assist can make a difference.

Figure 8. 2 Automation Methodology



Source: APQC Tools for Re-Engineering Your Processes

A reliable RPA strategy should include several steps

1. **Discovery:**
   Assess organizational fit, appetite, and readiness for RPA and research available RPA tools and begin to sketch a vision for organizational transformation. It's important to bring in HR early to keep people at the center and establish an open, pragmatic approach from the start.
2. **Readiness:**
   Choose your RPA sponsor and project lead to champion the rollout and coordinate across diverse teams, identify business processes to first automate, and define success criteria.
3. **RPA vendor engagement:**
   Select the right vendor for your needs, based on long-term goals, user experience, security, and scalability."
4. **Proof of concept:**
   Put RPA to the test for your unique business context and needs – a PoC will put your business-case assumptions to the test and validate your implementation model.
5. **RPA pilot:**
   This is where businesses put an automated process into everyday operation and evaluate impact based on the predefined success criteria.
6. **RPA center of excellence:**
   Establish a hub for RPA implementation and adoption, concentrating expertise to all business functions along with a fine-tuned development environment, to help scale RPA across your organization.
7. **Expansion:**
   The CoE will communicate RPA implementation successes and goals, optimize the digital workforce, and identify additional processes for automation. Preconfigured bots and digital workers can help rapid scaling.
8. **Digital transformation:**
   RPA becomes part of your organizational DNA, as automating increasingly complex processes changes the nature of work for your people and business.

8.3 Process identification and usual candidates for RPA

To identify the best RPA candidates a mandatory step is to identify the structure of processes in the organization.

The desktop processes best for automation are similar to the ones the manufacturers have been following for some time now. On the assembly line, the lowest-hanging fruit for automation are those processes that are the most repetitive and require the least amount of human thought or creativity to complete successfully.

1. **Highly manual and repetitive processes**
   - High transaction volume processes
   - Highly frequent processes running daily, weekly (instead of monthly or yearly, which involve lots of manual work or work prone to human error)
2. **Rule-Based Processes**
   - Activities with clear processing instructions (template-driven), with decision making based on standardized and predictive rules
3. **Low Exception rate**
   - Activities with low number of variation scenarios existing in the process leading to different handling procedures
4. **Processes with standard readable electronic Input Type**
   - Triggered by standard and consistent inputs. The inputs should be in a readable input type like Excel, Word, email, XML, PPT, readable PDFs etc.
   - Triggered by input types which are not readable (scanned images with no OCR are not prone to automation.)
5. **High Volumes**
   - Processes with high transaction volumes (and high frequency).
6. **Mature and stable processes**
   - Well documented, stable, predictable
   - Known operational costs
7. **Changeable Processing Method or System Change**
   - The processing method cannot be changed
   - Fundamental changes are not required in the underlying technical architecture of the current systems (e.g. new interface development or changes in configuration for existing systems to enable automation)

- We strongly recommend avoiding automating a process that will be changed in the short term

8. **Automation Savings**
    - It's recommended to automate only the processes that can provide a saving in terms of human work-effort of minimum 1 FTE (Full Time Equivalent)

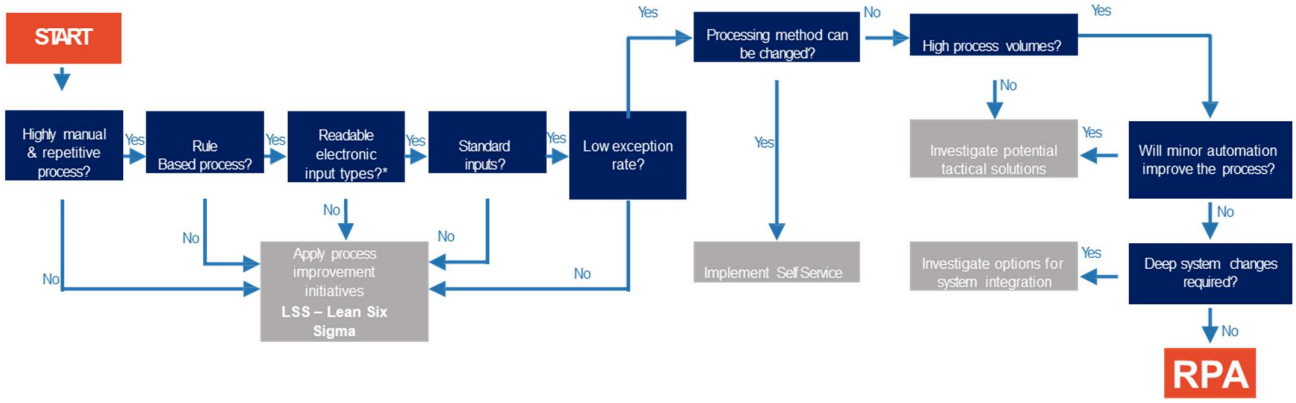


Figure 8. 3 Process identification for RPA (UiPath)

In order to benefit from a rapid ROI, choose processes that passed through a **transformation initiative** using the **Lean Six Sigma methodology.**

8.4 RPA impact, risk analysis and classical performance indicators

8.4.1 RPA Impact

Beyond costs, one of the best ways to think about how you'll measure the efficacy of your RPA strategy is to think about metrics that reflect what RPA is good at.

- **Productivity**: Compared to employees, RPA complete the same tasks faster and work 24/7 without need for time off or sick leave.
- **Accuracy:** RPA complete their tasks without errors.
- **Consistency:** Robots perform the work identically without variation
- **Reliability:** Robots are always ready to work, don't take breaks and, never get sick.
- **Compliance:** Bots follow regulatory rules perfectly and never forget a step. In other words, regulatory compliance can effectively be programmed into a process.

- **Employee Satisfaction:** Employees can dedicate more time to more meaningful work. This is a good example of where qualitative measurement can be as important as numbers.
- **Customer satisfaction:** By freeing up your customer-facing employees from forms and tabulations, you're making them available for customer interaction.

8.4.2 RPA risk analysis

RPA tends to fail if the process being automated is not as robotic as initially thought, or the resulting automation is run in an environment that is much more dynamic than previously identified.

- The process is more dynamic than you realize. This is probably the biggest pitfall: It essentially means you've automated the wrong process. If a process requires decision-making on a case-by-case basis, you still want humans closely involved.
- The target UI changes, but your RPA bot doesn't get the memo RPA is good at following instructions; it's not good at learning on its own or responding to unexpected events.
- You underestimate the political implications Business areas that don't have the attention of key executives may also be a poor fit for RPA. This can be especially important in organizations where "automation" is a dirty word of sorts, often because it makes people paranoid about their job security.
- You have unrealistic expectations Like any technology initiative, you need metrics to measure the results and ensure that RPA is meeting its intended goals. Just make sure those goals are achievable, and that you're not trying to use a screwdriver to hammer a nail.

A classical **FMEA** (Failure Mode Effect Analysis) would be recommended to run when implementing a RPA for any kind of processes. This is a structured approach to:

- Predict failures and prevent their occurrence in functional areas which generate defects.
- Identify the ways in which a process can fail to meet critical customer requirements.
- Estimate with a score from 1-10 the **Severity** of a failure, frequency or **Occurrence** of a failure and **Detection** controls to catch any problems or defects

- Multiply the three scores to calculate a **Risk Priority Number** (RPN) and sort the risks from highest to lowest.
- Prioritize the actions that should be taken to improve and control the process using the Risk Priority Number.

8.4.3 RPA classical performance indicators

To develop a robust business case that can stand up to executive, operational, and tactical scrutinization, it's best to build a holistic business case consisting of four pillars:

1. **Financial Impact**
   - Average annual cost savings
   - Five-year cost savings
   - Payback period
   - Five-year return on investment
2. **Business Operational Value**
   - Process efficiencies: processing time
   - Process efficiencies: daily throughput
   - Improvement in data analytics capability
   - Improvement to compliance/accuracy
3. **Workforce Impact**
   - Number of employees reallocated
   - Annual labor hours saved
   - Reduction in case workload per tax
4. **Strategic Alignment** – considering the overall strategy for an organization, country or region, such as European Union.

9 Survey Analysis

9.1 Survey Objectives

9.1.1 Methodology

Research methodology
The research methodology comprises:

- **Desk research** – Port IT infrastructure assessment. Literature review for defining inland waterway transport infrastructure and associated costs and expenditures. Analysis of the previous written studies and also EU regulations that have a link with the project objectives. Analysis of the participating ports in terms of processes and operations run within the port, but also communication with other ports.
- **Qualitative field research** – Questionnaire design. Data collection. Data analysis. A questionnaire to evaluate the possibility to implement Robotic Process Automation solutions and to evaluate its implementation impact (cost vs. benefit analysis). The results are included in an individual chapter of this study.
- **Interviews** – conducted with Port Authorities (public and private), Terminal operators, Shipping Owners, Shipping Agencies and Forwarding companies.

9.1.2 Questionnaire

The survey was sent to 30 entities we have received 9 answers, one of the answer being sent from a Maritime only port.

Research questions
The survey was structured in such a way that there will be minimum to no overlap to previous run surveys in Dionysus or other projects (e.g. Daphne).

There are four sections that are covered in the questionnaire:

A. Port identification details - Question(s) to link information to previous studies
B. Data flow / communication inside the port
C. Data flow / communication between ports
D. Questions related to Change Management: moving towards people competencies in the digital world.

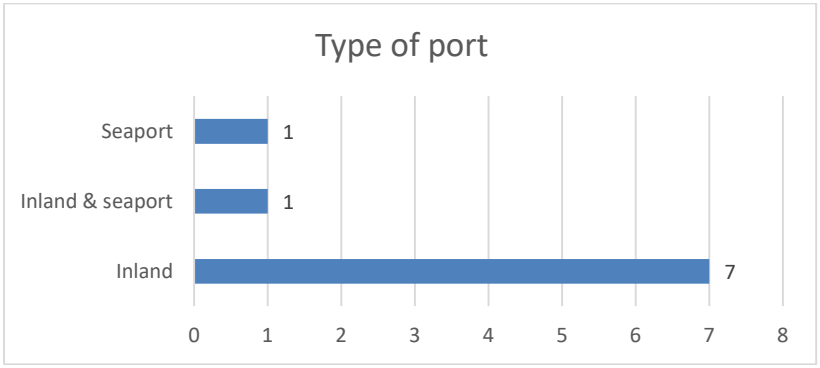
As previously mentioned in the survey the main goal of the study is to enable a faster and more sustainable communication between and inside the Danube

Inland & Sea Ports workflows through digitalization boosted by Robotic Process Automation (RPA).

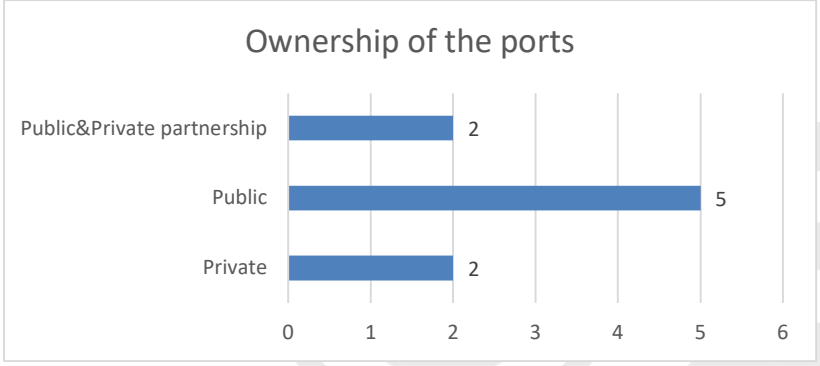
The main goal of this study is achieved by answering to some key research questions like:

- What are the main processes run between ports and inside the port?
- What are the most important one considering the volume and repeatability of the items within the processes
- Which processes, that if optimized by using a Robotic Process Automation will impact the most the communication between and inside the Danube Inland & Sea Ports?
- Which processes, that if optimized by using a Robotic Process Automation will impact the most the overall objectives of Dionysus project: to support the multimodal corridors and supply chains in accordance with EU Directive 2010/65/EU and EMSWe initiative

The Type of Ports answering the questionnaire were mainly Inland Danube ports:



On the other hand, when looking at the port ownership, we had a higher spread of the answers between public and private ownership of ports:



9.1.3 Interviews

More than 10 interviews were conducted with different entities that are involved in processes taking place inside a specific port or between different ports.

The discussions resulted in collecting several issues and possible improvement solutions for different processes (permits, authorizations, other requests). The result of the interviews is described below:

- **There are hardly any circumstances** when port authorities communicate between them
- Most of the communication between ports is done by Shipping Owners, Shipping Agencies and Forwarding companies
- Both Port Authorities and Terminal Operators communicate with Shipping Owners, Shipping Agencies and Forwarding companies when a ship is about to arrive or arrives in a port. The same being done, when the ship leaves the port.
- **Information exchanged between** Port Authorities, Terminal Operators and Shipping Owners, Shipping Agencies and Forwarding companies includes the following: **ship identification number, shipper information, consignee information, current shipment location, dates, proof of delivery, and shipment description (like type of cargo, quantity, etc.)**
- As previously identified in Dionysus Project, we have concluded from all interviews, that there is a limited capacity for both ships and ports to operate containers. Therefore, there is a direct negative impact in increasing the level of multimodal transportation.
- **Probably the most important information** requested by different players in the goods transportation is to know when a ship leaves a port towards another one. Information like: departure time, type of cargo (also layout of cargo), quantity, crew, estimated time of arrival (ETA), stops on the way in other ports.
- Most of the entities mention the fact that one of the most complex process, with direct impact in the time spent by a ship in a port are the customs formalities where already requested information by Port Authorities is being reprocessed.

9.2 Process mapping of port activities focusing on RPA readiness for implementation

In order to reach a proper understanding of RPA applicability for existing processes, we have defined 2 main areas where an in depth process discovery was done:

- Core and support processes inside the port
- Core and support processes between ports

In order to ensure a relevant study outcome, the research team has always referenced the Dionysius program digitalization objectives:

1. Improve multimodalism,
2. Enhance Supply Chain
3. Follow the requirements of EMSWe

Interviews and meetings with Terminal operators, Shipping Owners and Shipping Agencies, Freight Forwarders and other stakeholders revealed the need for services necessary for these entities. The below list links the need of services of the 3 Dionysus objectives mentioned earlier:

1. Transmission of information on goods to be loaded with seals and stocks, unloading confirmation, goods remaining on quay to shipping agents, freight forwarders and Customs
2. Real time tracing of goods status and movements
3. Berth allocation management
4. Collection of the B/L information entered by freight forwarders
5. Customs declaration and Transmission of the Customs clearance status
6. Ship departure confirmation
7. Harbor dues
8. Transport order management
9. Government agencies (e.g. veterinary inspection) declarations
10. Fleet management (managing port's vehicles), including Truck appointment system and Truck arrival pre-notification

On top the specific objective of this study was detailed with respect to enabling a faster and more sustainable communication between and inside the Danube Inland & Sea Ports workflows through digitalization boosted by Robotic Process Automation (RPA)

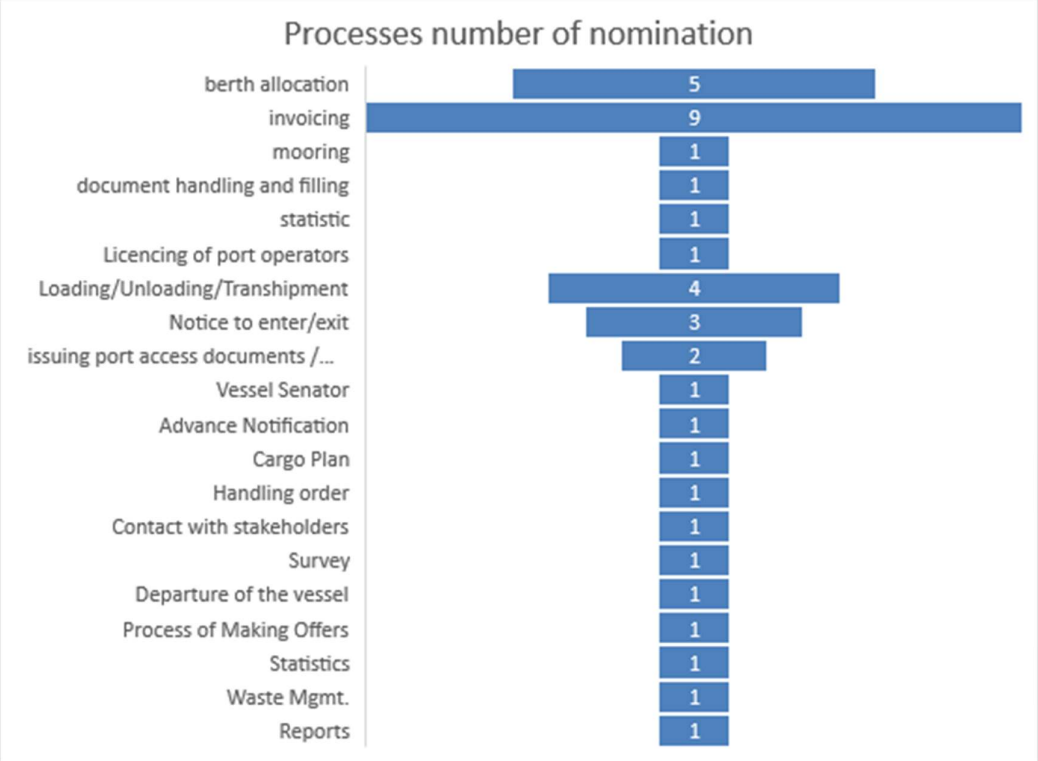
9.2.1 Inside Port Processes

There were 20 distinct processes nominated as the most 5 important among the 9 ports

Top 5 processes include 3 process common for multiple ports and 2 processes rather valid for Port Constanta and APDM Galati due to the volume of work and transactions occurring (notice to enter/exit the port and issuing port access documents / permits to access premises):

1. Invoicing Process
2. Berth allocation process
3. Merchandise tracking (Loading/Unloading/Transshipment)
4. Notice to enter/exit a port
5. Issuing port access documents / permits to access premises

Figure 9. 1 Processes Overview



1. Invoicing process: steps in the process

- Operators work in the ERP application, Issued Invoices
- The company database is stored here
- Invoices appear with a specific identifier (those processed are alpha numeric)

1. A range of numbers (standardized) is declared.
2. The pdf is listed (the invoice number is not filled in automatically, it must be entered manually - the name of the document, being identical to the standardized and printed invoice)
3. Open Outlook - copy / paste the email address (the email from where you received the invoice data), attach the invoice and the account where you can pay (untypified). This PDF invoice takes the place of the proforma. The use of this format alone is not yet accepted.
4. The form is either printed and sent by courier to the beneficiary or sent by email.
5. Receipt confirmation check

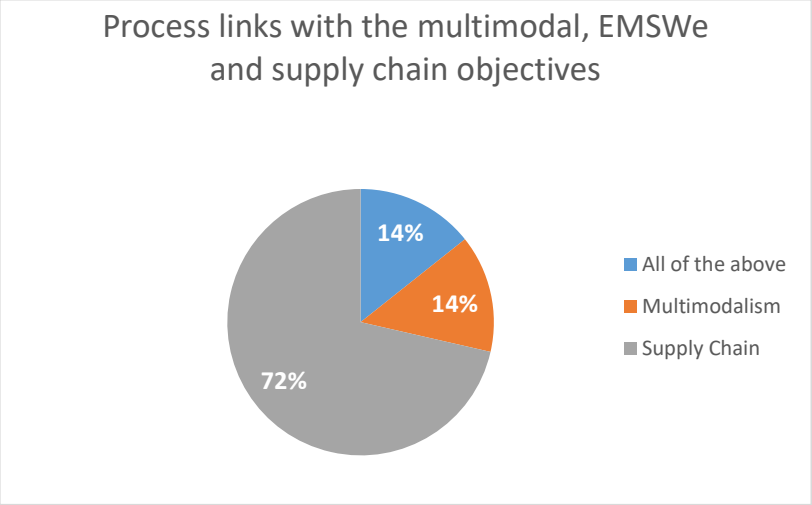
General Process Data linked to RPA implementation

- **Volume**: depending on the port varies between: ~ 50 invoices per month, which are sent by mail
  More than 1.000 (up to 5.000) bills per month. Approx. 3000 are sent by mail.
- **Input (Sources and Applications used)**: Outlook, ERP, Neptun, PDF adobe, NTExpert, Web application, Invoicing system.
- **Average processing time:** 10 - 60 minutes depending on the port and the degree of automation (60 min - only e-mail and PDF)
- **People involved in the process:** 3-5 people in ports with a volume of more than 1.000 invoices per month, less than 3 people in those with less than 50 invoices.
- **Exceptions from performing process rules:** 0%-10% Invoicing process has clear rules to perform/carry out the process.
- **Input type in the process:** 83% are standard, 17% non-standard.

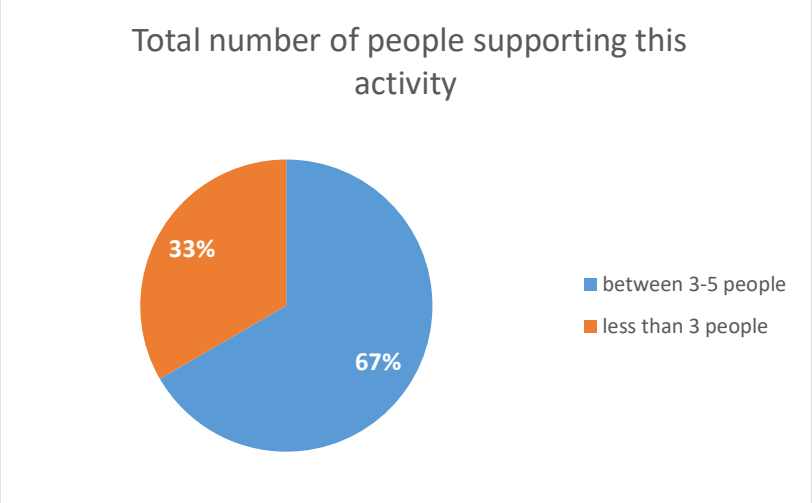
As **best practice**, Port Governance Agency (as a central port authority for all ports and harbours in Republic of Serbia) already uses a RPA, were the

automation links 2 application: the web application (portal) and the Invoicing System.

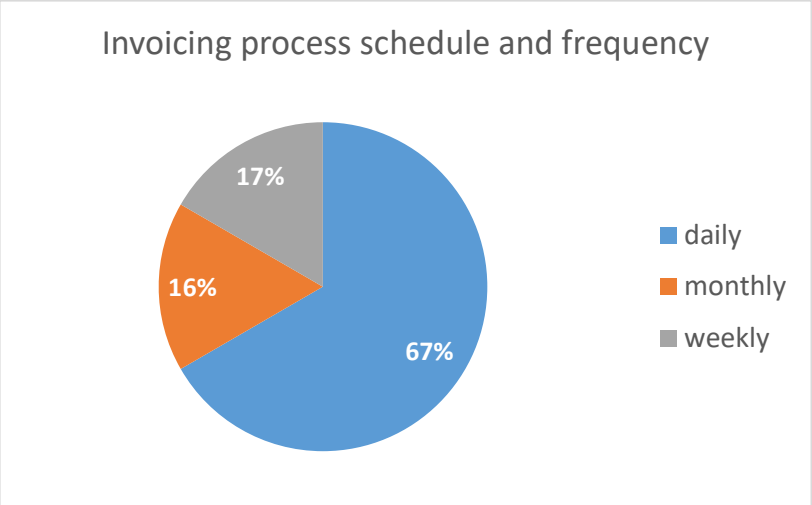
Figure 9. 2 Processes links to Dionysus Objectives



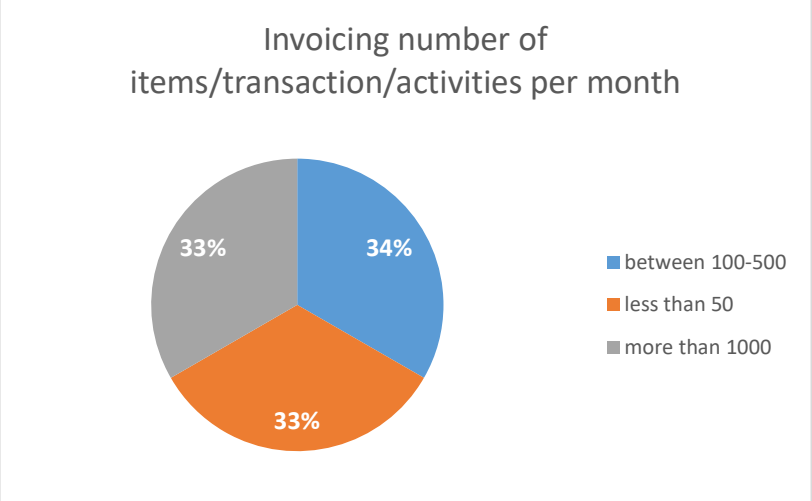
By optimising the invoicing process using the RPA, 72% of the answers received consider this will have an impact on the supply Chain objective of Dionysus project.



In 67% of the answers received there are less than 3 people involved in the invoicing process and 33% of the respondents mentioning invoicing process have a team of up to 5 people handling the activity.



High volume ports have a daily occurrence of the invoicing process, while the small ports run this process on a weekly or monthly basis.



67% of the responding ports have high and medium volumes of invoices issued per months and 33% of respondents have less than 50 invoices issued per months.

2. Berth allocation process:

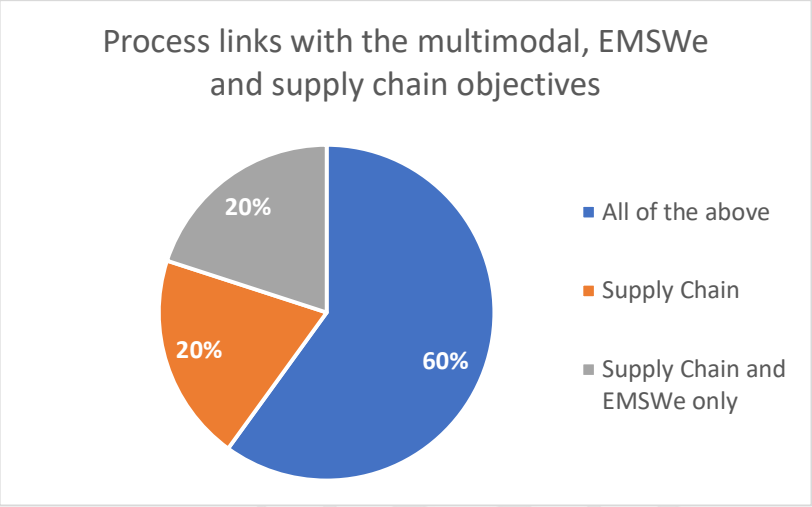
1. Request to receive a berth. It is usually a daily process

Submit notice to enter the port; the pilotage request is submitted for the berth request

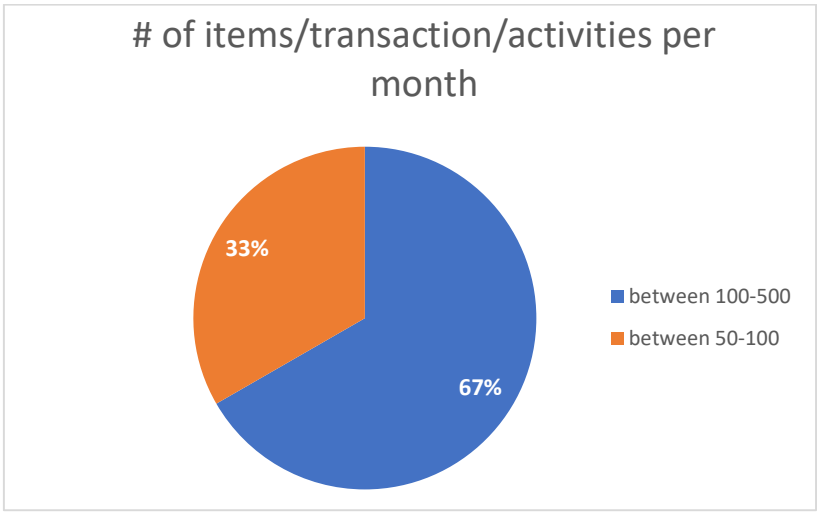
2. Analysis of request and berth allocation. Approval of the berth by the operator and approved by the captaincy and port authority
3. Answer to client. Provide the quail number where the vessel can do the landing

General Process Data linked to RPA implementation

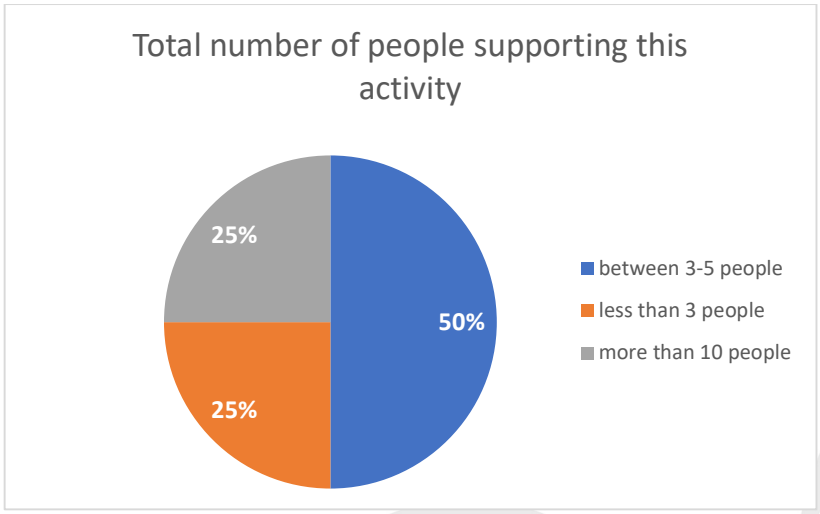
- **Volumes**: In most of the cases (67%) between 100 – 500 per month, showing a high volume of transactions.
- **Input**: phone calls, PDF, E-mail, Handwritten, Web Application, SIIP
- **Average processing time** for execution: 5-35 minute
- **People involved in the process:** in 50% of the cases there are more than 10 people involved in this process, and the rest is equally split to processes where 3 to 5 people or less than 3 people are involved.
- **Exceptions** from performing process rules: 0%-1%. Very low exception rate.
- **Input type in the process:** 80% are standard, 20% non-standard.
- **The process has a daily frequency**



In 60% of the answers received, entities consider this will have an impact on all of the Dionysus project objectives.



Two thirds of the answers show that the process has a high volume of transactions, being therefore a proper candidate for Robotic Process Automation.



3. Cargo tracking (Loading/Unloading/Transshipment) process:

1. Cargo owner or his freight forwarder will give written order to the Port Operator for the loading/unloading/transhipment operation. This work order can apply for the whole convoy if all the vessels and total amount of goods are stated. Custom clearance is obligatory for imported goods (just outside EU region)

One of port operators report commodities via a web application (not used 100%). Used for different reports and statistics.

2. Port operator will plan the operation and start the execution.

3. Acceptance will be made for loading/unloading of goods to/from port storage.

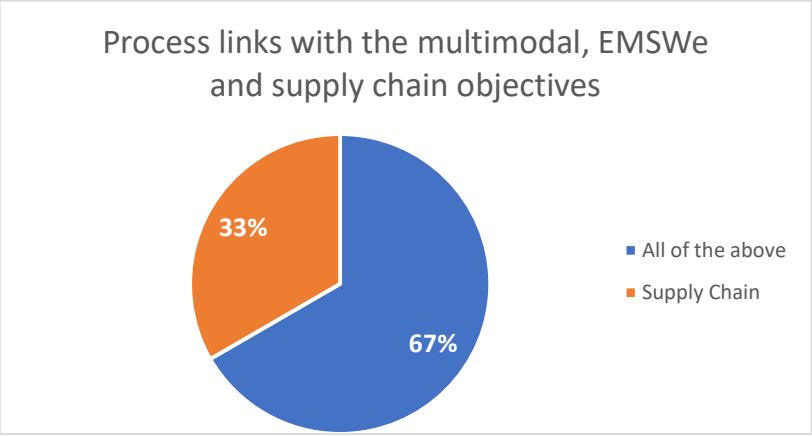
One of the ports uses a system to operate the received data.

4. For the transhipment operations, Cargo owner/freight forwarder should also send the list of tracks (registration plates and driver names) or nominate railway cars. Separate receipt will be made for the goods transhipped to each truck/railway car.

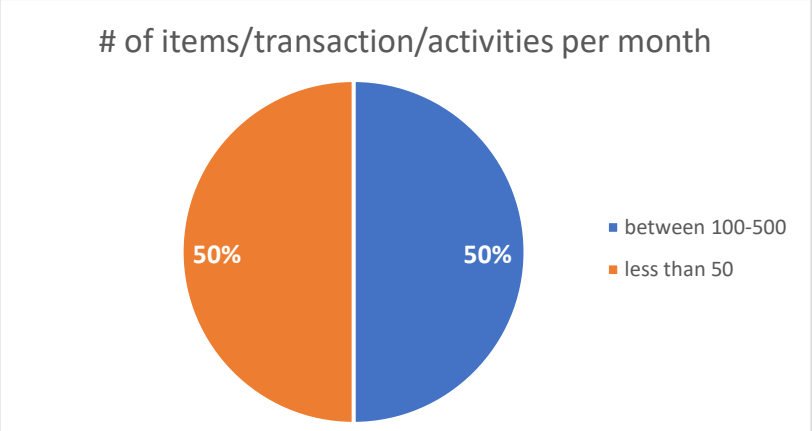
5. Weighing on the port weighing scale can be performed as part of these operations, if ordered by cargo owner or customs officer.

General Process Data linked to RPA implementation

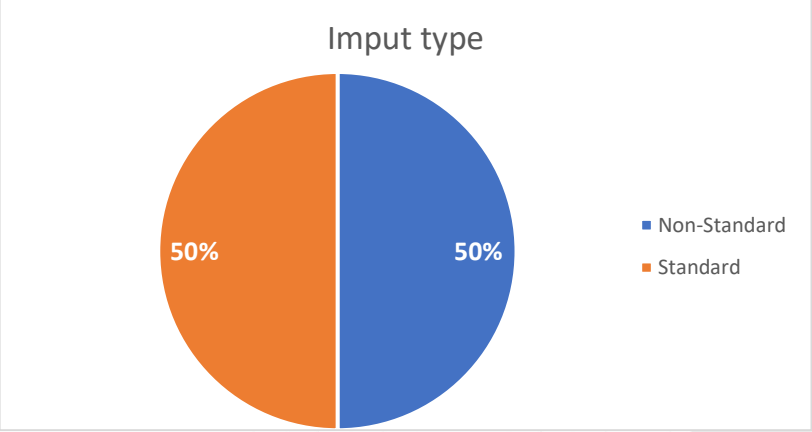
- **Volume:** between 50 - 500 per month depending on the port
- **Input, Sources and applications used:** E-mail, paper, Web application, Neptune system, Excel
- **Average processing time:** 5-10 minutes
- **People involved in the process:** less than 3 people
- **Input type in the process:** 50% are standard, 50% non-standard.
- **Exceptions to the execution rule:** 0%
- **The process has a daily frequency in all cases.**



67% of the answers received consider that an RPA process optimization will impact all of the Dionysus project objectives.



50% of the answers show that the process is high in volumes.



50% of the answers show that the input type is standard. The rest of the input would definitely need to be standardised before any RPA implementation.

4. Notice to enter/exit a port – process description done for Port of Constanta

1. All notices come by mail or fax (less than 5%)
2. The mail is printed.
3. Open the ERP application
4. The ship is searched according to CNP, and all data appear (If the ship has not been in port, all data must be entered manually)
5. The operator checks the details.
   A revision takes 3-4 minutes. A notice lasts ~ 10 min
6. The real (entry, exit, effective maneuvering of ships) is done through the station

General Process Data linked to RPA implementation

- **Volume:** 20 - 25 approvals per day and 4.000 maritime per year. There are differences in volume and frequency between the analyzed ports. (weekly, less than 50 per month / less than 600 per year)
- **Input, Sources and Applications used:** Outlook, SIIP, Neptune
- **Average processing time:** 5 - 40 minutes depending on the port and the degree of automation (40 min - phone and e-mail only)
- **People involved in the process:** 3-5 people
- **Exceptions from performing process rules:** 0%-10%
- **The standard format is not respected in all cases,** but it can be standardized over time (only a few beneficiaries do not comply with the existing standard format)

5. Issuing port access documents / permits to access premises. Process description done for Port of Constanta

1. The operator sends a request to the portal - PORT site: complete the request and adds documents: ID, car registration, affidavit (not standard).

Scanning is not standardised at the moment.

2. The application arrives in DMS (document management system) with status "added"

3. Assigned no. of registration (manual - one person) at the Registry. "Unregistered" status

4. The application is processed in the application portal.)

5. The information arrives in the system at the authorization service. The request is manually assigned to one of the 3 operators. "Processing" status

6. The application is opened: Status "in partial processed".

7. Check doc vs application information (table), including if it is the correct form (latest version).

8. Print the document.

9. The Neptun (ERP) application: Vehicles and Permits opens. The number of registered vehicles is checked for vehicles (if it does not exist, it is entered manually). The permits section it will be checked the required start date vs. the end of the existing permit.

10. A decision is made (receives / does not receive a permit). The process flow closes (fully approved). Resolution: partially approved, approved, rejected!

The resolution automatically reaches to the economic agent (from the portal).

11. The operator returns to the portal and enters the series of permits

12. Generate the invoice

13. Copy the mail from the portal and send it to the invoicing service in Outlook.

The invoicing and payment process takes place and then they appear automatically in Neptun (ERP).

14. Select the paper type based on the expiration date (current year, next year, etc. colour).

15. Print and attach the sticker (template).

16. Cut and plasticize.

17. Select the related invoice (comes from the financial) and pair it.

18. The economic operators take the documents from the gate

General Process Data linked to RPA implementation

Process data also includes ADPM Galati

- **Volume:** 30,000 permits per year.
- **Input, Sources and Applications used:** SIIP + ERP Portal, Outlook, Neptune, PDF, RoRIS, MSWe
- **Average processing time:** 3-15 minutes

- **People involved in the process:** 3-10 people depending on port
- **Input type in the process:** all inputs are standard.
- **Exceptions to the execution rule: ~ 2**%
- **The process has a daily frequency in all cases.**

The foreseen impact is mainly in the enhancing the multimodalism objective but also touching all the others.

9.2.2 Between Ports Processes

There are only a few instances when port authorities communicate between each other. Most of the communication is actually carried by **Shipping Owners**, **Shipping Agencies** and **Freight Forwarders.** This information is related to:

- Name, size, vessel registration, and capacity of vessel,
- Cargo departure notifications, type and quantity of reloaded goods
- Agents, ship and port ship-owners
- Orders for loading, unloading, delivery orders, notifications of arrival
- ETA – estimated time of arrival
- Berth info.

There are still several pieces of information that port authorities would like to have in the future, as being communicated from other ports, especially from where ships are leaving from:

- Cargo related information: quantity, type, when loading / discharging of the vessel finished
- Information about the actual vessel
- General cargo information
- ETA – estimated time of arrival

This is an interoperability project, aggregating data from multiple entities, RPA could be used for electronic data exchange to different authorities (port authority, Police, Customs), also linked to the River Information System that is already in place in different ports.. Also data may be persisted into a blockchain platform, i.e. Blockchain as a Service, that will ensure immutability of data, integrity, backup, reconstruction and auditability.

9.3 Digital systems used on existing processes

As mentioned in the previously run study: **"Integrating Danube Region into Smart & Sustainable Multi-modal & Intermodal Transport Chains, D.T2.4.1 Inventory on port digitalization capabilities in the Danube Region"**, many of the tasks related to port operations are not digitalized and provided in an outdated way (emails, spreadsheets, phone calls). Moreover, a communication platform among port stakeholders and private / public entities involved in port operation is missing in most of DR ports.

Different entities involved in the survey are using digital systems that differ a lot, and we have noticed a correlation between system used and the type of ownership.

- Software: ERP's, Invoicing System, e-invoicing system, NEPTUN system, MOVER VTMIS, SIIP
- RPA linking 2 applications (e.g. Web portal and Invoicing system), scan system
- Web applications: portals, internet browser, cloud solutions
- Microsoft Office: Outlook, Word, Excel
- Adobe (PDF)

On the other hand, there are several instances mentioned, where handwriting is still being used (in processes la berth allocation, custom related documents, etc.)

During the interviews we had with the different participating entities in the study, emerged the conclusion that port operations are on a low level of digitalization and often there is no Port Community Systems in place. We have re-confirmed that the level of digitalization is not at the same level in all ports, we have found several ports actively improving their digitalization platform or using robotic automation in their processes.

The outcome of the support study leads to the conclusion that the objectives of the RFD were not (or only partially) attained. The objective of the RFD is to simplify and harmonise the administrative procedures applied to maritime transport, and it sets an obligation for Member States to establish NSW for reporting formalities from ships arriving in and/or departing from ports. The information should be submitted electronically and only once thus removing the need of submitting same or similar information separately to different authorities. We have seen that:

- Paper reporting is still used to a certain extent in more than 50% of ports, often as duplication;
- Reporting is fully digitalized and harmonized only in a few EU countries;

- True single window submits only once reporting is available only in a few EU countries;
- The information is seldom shared and re-used, notably between EU countries.

Furthermore, not enough progress has been made on the EU level harmonisation - all NSWs implemented are different. Therefore, the positive impact of National Single Windows is small, sometimes even negative for the shipping industry.

There are three ports (reflected in the "D.T 2.4.1 Inventory on port digitalization capabilities in the Danube Region" study) that are using at this stage a PCS system: Nikopol, Linz and Izmail. On top, there are other ports that have ERP systems implemented (less than 30%), and also some RPA solutions for different processes (mentioned in the "Process mapping of port activities" section)

A proposed port-community-network infrastructure (PCS) should have a "Minimum digital infrastructure functionalities" [4] with following functionalities:

- Management dashboard
- Integration with MSW (Maritime Single Window), customs IT system, Navigable Canals Administration IT system, with other transport applications.
- Car access control in the port
- Berth management, Cargo traffic management in the port area
- Management of operators / agents in the port area and the services offered by them
- Cargo Reporting, Environmental System, Dredging Monitoring System, Tracking and tracing, Storage space management
- Management of the movement of ships in port and cargo traffic
- Security infrastructure and IT incident management (helpdesk & support), User management, Data layer
- Hardware infrastructure

As already mentioned in the current report part of these processes would be improved if a RPA solution would be implemented (Car access control in the port, Berth management, Cargo traffic management in the port area, Cargo Reporting, Environmental System, Dredging Monitoring System, Tracking and tracing, Storage space management, Management of the movement of ships in port and cargo traffic).

Considering the fact that Digitalization is affecting many sectors and industries (e.g. transport and logistics), the use of digital technologies is essential to streamline business processes between shippers and logistics actors. Several modes of transport have adopted different kinds of intelligent transport systems and are investigating the possibility of using (semi-) autonomous vehicles. Rapid technological developments have reduced the implementation barriers for such approaches. Digitalization will always raise the issue of data security and data privacy. This fact, may sometimes, implies high costs to maintain quality and security of data. This is why integrated solutions that will bring together automation, through RPA, and security, through blockchain technologies, will always ease and optimize processes and costs of a port operations. Public authorities responded to this trend by providing the necessary regulatory frameworks and through specific digitalization initiatives.

From previous studies, there are three areas where digitalization is critically important for inland water transport (see below). Within our study we have also identified these areas show an optimisation potential through implementation of Robotic Process Automation:

- Improving navigation and traffic management: this is important in order to allow more effective use of infrastructure resources and to reduce the cost of fuel for operators of vessels;
- Integration with other modes of transport, in particular in multimodal hubs: this is important in order to optimize terminal processes and to allow better integration of IWT in supply chains and multimodal logistics operations, potentially attracting additional customers;
- Administrative workload reduction: reducing the number of business-to-government statements (thus saving costs and improving efficiency) and making law enforcement more effective and efficient.

To be an efficient intermodal node, a port needs to have adequate land available in the port, relevant terminal infrastructure, suprastructure, facilities and equipment, all supported by digitalized systems or software, also including Robotic Process Automation.

10 RPA solutions proposed to be implemented

10.1 Description of a Robotic Process Automation

Operations are unique/contextual to any port, therefore, an off-the-shelf solution will not fit to all parties. Still, for the identified processes, a Robotic Process Automation can be implemented, but in some cases this will require several levels of apps integration in order to automate workflows and process data. In general, with the right integration, an RPA solution will have the following benefits:

- Reduce costs associated with wasted time on ineffective business processes.
- Boost innovation at scale by empowering ops-people to automate business processes.
- Interact with clients more effectively

RPA improves operations efficiency by automating tasks, eliminating repetitive, boring tasks & ultimately increase customer satisfaction through effective processes. Ultimately, is a tool for operating teams to faster and better cover the needed outcomes related to process automation, data availability.

Automation use cases identified during the survey and interviews with different stakeholders:

- **Increased productivit**y: RPA solution help technical and business people to get things done faster, replacing repetitive tasks with visual actions that only need simple configuration. Ports are using multiple systems to operate day to day business, but the tools they use are not natively integrated, so people are manually moving data from one place to the another.
- **Flexibility:** with an RPA solution you can design and build your process, depending on the port needs, implement your own “Custom Action” and add it to the platform.
- **Data deduplication** - when there is a high volume of data operated by multiple persons and there is no clear way of identifying duplicate data or the data comes from unstructured sources (e.g. online forms, surveys, etc.).
- **Ports could generate documents fast** (based on a template) with varied formats – as a result of their port operations, ports generate large volumes of documents (e.g. contracts, offers, invoices, emails, memorandums, term-sheets, classic reports, etc.)

- **Traffic predictions** – ports would benefit from predicting client's changes or seasonality, use multiples systems related to their clients' activity to produce better statistics and plan ahead.
- **In logistics and supply chain** management ports can sync requests and receipts, coordinate inventory levels, automate ordering process and collect and check data from different applications, web, email to assess performance
- **Marketing and customer support** – automation can be used even as a basic/advanced chatbot during interactions with external systems & clients (databases, 3rd party systems, social media) or any internal sources (chat tool, Customer Relationship Management software, emails) facilitating client data sync and information centralization.

The following cost estimations are made considering the current market conditions and taking into account a generic description of the top processes identified through the survey. Considering the differences between ports processes, their existing IT infrastructure and different technical solutions for an RPA implementation, the cost estimations are approximate and given in intervals.

- Costs are taking into account execution time for the RPA solution per month. Then multiplies the monthly fee to an annual cost. Selecting multiple RPA services/ automations, will bring the price down.
- Implementation costs for each "use case" is taking into account the man hours typically needed for a similar automation, but they can be lower (or higher) depending on the customization each port needs.
- In addition to the RPA execution hours, depending on the process, there will be a need for adjacent services to implement automation (not knowing if all services expose API or SQL access to the database, it is also considered an Optical Character Recognition (OCR), Intelligent Character Recognition (ICR) or Integrated Data Processing (IDP) modules).
- Maintenance is not included in the cost estimations. In case of a change in the port system architecture, all the necessary changes in the automation will be charged separately.
- A typical implementation road map will include
    a) A Discovery Workshops (Key stakeholders' alignment, expert discussion)

b) Process and context audit
c) Business analysis
d) Implementation and automation of processes, systems and services integration
e) QA
f) Change Requests
g) Sign Off

1. **Invoicing process – cost estimation**

- RPA monthly Execution time: 8-12 hours
- Cost/hour: 150-200 EUR
- Estimated monthly cost: 1.200 – 2.400 EUR/month
- Estimated annual cost: **14.400 – 28.800** EUR/year
- Implementation man hours: ~ 120 hours
- Implementation cost: 10.000 – 12.000 EUR

2. **Berth allocation process – cost estimation**

- RPA monthly Execution time: 3-5 hours
- Cost/hour: 150-200 EUR
- Estimated monthly cost: 400-1.000 EUR/month
- Estimated annual cost: **5.400 – 12.000** EUR/year
- Implementation man hours: ~120 hours
- Implementation cost: 10.000 – 12.000 EUR

3. **Cargo tracking (Loading/Unloading/Transshipment) process – cost estimation:**

- RPA monthly Execution time: 4-6 hours
- Cost/hour: 150-200 EUR
- Estimated monthly cost: 600 - 1 2.00 EUR/month
- Estimated annual cost: **7.200 – 14.400** EUR/year
- Implementation man hours: 250-300 hours
- Implementation cost: 25.000 – 30.000 EUR

4. **Notice to enter/exit a port – cost estimation**

- RPA monthly Execution time for Maritime port: 2 hours
- RPA monthly Execution time for a Fluvial port: 2 hours
- Cost/hour: 150-200 EUR
- Estimated monthly cost: 300-400 EUR/month or 600 - 800 EUR/month for a port with maritime and fluvial access
- Estimated annual cost: **3.600 – 4.800 EUR**/year or **7.200 – 9.600** EUR/year for a port with maritime and fluvial access
- Implementation man hours: ~120 hours
- Implementation cost: 10.000 – 12.000 EUR

5. **Issuing port access documents / permits to access premises (process description done for Port of Constanta) – cost estimation**

- RPA monthly Execution time: 25-35 hours
- Cost/hour: 150-200 EUR
- Estimated monthly cost: **3.750 – 7.000** EUR/month
- Estimated annual cost: 45.000 – 84.000
- Implementation man hours: 250 - 300 hours
- Implementation cost: 25.000 – 30.000 EUR

10.2 Description of a Robotic Process Automation on premises through a licensing model

If there are certain constraints that require installation on port premisis, then licensing is adapted to a subscription model on CPU-Core.

Considerations:

- Hardware requirements are rough estimates based on our current production environment and tools system requirements. In order to leverage a accurate list of system requirements we will need to perform a benchmark on all of our components to test the performance under load on different setups.

- Required instances may increase as of time of writing this survey backend refactoring is in planning and we may add other dependencies such as a file based database.

Figure 10. 1 RPA on premises automation

If there are certain constraints that require installation on premises, then licensing is adapted to a subscription model where implementation starts from 100.000 Eur.

10.3 People, processes, technology integration and change management

Change involves replacing one situation with another, which always causes feelings of discomfort or fear. From these feelings, there is resistance to change, resistance that is manifested by a stagnation of a shorter or longer duration, depending on several factors:

- Narrow self-interest. People expect a significant loss, as a result of the change, they fear that they will lose the position they won, that they will lose prestige and competence, that they will work harder.
- Misunderstanding occurs when the change is insufficiently publicized, its implications are not understood.

Any RPA implementation should include a change management component, including the 3 business pillars: people, processes, and technology. Processes will change, due to implementing a new technology and on top people need to be on boarded into this change initiative.

The implementation owners should consider the following factors for a possible resistance to change:

- Different assessment of the situation, generated by differences in perception of the situation or lack of information
- Intolerance of change, which is generated by a lack of confidence in one's own ability to acquire new skills and competencies.
- Intolerance of other points of view contrary to one's own vision, as a manifestation of the experience gained, of intolerant behavior or of the cultural environment of dictatorial essence

- Distrust in the initiators of change, in their ability to grasp the real situation and to propose effective measures for change

10.3.1 How will processes adapt

There will be a process redesign phase, before implementing any RPA solution

A typical implementation includes a business and process analysis followed by a process adjustment to integrate the new automations. Analyzing existing port processes (whether or not you intend to automate them) you begin to recognize redundancies, inefficiencies, areas of risk, and more. Business and process analysis is core to improving how your business operates while automating repetitive tasks allows your employees to contribute in more meaningful, value-added ways.

An example of an “As Is” process, detailing departments involved and all the steps currently performed & all the waste (approval loops, multiple validations & checks, manual reporting and document handling):

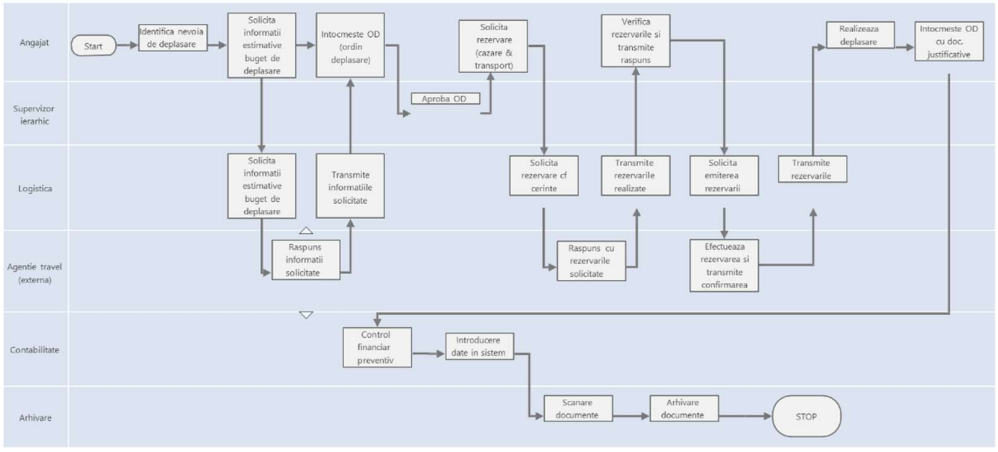


Figure 10. 2 “As Is” Process description example

“Start from the Voice of the Customer” is a key concept in adapting processes to new technologies and automations. Begin by considering the output of the process and how it needs to respond to customer requirements, what it needs to be.

Once defining and documenting the requirements that must be delivered is done, we can begin drawing the new design, by mapping out the “TO BE” process. The goal is to maximize the use of automation and minimize the movement between steps, wait times, and overall waste in the process.

Activities before and after the actual automation will also need to adapt, on one hand the inputs in the new automated process will need to be standard (digital,

machine readable) and on the other hand the output will be in a standardized format (an email, electronic document or other digital message).

In a "To Be" / redesigned process, that includes an RPA implementation, several process steps identified as waste are removed, while some activities/tasks will be taken over by the automation. Below example of a "To Be" process involves less departments, fewer steps that the initial activity and uses colors to indicate the activities done by people (white), RPA (yellow) or external parties (grey):

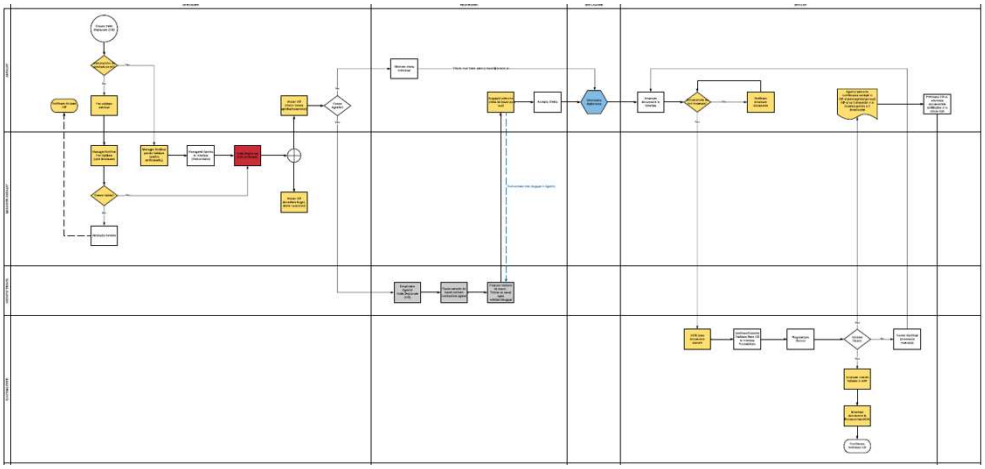


Figure 10. 3 Example of a "To Be" / Redesigned Process

The cost of implementation may vary from one port to the other, depending on the existing digital solutions that are being used. We recommend linking this to the other achieved Deliverables: the **Inventory on Port Digitalization Capabilities** in the Danube Region and the **Study on Port Pricing Systems**, it will be extremely useful for the further development of Inland Waterway Transport activities to leverage the information provided in there.

A challenge that is to be thoroughly considered, based on the detailed analysis that was done is the fact that in some cases multiple integrations between systems are required. These are hard to maintain, debug and even harder to scale or change.

10.3.2 New skills required for people

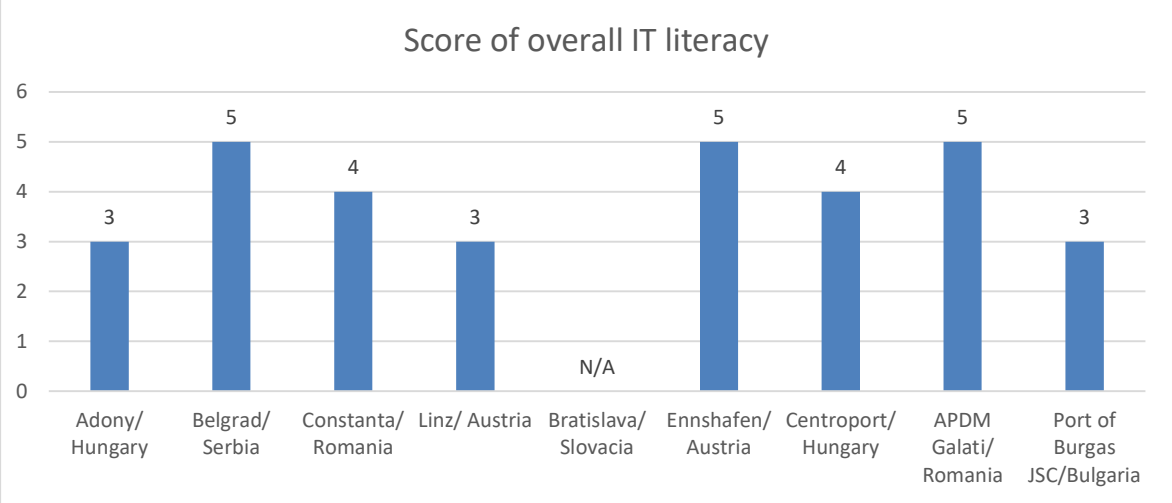
Overcoming Resistance to Change

"Until now, the IT was supposed to help me. Now, it seems to want to replace me". People are definitely afraid of any kind of "robots". They were afraid when physical robots were implemented and they are afraid also now.

Persuading sceptics and reducing fear is ultimately about telling a compelling and honest story, it's about change management. The steps in doing that are:

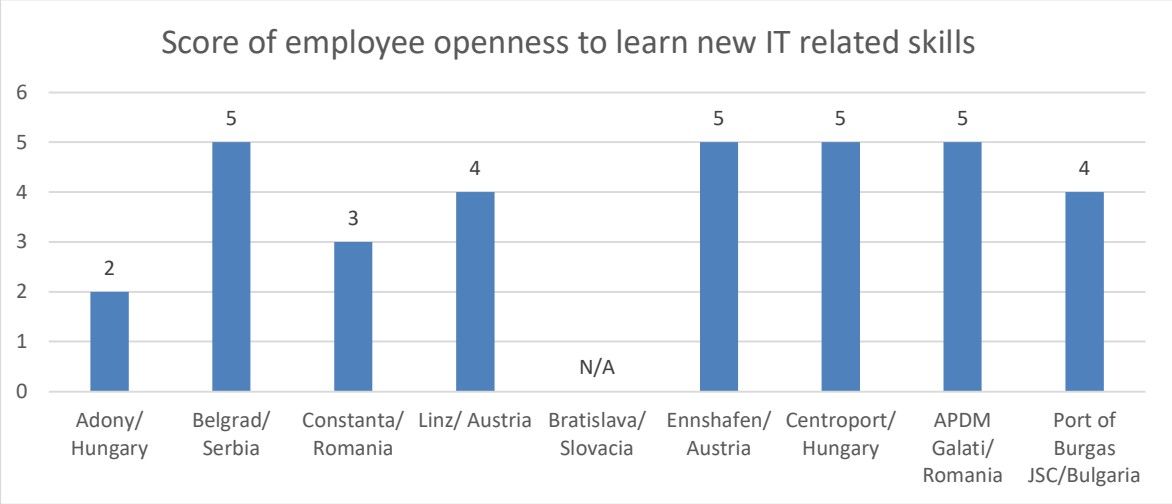
- Pick a winning automation proof of concept (POC) that is not too difficult yet aligns with a larger digital transformation initiative and will show business value.
- Actively engage the workforce with education and training to mitigate the fear of uncertainty of job loss and marginalization.
- Develop the POC with the very employees that will be impacted and ultimately benefit.

Figure 10. 4 IT literacy



IT literacy has improved over time, and the results that were collected in this survey, show that there is actually an above average level of IT literacy of the people involved in port processes. Therefore, the conclusion is that there is a good platform of knowledge to move towards digitalization.

Figure 10. 5 Employee Openness to learn new IT related skills



Considering the answers collected here, there are clear differences in terms of possible acceptance of an RPA implementation. Therefore, we recommend a development plan for the operators involved in processes that show RPA implementation potential for specific digital abilities.

At the European union level, there has already been developed a Digital competence map, that can be used in the people development plan, proposed above.

Table 10. 1 EU Digital Competence Map

	Basic User	Independent user	Proficient user
Information processing	I can look for information online using a search engine. I know not all online information is reliable. I can save or store files or content (e.g. text, pictures, music, videos, web pages) and retrieve them once saved or stored.	I can use different search engines to find information. I use some filters when searching (e.g. searching only images, videos, maps). I compare different sources to assess the reliability of the information I find. I classify the information in a methodical way using files and folders to locate these easier. I do backups of information or files I have stored.	I can use advanced search strategies (e.g. using search operators) to find reliable information on the internet. I can use web feeds (like RSS) to be updated with content I am interested in. I can assess the validity and credibility of information using a range of criteria. I am aware of new advances in information search, storage and retrieval. I can save information found on the internet in different formats. I can use cloud information storage services.
Communication	I can communicate with others using mobile phone, Voice over IP (e.g. Skype) e-mail or chat – using basic features (e.g. voice messaging, SMS, send and receive e-mails, text exchange). I can share files and content using simple tools. I know I can use digital technologies to interact with services (as governments, banks, hospitals). I am aware of social networking sites and online collaboration tools. I am aware that when using digital tools, certain communication rules apply (e.g. when commenting, sharing personal information).	I can use advanced features of several communication tools (e.g. using Voice over IP and sharing files). I can use collaboration tools and contribute to e.g. shared documents/files someone else has created. I can use some features of online services (e.g. public services, e-banking, online shopping). I pass on or share knowledge with others online (e.g. through social networking tools or in online communities). I am aware of and use the rules of online communication ("netiquette").	I actively use a wide range of communication tools (e-mail, chat, SMS, instant messaging, blogs, micro-blogs, social networks) for online communication. I can create and manage content with collaboration tools (e.g. electronic calendars, project management systems, online proofing, online spreadsheets). I actively participate in online spaces and use several online services (e.g. public services, e-banking, online shopping). I can use advanced features of communication tools (e.g. video conferencing, data sharing, application sharing).

Content creation	I can produce simple digital content (e.g. text, tables, images, audio files) in at least one format using digital tools. I can make basic editing to content produced by others. I know that content can be covered by copyright. I can apply and modify simple functions and settings of software and applications that I use (e.g. change default settings).	I can produce complex digital content in different formats (e.g. text, tables, images, audio files). I can use tools/editors for creating web page or blog using templates (e.g. WordPress). I can apply basic formatting (e.g. insert footnotes, charts, tables) to the content I or others have produced. I know how to reference and reuse content covered by copyright. I know the basics of one programming language.	I can produce or modify complex, multimedia content in different formats, using a variety of digital platforms, tools and environments. I can create a website using a programming language. I can use advanced formatting functions of different tools (e.g. mail merge, merging documents of different formats, using advanced formulas, macros). I know how to apply licenses and copyrights. I can use several programming languages. I know how to design, create and modify databases with a computer tool.
Safety	I can take basic steps to protect my devices (e.g. using anti-viruses and passwords). I know that not all online information is reliable. I am aware that my credentials (username and password) can be stolen. I know I should not reveal private information online. I know that using digital technology too extensively can affect my health. I take basic measures to save energy.	I have installed security programmers on the device(s) that I use to access the Internet (e.g. antivirus, firewall). I run these programmers on a regular basis and I update them regularly. I use different passwords to access equipment, devices and digital services and I modify them on a periodic basis. I can identify the websites or e-mail messages which might be used to scam. I can identify a phishing e-mail. I can shape my online digital identity and keep track of my digital footprint. I understand the health risks associated with the use of digital technology (e.g. ergonomic, risk of addiction). I understand the positive and negative impact of technology on the environment.	I frequently check the security configuration and systems of my devices and/or of the applications I use. I know how to react if my computer is infected by a virus. I can configure or modify the firewall and security settings of my digital devices. I know how to encrypt e-mails or files. I can apply filters to spam e-mails. To avoid health problems (physical and psychological), I make reasonable use of information and communication technology. I have an informed stance on the impact of digital technologies on everyday life, online consumption, and the environment.
Problem solving	I can find support and assistance when a technical problem occurs or when using a new device, program or application. I know how to solve some routine problems (e.g. close program, re-start computer, re-install/update program, check internet connection). I know that digital tools can help me in solving problems. I am also aware that they have their limitations. When confronted with a technological or non-technological problem, I can use the digital tools I know to solve it. I am aware that I need to update my digital skills regularly.	I can solve most of the more frequent problems that arise when using digital technologies. I can use digital technologies to solve (non-technical) problems. I can select a digital tool that suits my needs and assess its effectiveness. I can solve technological problems by exploring the settings and options of programmers or tools. I regularly update my digital skills. I am aware of my limits and try to fill my gaps.	I can solve almost all problems that arise when using digital technology. I can choose the right tool, device, application, software or service to solve (non-technical) problems. I am aware of new technological developments. I understand how new tools work. I frequently update my digital skills.

11 Conclusions

The study run has reached its objective in understanding how a more sustainable communication between and inside the Danube Inland & Sea Ports workflows could be improved by Robotic Process Automation (RPA).

Collecting data through different channels (questionnaire, interviews, process visits, desk research, etc.) the study has identified more than 2 solutions (as required) for an RPA solution implementation.

20 distinct processes were nominated, having a potential for RPA implementation. These processes were analyzed in depth and 5 have been proposed for being optimized with a RPA solution: Invoicing Process, Berth allocation process, Merchandise tracking (Loading/ Unloading/ Transshipment), Notice to enter/exit a port and Issuing port access documents / permits to access premises, the last one being specific to Port of Constanta and APDM Galati.

There are also other processes that, from the input type, the existing rules and the steps that are being made, would make sense to have an RPA implemented, but at this moment, due to the reduced volumes involved, they do not become economical candidates for such an implementation (e.g. Licensing process, Order handling, Process of making offers).

All processes identified have impact in the overall Dionysus objectives: Improve multimodalism, Enhance Supply Chain, Follow the requirements of EMSWe. From the data gather, the highest impact is on the Supply Chain objective. Multimodalism, still being applicable only in very few situations, as ports do not have the proper infrastructure yet.

For processes between port the survey shows that there is little of no communication between ports run at the port authority level.

We do recommend here the implementation of an RPA solution that could link systems like: River Information System, local standardized software or portals. RPA could be used for electronic data exchange to different authorities (port authority, Police, Customs etc.). This would be done in order to facilitate preparation of incoming ships from the destination port, with a direct impact in the supply chain objective and also to reduce processing information several times from the ship owners and other entities involved.

The RPA impact is essential in taking a decision of whether to implement it, or not. The RPA will not redesign processes by itself, but it will increase productivity, accuracy, consistency, reliability, it will ensure compliance, and increase customer satisfaction.

As identified in the study, the major pitfall for implementing a RPA for processes inside the port is the type of input that processes have. In case the document is not standardized, there is an obvious requirement to have a structured content in a standard document. If the input is not digital, a scanning and character recognition software could be implemented, at extra costs and still the risk of having items which are not recognized is high. The recommendation is to eliminate any handwritten document, and if paper is still required, at least to be a print-out of a document filled in digitally.

Considering the possible change that an RPA solution will bring people are to be considered in the implementation plan. Although IT literacy has improved over time, this representing a good platform of knowledge to move towards digitalization, some of them will be afraid of implementing a robot on their desktop. The same happed also, when we introduced physical robots in the industrial area.

Therefore, we recommend a development plan for the operators involved in processes that show RPA implementation potential for specific digital abilities and also a thorough Change Management plan, where transparency, trust, communication are key objectives.

Figure 11. 1 Knowledge allocation among organizations

80% of knowledge/ know-how usually sits with employees

Source: IBM Analysis based on Industry Reports/Market Research

12 Annexes

12.1 Annex 1: Technical Description of a Robotic Process Automation cloud solution

An RPA Solution may have different requirements depending on the existing IT infrastructure, but also on the process inputs and outputs. An Application Programming Interface (API) platform, interacting directly with backend systems can ensure communication and information exchange with each other. This will be able to:

- easily build connectors that integrate applications
- integrate fast (real-time connectivity and response)
- add custom code to create custom elements (actions, credentials)
- easily build processes in a simplified development environment, having an intuitive drag-and drop canvas

Core features of the RPA cloud solution:

1. **Process Designer** is the core piece of the solution proposed where all elements are put together to build powerful integration processes. It consists of:
    - Canvas where you drag & drop actions from the Toolbar to create a process
    - Toolbar is the collection of actions you need to create a process. You can use:
        a. Platform actions - a collection of predefined actions created by the RPA "as a service" solution
        b. Custom actions - a place for you and your team to expand the actions list, by creating actions that meet your specific needs.

2. **Credentials** connect to other platforms, servers, applications in a no-code way by using dedicated actions (e.g. Call API action, Send email). For requests that require authorization, it is necessary to add the relevant credentials to Credential Manager.
   Use the Credentials Manager to configure the authentication credentials of the REST API, email server or FTP you want to access. Once created, you can reuse that configuration in actions such as Call API without reconfiguring the authorization steps every time.

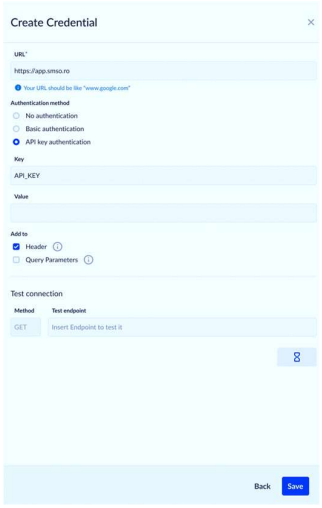


Figure 12. 1 Create Credentials

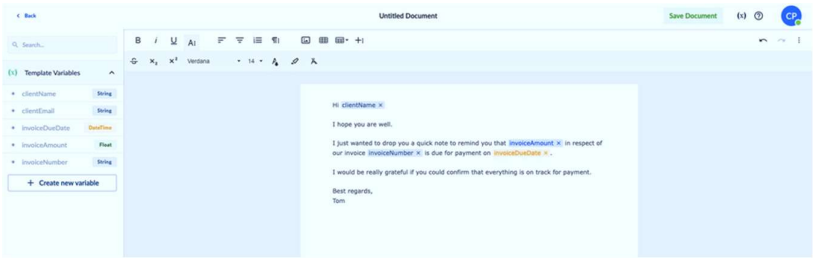
- Custom credentials - you can define a custom credential type in a standard format using a JSON-like definition, if you need a different credential type in your work.
- Platform credentials:
  a. REST API - configure the authentication credentials of the REST API web services to which you want to connect in a codeless way
  b. Email server - Most email accounts have two servers: one that lets you send emails to other people, and another that lets you receive the emails that other people send you.
  c. FTP allows you to authenticate and work with FTP server for file management purposes.

3. **Data Models** create custom data types that meet your port/activity needs. It helps you define the relationships between the data elements (attributes) you have, to give it a structure. Data models can be created manually, defining attributes one by one. Or you can opt for automatically generating a data model structure starting from a file, saving valuable time for you and your teams.
4. **Process Variables** acts as a placeholder for data that can be accessed throughout the lifecycle of a process. When the process is running, it passes dynamic data between actions. It is how data is transferred between actions in a process. Data types can be any primitive or a data model.
5. **Custom Code:**

- Custom actions - if you can't find everything you need to design your process, you can create your own custom action that you can reuse in any process.
  Custom actions are actions entirely defined by the user. When you cannot run an application function by using standard actions, you can create a Custom Action tailored to your needs.
- Custom credentials - you can define a custom credential type in a standard format using a JSON-like definition, if you need a different credential type in your work.

6. **Document Designer** gives you more options and flexibility throughout the entire automated process. With Documents Designer you can create document templates and automate and simplify the process of filling in data using variables. The real strength lies in its ability to complete data templates on demand. Stop copying and pasting data into a word processor manually, saving your sales reps time and making sure your document is 100% accurate by eliminating human error. When data changes, a single click is required to produce a fresh, updated document.

Figure 12. 2 Document Designer example



7. **Integrations:**

- Call API actions: enables you to perform REST/HTTP requests to a specified web API to query data from apps and services. You can retrieve, add, delete and update data.
- Webhooks: are one of a few ways web applications can communicate with each other. It allows you to send real-time data from one application to the RPA solution whenever a given event occurs.
  You can use webhooks to receive data from external apps and services when an event occurs. Also, webhooks can be used as triggers for process flows when we want to receive data and use it to kick off a process based on the data received. This allows several different

services to connect to the RPA "as a service" solution and run a process when data is received.

- API Key: you can generate and use an API key to access the RPA API from other apps and services, to perform a wide range of authenticated operations. You can run a process, add, update, delete processes & access process related resources directly through the API.

12.2 Annex 2: Technical description of a Robotic Process Automation on premises through a licensing model

For an implementaion on premises through a licensing model, the following topics are to be considered.

- Once you obtain the hardware you may install the dependencies on their respective machines, it is recommended that these technologies to be installed on bare-metal and configured using unix daemon capabilities(systems).
- By the end of dependency installation you should have multiple services up and running which you should modify the configuration of Automation to access these resources. Automation should be delivered as artifacts and make use of systemd and crontab.
- Setting backups: each of the persistence should have automatic backups set, which should depend on crontab.
- Database initialization :upon service starts all of the automation components should try create its database schema, and apply all migrations necessary.

Table 12. 1 Database initialization example

Name	Description	Type
Keycloak	Main authentication provider	auth-provider
Nexus	Used for saving CA/PA	package-registry
MySQL	Main persistence layer	database
Postgres	Keycloak dependency	database
Redis	automation dependency	broker

- Hardware Requirements: All of the numbers in this section are a rough estimate based on our current production environment and on system requirements provided by each of the software provider. A possible

Automation can go up to 7 microservices which most of them would be recommended to be ran on their own instance so that we can easily monitor, troubleshoot and fix problems without interfering with the entire system.
Though to be cost-efficient we've splitted the execution of automation into 2 instances:

a) Automation Components (WebAPI, Scheduler, Authentication-Proxy, Notification-System, Frontend)
b) Automation Execution (Action-Orchestration, Action-Execution)

The dependencies of automation require to be isolated on their own instance due to various reasons, thus considering current dependencies there will be required 5 aditional instances alongside automation ones

Table 12. 2 Table of Hardware requirements example

Instance	Cores	Mem	Disk	OS
MySQL Database Instance	4 vCPU	16gb	100gb	ubuntu:20.04LTS
Redis Instance	4 vCPU	2gb	10gb	ubuntu:20.04LTS
Keycloak Instance	2vCPU	4gb	10gb	ubuntu:20.04LTS
Postgres	2vCPU	4gb	10gb	ubuntu:20.04LTS
Nexus Instance	4vCPU	4gb	100gb	ubuntu:20.04LTS
Automation Components	4vCPU	16gb	10gb	ubuntu:20.04LTS
Automation Execution	8vCPU	16gb	100gb	ubuntu:20.04LTS

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