ASSESSMENT OF THE SMART TRAFFIC MANAGEMENT SYSTEM

for the Budapest Freeport

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Partner name

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A PROJEKT AZ INTERREG CENTRAL EUROPE PROGRAMBÓL, AZ EURÓPAI REGIONÁLIS FEJLESZTÉSI ALAP TÁMOGATÁSÁVAL, AZ EURÓPAI UNIÓ ÉS MAGYAR ÁLLAM TÁRSFINANSZÍROZÁSÁVAL VALÓSUL MEG.

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EXECUTIVE SUMMARY

Freeport of Budapest Logistics Ltd. (FBL) is managing the site of Budapest DOCK Logistics and Industrial Park.

The site has many facilities, such as railroads, quays, bays, warehouses, container depos, etc. At peak season, over 5000 vehicles enter the port area through the three road gates. Over 70 tenants of the spaces are all dependent on the efficient management of the road traffic arriving to the port.

This case was chosen to be one of the pilot actions in the Corcap project because we understand that there is no solution for an automated traffic management system on the market for such type and size intermodal logistics centres.

FBL introduced the concept of an automated access control and traffic management system that had to be built on the existing infrastructure, and to take operation and navigation on site to the next level of technology. This pilot action considered the fact that after development and implementation, the transferability of the system is a key priority and the goal of the project is to eliminate the issues that development, implementation, and operation may cause when the system is transferred to other stakeholders. Considering these, the pilot action was successfully delivered.

To specify business requirements, key tenants were involved in the project from the very beginning to understand their needs and to learn the systems they use.

Based on the business specification, a detailed technical specification was accepted to kick off the development and supply of a smart automated access control and traffic management system. Although the development and implementation of this project were delayed compared to what was planned, the pilot action proceeded according to the schedule of the Application Form.

The system to automate and control access and to manage traffic efficiently required digitalization and development of a mobile navigation application, an info point with kiosk, smart screens with license plate recognizing cameras, Wi-Fi data communication, cloud service, a database, statistics, and an administration platform.

The required outputs of a scalable, basic system that can automate, digitalize, communicate, learn, and be integrated part of other systems are all delivered in this project.

Transferable know-how and a product to be developed are the results of this pilot action.

Such a result could be an important pioneer approach for the digitalization of terminals, and we hope that our experiences with this pilot project will enable other logistics centres in the CE region to implement efficient IT solutions in the future.

The delivered system of this pilot action is developable and fully scalable. The core functions (mobile navigation, license plate recognition, system communication) that were developed are easily adaptable and readily transferable to any site. Even partial dissemination is possible.

Thanks to the numerous workshops and lectures, companies with similar or different profiles are already interested in the transferability of this system, but FBL will promote the implemented system at further workshops, discussions, and other events whenever possible, and will continue to do so in the future.

INTRODUCTION

The European Federation of Inland Ports (EFIP) defined the challenges facing the inland ports. The meaning of digitalization is not always well understood, and the level of digitalization differs from one port to another. An important challenge is to find the right balance between on one hand finding tailor-made solutions for digitalization in inland ports and on the other hand securing harmonized and standardized Intelligent Transport Systems in ports.

At Freeport of Budapest Logistics Ltd. (FBL), there was an urgent need to modernize the access control and traffic management system, establishing a reliable vehicle identification, access control, routing, and port information system.

It was often the case that non-target foreign drivers who stopped at the port in an irregular manner and asked for information about their destination from anyone they met. Road vehicles had to be supported by automatization and digitalization.

While complex and boxed, already existing products would have been expensive and due to special infrastructural needs of the site, the development of a state-of-the-art, innovative traffic management IT system was necessary to help vehicles to reach targets and to reduce congestions at gates and tenants from time to time.

The required automated access control and traffic management system (smart system) that was developed is based on automated license plate recognition and navigation application, supported by a kiosk and smart screens to manage the flow of road vehicles efficiently on site.

This pilot action was the implementation and test environment of such development on the site of FBL.

The smart system of FBL and the integrated tools developed recorded the lessons learnt from the implemented processes, the experiences at the gates, and their impact on the life of FBL during the Pilot Action.

The effect of the system is evaluated against what was planned. Lessons learnt during implementation, and the success factors for deliverability are identified.

Experiences are shared with other target groups and international partners.

This pilot project required locations and site digitalization, the development of a navigation application for the site of FBL and a database and its management system with artificial intelligence. Navigation is supported with specially designed and built smart screens and an info point with a kiosk implemented. During the pilot action, efficient solutions were found to help visitors to navigate on the site of FBL.

Wi-Fi technology was set up for data communication between systems (FBL's internal system and the smart system) and for accessing the navigation application. Continuous discussions with tenants took place to evaluate interaction capabilities of the smart system with different systems on site.

This pilot action allows other multimodal logistics centres or similar size/complexity sites to adopt and apply a well-developed and documented solution.

1. IMPLEMENTATION PROCESS OF THE PILOT PROJECT

After action planning, this pilot project was kicked off and implementation started to take place by specifying the exact business needs of FBL with the help of an external expert company. It was commissioned to specify the logical and physical design of the smart traffic management system that shall fulfil the requirements of the Corcap project and will deliver the most added values as a result of the pilot action.

Based on the accepted business specification, a detailed technical specification was made by the chosen software development company. After accepting the suggested technical details of the developable system, this technical specification was signed by FBL, and the development of the software and supplying the required hardware could have started.

The technical details of the software determined the requirements of the hardware and backwards as well. The “available” technology also had an impact on the chosen platforms for software development. Once the hardware specification and the list of hardware were complete, the supplier was sourced.

The key part of software development is the application of it into hardware. Once the supplier was chosen and hardware started to become available, the supplier was introduced to the developers and installation, implementation and testing could take place off on-site of FBL.

Once both hardware and software were implemented on-site, the developed system could be tested and fine-tuned to be able to work in the live environment and to meet the requirements of the technical infrastructure of FBL.

When the smart system was up and running as expected, promotion of the navigation application, and the function of the system to interact with tenants took place and it became possible to start collecting live use cases.

During this project implementation period, the project manager held regular meetings with the subcontractors. The manager made short presentations about the project status and discussed project problems and questions during these meetings.

Structured email and personal interviews were organised with tenants to understand their daily operation and to identify connection /development points. Specific features of the smart system had to be based on the requirements of the tenants and on the system they use. The design of the smart system based on tenants’ experience was key.

Besides, they specified needs and function requirements, they helped with testing and evaluation by providing feedbacks on the use of the smart system.

The external expert company was keeping an eye on the progress of development and implementation of the project. It helped to transfer business requirements to the development by consulting with the expert team during the project. It was also commissioned to write the evaluation report as a closing of this pilot action.

1.1. Business requirements and specification

The business specification summarized the requirements, needs, and the plan of the smart system (automatic access and traffic control system) for road vehicles at FBL.

To specify exact business needs, besides continuous discussions with stakeholders, on-site consultations, field visits, infrastructure surveys, and interviews with tenants took place several times.

Field visits to the site of FBL were held for the external expert company to help to understand the needs and challenges of FBL. Gates, site, junctions, and traffic were observed, the operation of the corridor and the access control camera installation was demonstrated. All points of entry were showed and bottlenecks of all the different gates were discussed. Main traffic flows and directions were demonstrated. Methodology of warehouse coding was introduced together with the plans of ongoing and future developments on site.

Bottlenecks and opportunities of the site of FBL were discovered during site visits. Solutions for the challenges were discussed. Requirements of the automated access control and traffic management system were understood.

The map data to be digitized (location, area, roads, building positions) were surveyed. Pictures were taken and visualization was made to support the system development of the pilot action.

There are three gates in operation on the territory of FBL currently. An automatic access control system was already implemented here, which had to be brought into line with what is now being planned.

The smart system was planned for an estimated average traffic of 5000 vehicles daily in peak season.

Barriers and cameras were already installed at the gates. Pictures were taken of the vehicles automatically during entry and the images were saved. The system of FBL has a license plate recognition feature, but its operation is unstable sometimes. The recognized license plate number is saved when the recognition was successful. The barriers automatically open after a pre-set waiting time with the support of sensors built in the road. There was no control of access in place, nor real use of the saved license plate number information earlier.

Traffic management of vehicles was not solved after they got access to the site. Due to lack of capacity and space, the creation of a buffer area was necessary for the purpose of the pilot action.

Based on these requirements and needs, offline and online artificial intelligence sensors, cameras, cloud-based solutions, and mobile applications were specified to help developing an automated control system that enables efficient movement within the site of FBL with the aim of proper vehicle management by tenants and FBL when needed, so that it can provide a solution to bottlenecks and to become a greener, faster and more efficient service provider.

1.2. Detailed technical specification

The business needs and requirements designated the available technologies that could provide solutions for the required system.

The technical infrastructure of the access control system was introduced to the developers by the supplier of FBL who supplied and developed the current corridor and access control/license plate recognizing camera system.

FBL set up an automatic access control mechanism at all gates. Upon the arrival of a vehicle, the camera records the image of the license plate and recognizing the license plate number. When recognition is successful, image and data are stored digitally. Sensors open the barriers automatically after a specified short time.

Technical specifications were discussed between the parties (supplier of FBL and developer), and development opportunities were introduced. Database access opportunities for developers were discovered. The server/hardware environment of the cameras' data management system was shown.

The pilot action had to build on this already existing technical infrastructure and the IT system behind it.

Functions of the system had to be modelled and development platforms determined.

Flow diagrams of the processes of functions had to be drawn and IT infrastructure planned.

Digitalisation opportunities of site information were checked, and geolocation was set.

The design and functioning of the system were planned and the FBL accepted the documentation for these detailed technical specifications for development.

1.3. Software development

Once the concept and development needs were finalised based on the business specification, the aim was to develop a software that provides a solution for traffic management by being capable of providing information that can be sent to the tenant via the admission system. The smart system had to have the function for tenants to be able to confirm the right of the vehicle to enter.

Current provider of systems and the IT of FBL agreed on the details of the requirements of the software development. Due to the smart system's server demand that FBL did not own, a cloud-based design of the system was decided. Data communication could only be implemented with the help of Wi-Fi technology using antennas for transmission between the units of the smart system and the network of FBL.

After the framework of the development and cooperation with FBL was arranged, the development of the software took place and it used scrum methods. Works were done in sprints. A sprint took only a couple of weeks. In the sprint, the developer team made daily stand-ups. During the stand-ups, the team members explained their tasks and problems to each other.

The development team helped to evaluate this pilot. It provided documentation and consultation with all the reports that FBL required, and it provides support and maintenance of the smart system in use.

1.4. Purchasing hardware

The supply of hardware for the project required an agile approach, that enabled finding the best solution that matched the system requirements and was either available on stock or it was possible to develop/build for the best price on time.

Neither the kiosk of the info point nor the smart screens were available off the shelf.

1. Figure: Tailor-made kiosk of the smart system (info point)

Source: FBL

To find a supplier who could manufacture the kiosk and screens with the functions and parameters that the system required made the supply process more difficult.

2. Figure: Tailor-made screen of the smart system equipped with license plate recognizing camera and Wi-Fi antenna

Source: FBL

Also, the software elements of the hardware had to be compatible with the developed software, or the devices are prepared for the installation of the software of the smart system. This required extra effort and resources from both the hardware supplier and from the software developers.

1.5. Implementation and installation

When the manufacturing process of the hardware finished, the supplier could start installing those on-site of FBL. This required extra work as well. Electricity, Wi-Fi communication, concrete base for the screens had to be established before installation could take place.

3. Figure: Supplier primer work in order to be able to install hardware on-site of FBL

Source: FBL

First, the position of the hardware had to be agreed with FBL, then permissions had to be obtained for digging up some part of the site for electric cables to be laid. Wi-Fi antennas had to be installed to towers and set up for communication from hardware to hardware and system to system (developed – FBL).

After all of the hardware was on site, installation of the developed software could take place on-site of FBL.

This required several attempts due to the lack of in-depth knowledge of the system of FBL and compatibility and reliability (electricity failures, camera) issues occurred.

4. Figure: Installation and implementation on-site of FBL

Source: FBL

1.6. Testing

Due to COVID-19 restrictions, the integration of the developed system to the existing infrastructure of FBL took more time and effort then expecting. Therefore, the User Acceptance Test (UAT) of the system got delayed a few weeks.

Set up and installation of the system were done live by testing the operation with cars on site. Testing was done iteratively with continuous feedback from FBL, followed by a one-month fine-tuning between September and November 2020, before the system got tested and was up and running the assessment could began in the Freeport.

5. Figure: Testing the navigation support started at the kiosk

Source: FBL

FBL’s on-site infrastructure provided some challenges after the implemented system gone live, but it has been fine-tuned and the smart traffic management system started functioning properly on-site.

1.7. Evaluation and assessment

The assessment of the smart system of FBL took 6 months.

User experiences were collected, efficiency was monitored, and transferability was evaluated because of this assessment.

The scope was to develop and provide a smart system for FBL until the doors of the tenants and it was well established with this pilot project. An evaluation Excel has also been prepared for this, which evaluates the implementation and the result obtained.

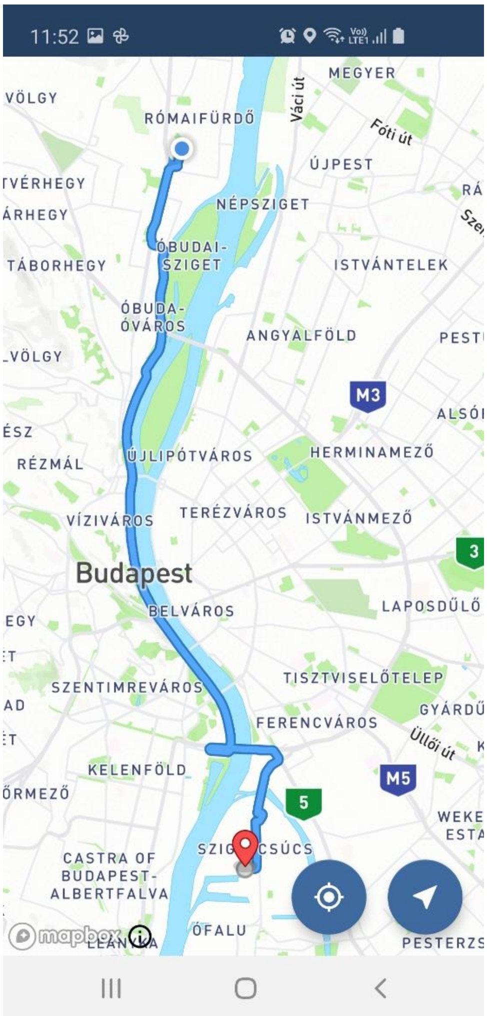
2. Assessment of the smart system

2.1. Effects

The pilot project triggered the digitalization of locations, positions of buildings, gates, roads on-site FBL. While the major map data providers like Google were not possible to influence to have updated digitalized map data of the site, an alternative way had to be found.

The navigation application (DOCK App) of the smart system was developed based on the solution of a 3rd party map provider (Mapbox). Their solution use opensource map data (OpenStreetMap) that was possible to edit and update with roads, building, gates, traffic rules. Also, the digitalized positions of the tenants were possible to add to this solution as a list/database.

This way, anyone who needs direction towards a tenant of FBL, can plan its route ahead and will be directed to the address with the help of the mobile application.



6. Figure: Planned route to a tenant of FBL on OpenStreetMap with the solution of Mapbox, using DOCK App

Source: FBL

The data that one enters the application via a mobile device will be added to the smart system. Upon arrival at the gates, once the licence plate recognition is successful by the cameras and the software that are used at the gates, the smart system checks the database of FBL and when input data matches with database data, the arrival of the vehicle can be signalled to the tenant where the vehicle navigates to.

The automated access system that FBL had already complete the developed system, but that was only capturing data (licence plate number images) and converted it into licence plate information via recognition. It provides the ability to work with port entry information and to automate access to the site.

This feature allowed FBL to reduce congestions and long queues at the gates, also human labour became unnecessary at the gates which resulted in savings on wages. (There were at least three people at the three gates all the time earlier. As an estimate, it cost 4,500 EUR/month/3 receptionist for FBL. However, the monthly fee of the cloud-based service from Microsoft Azure is around 40 EUR/month for the current use + operation fee of the mobile application account that is 99 USD/year for iOS, and it cost 25 USD for Android only once.)

The ability to notify tenants about arrivals of vehicles to gates is a breakthrough, although it is only set up for one key tenant (MASPED Logistics Ltd.) during the pilot period.

When the smart system finds matches in the database, the license plate number is sent to the tenant that was entered as a destination for that input and recognised licence plate number.

Tenants can have access to an online administration platform where the notification messages pop up. It provides the licence plate number and options to the action. The tenant can either call in the vehicle straight away, put action on hold, or send the vehicle to buffer till ramps free up for loading.

If the vehicle is sent to buffer, a message and replanned route to the buffer parking is sent to the device the driver uses for mobile navigation. The tenant can call in the vehicle from buffer via the online administration platform and it will send a message to the device of the navigation together with the route planned to tenant from buffer.

The time of loading and unloading can be recorded by the tenant with the help of the administration platform. Once the recording is done, the data can be saved into the database of the system.

These were requested as important functions when requirements were collected. The tests and pilot proofed it functional, however, there are few bottlenecks when applying it during live operation.

There is no list /prebooking of arrival vehicles from the tenants that the database could check continuously. Only those license plate numbers can be notified to the tenants that are entered into the mobile navigation. Till critical mass start using the navigation application, it is not worth it for tenants to have resources checking the administration platform for one or two vehicles a day.

The key tenant in this pilot specified an exact need that could work with their operation, but the development need of such a system to add to this system was out of the scope of the pilot project.

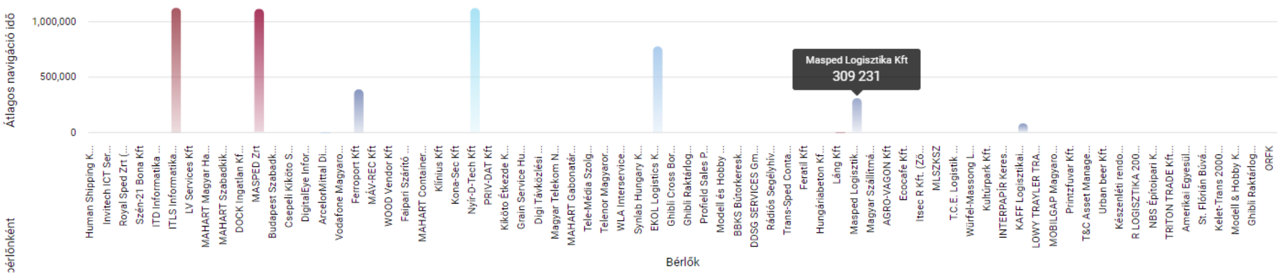
The basics are done and there is interest and need for such further development when further possibilities occur in this or other projects.

Such interaction between drivers and tenants would solve queues at ramps and avoid jams on site. There are so many opportunities to fulfil the different needs of each tenants yet present a global solution for traffic management to tenants and avoid problems on site.

Once the system is connected to tenants and they are able to check incoming information promptly, the function of adding vehicles to the blacklist will work as required. After FBL liquidated the human element at the gates and set up automated access, the control had to be automated as well. The system was developed for such need. This way, those who would enter a certain tenant, but do not show up or that tenant would not want that vehicle, could blacklist that licence plate number. Also, FBL can add vehicles to the list if something suspicious is observed, noticed or something bad is reported by the security team.

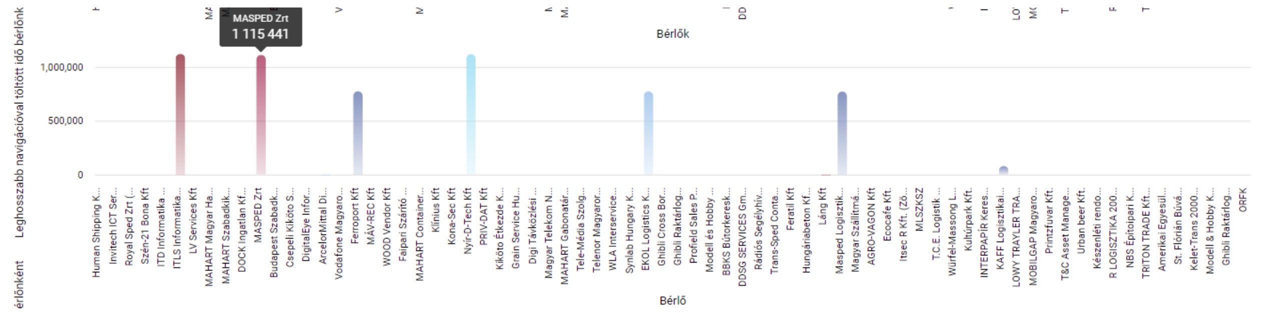
If a vehicle is on the blacklist and recognised at the gates by the cameras, the system can send an alert to security, plus the navigation application would replan the route for that vehicle to the next exit gate. This way control could be added to the access system.

Based on the logs the system saves, FBL can have different data, information, and statistics according to demand. However, average, shortest, and longest navigation time was specified as must-have indicators.



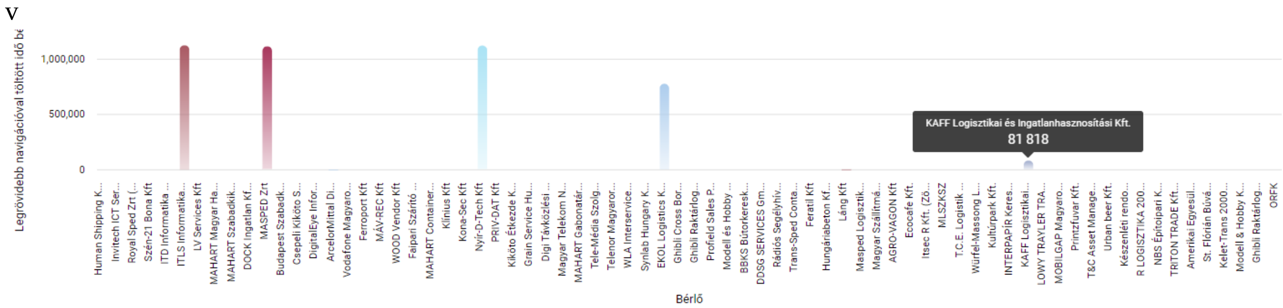
7. Figure: Graph of the average navigation time per tenants

Source: Administration platform of the smart system of FBL



8. Figure: Graph of the longest navigation time per tenants

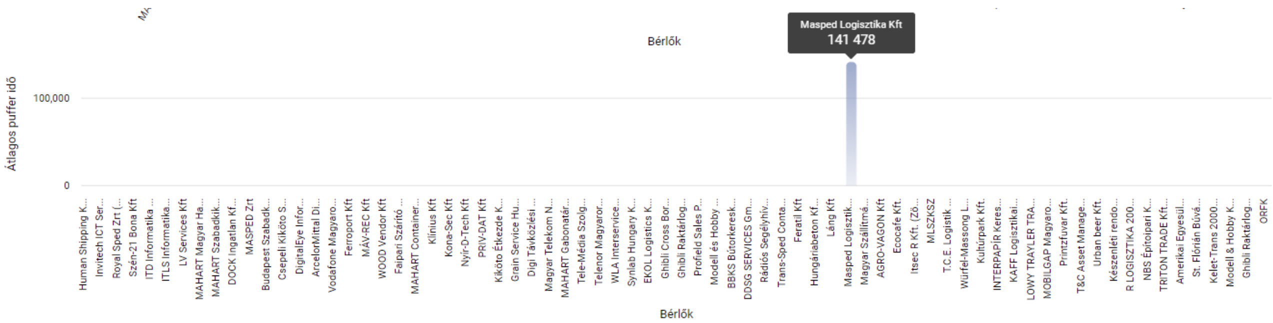
Source: Administration platform of the smart system of FBL



9. Figure: Graph of the shortest navigation time per tenants

Source: Administration platform of the smart system of FBL

There is also a graph for average buffer time per tenant, but this only works for the key tenant (MASPED) during the pilot project.



10. Figure: Average buffer time per tenant

Source: Administration platform of the smart system of FBL

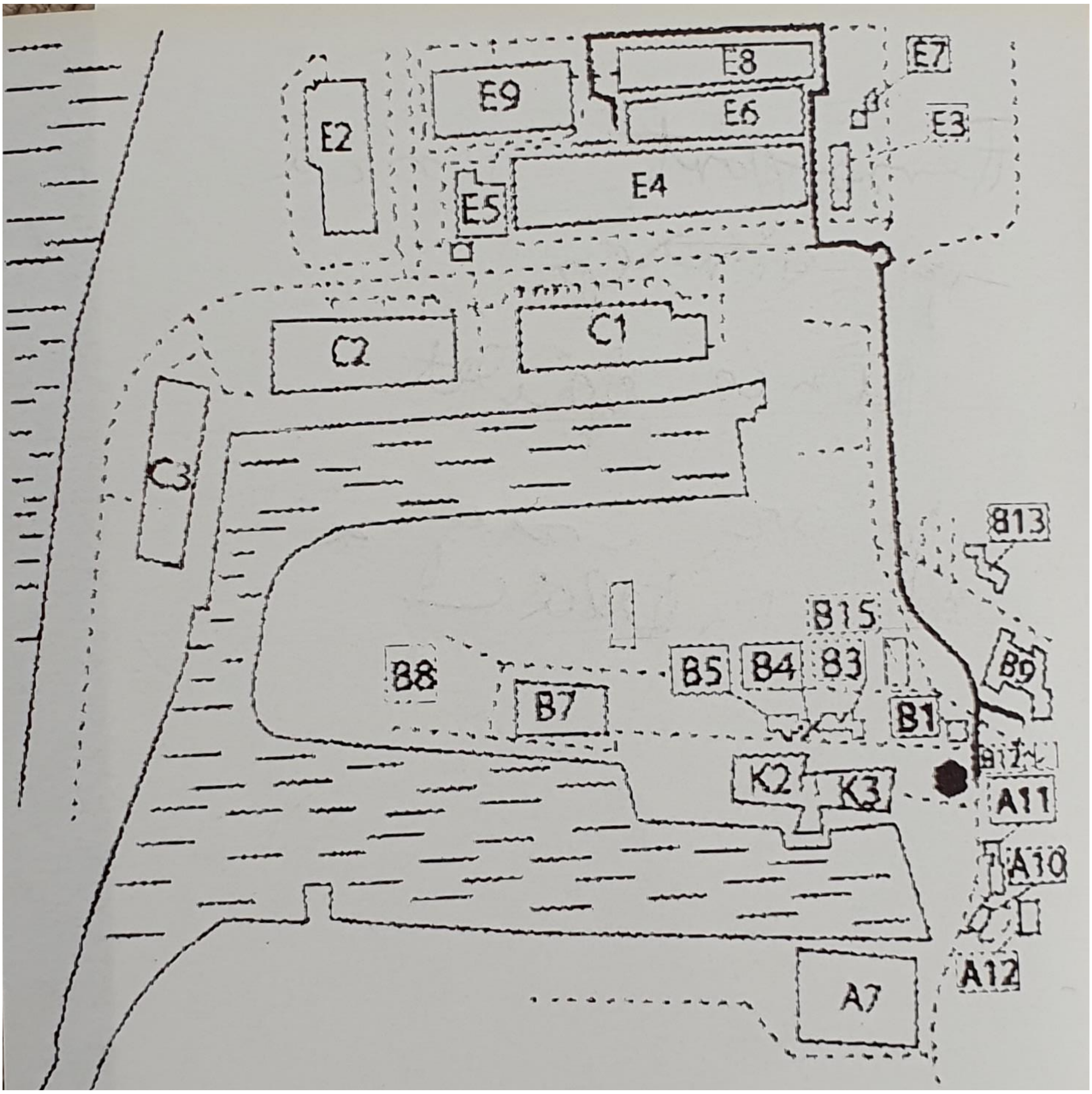
The number of mobile navigations to tenants are all recorded and when the route is planned to a tenant with the help of the kiosk at the info point as well, the statistics function of the administration platform will visualise those data for FBL. These graphs of the statistics are dynamically changing. Those only show the tenants that had a route planned to.

11. Figure: Visualisation of the number of kiosk and mobile navigations to tenants

Source: Administration platform of the smart system of FBL

The special message function is also there to support FBL with an extra communication platform when needed. It is possible to display messages on the implemented smart screens on-site. The administration platform provides access to the messaging function. FBL can type in notices, messages up to 2000 characters, and display this text till required. The messages will be shown where the screens normally display the license plate numbers.

The info point has multiple functions and complements the mobile navigation application. The kiosk of the info point is set up to be used in multiple languages and any translation of the screens can be uploaded to provide service for different nationality drivers. The inputs are the same as for the mobile navigation, but the kiosk can print a map with the route on it, and navigation from the kiosk to the required tenant is supported with direction signals on the smart screens.



12. Figure: Printed a map from the kiosk with the route to the desired tenants' building code on it

Source: FBL

Three smart screens got implemented on-site of FBL and all help with directions at junctions. Those were set up to pilot such function and start supporting navigation from the info point along the main road of the site, positioned to the largest junctions. The first screen gets input from the kiosk directly and displays the licence plate number that the driver entered at the kiosk. Based on the location of the tenant and the route from the kiosk, the first screen directs the diver left or right (north or south).

13. Figure: Demonstration of signalling directions on a smart screen

Source: FBL

The second screen is installed with a license plate recognizer camera and when that recognises the license plate number and finds a match in the database of the system, the route to the tenant that the kiosk provided is supported with direction arrows. The license plate number is also displayed on the screen. This way when more kiosk navigation is started after each other, the vehicle that is arriving at the screen will know which direction support belongs to it. The third screen works the same, but that is situated in front of a roundabout and the displayed information is circular graphics with the number of exits to use.

The info point also provides free internet to download the mobile application when that is rather preferred. It uses Wi-Fi technology. The driver can just connect to the Wi-Fi and the application will be downloaded onto the mobile device that was connected.

Navigation to tenants got simpler and different functions would be available both for FBL and the tenants when funding will be available (the scope can be expanded).

2.2. Lessons learned

At action planning, the pilot projects got wide time windows for the completion of the tasks, and this project filled in the available time.

Although the development and implementation of the smart system for the site of FBL were delayed compared to what was planned, the pilot action proceeded according to the schedule of AF.

COVID-19 created few challenges during the development, implementation, and testing phase of the project, but major delays occurred at the sourcing of the hardware.

After the business specification was delivered in 2019, sourcing the software developers and specifying the technical details were done according to the original schedule, but finding the supplier of the required hardware and technology took more time than estimated. Delivering the smart system (HW and SW) was rescheduled and it had been implemented by mid-August 2020.

The integration of the smart system to the existing infrastructure of FBL took more time and effort and therefore the User Acceptance Test (UAT) of the system got delayed a few weeks as well.

By the time the system got tested and it was up and ready to run smoothly, the pilot period had to be rescheduled. The real assessment of the smart system of FBL, could not start till November 2020.

We had limited opportunities to collect real user experiences and measure efficiency other than all the challenges we had to come across and solve during the implementation and testing period.

When business specification started, there were technologies and references of hardware at hand. The concept of the required system that would have delivered the solution to this project was based on that available hardware and technology information. When the detailed technical specification took place, the software developers had to rethink the technology and respecify the hardware as well, due to access challenges to available solutions. This was challenged further when tailor-made hardware solutions were chosen during supplier selection.

A lot of extra SW development hours had to go into the hardware implementation phase due to the specific requirements that the project needed. The hardware was not set up for the software as it was required and there were some competency issues as well by the supplier.

Data communication of the devices could only be managed via Wi-Fi, therefore the setting of antennas and infrastructure also needed extra resources. The subcontractors had to be connected to deal with each other to help to deliver the solution more efficiently.

There were several environment studies/field visits, IT infrastructure observations during the specification period, but somehow the endowments of the site did not come across till the very end when the system just could not operate for several reasons. The site is very busy and continuously developed, therefore cutting electric wires and shortage of power/blackouts is a daily issue. The hardware and software had to come across the effects of this challenge at the end of the project when extra resources for uninterruptible power supply for instance were not available.

The IT infrastructure was observed by specialists but only when the detailed technical specification was presented to be accepted by FBL, we noticed that the required server infrastructure will not be available on site. This triggered the cloud-based solution and using Microsoft's Azure platform during the pilot period. However, the system had to be ready to move to the server on-site when FBL is able to set up and operate the required environment after the pilot project.

These challenges could have been avoided when IT is thoroughly involved in the project from the very beginning. Such development became an integral part of the existing system of FBL, and it was not planned into, only planned based on it. The level of consultation or involvement of people in charge from the side of FBL was not sufficient throughout the project.

Set up and installation of the smart system were done live by testing the operation with cars on site. Testing was done iteratively with continuous feedback from FBL, followed by several months of fine-tuning.

During SW development, MASPED Logistics Ltd. was consulted for function solution development. The planned way of involvement of MASPED Logistics Ltd. was system integration; specification and development for their workflow and system that MASPED uses for they logistics services. However, the scope of the project did not make it possible to extra develop for they need and the function that actually got developed is not sufficient enough for them to evaluate the access control management and communication of the systems in their daily operation. Therefore, basic testing and feedbacks were received from them. It assures that the core function of communication between systems is developed and that it can provide a platform for further development and integration into different operation management systems.

Real-life scenarios were different at the beginning of the project than by the evaluation of the project. When requirements were collected, FBL highlighted that many drivers are lost, and it is an issue that they have difficulties to finding tenants. Especially, that foreign drivers cannot stop and just ask anyone on site.

Once the navigation application got released and the pilot project could have benefitted from a critical mass of downloads and users, the feedbacks of tenants and drivers showed that most of the drivers know their way around and it will be hard or rather it will take a longer time to get a large amount of people to use the application for navigation and have data from it.

The concept is proved, and the demand is valid. The smart system that got developed in this pilot action can work according to expectations. There is no such solution on the market and when it is further developed, it can provide a complex solution for similar size logistics centres in Central Europe or easter from it.

2.3. Success factors

Port locations got digitalized, and the navigation application is working well and considered as an indicator of the successful development of the pilot.

Visitors can be easily informed about the route to their destination, and statistics generated based on the usage of navigation application and the info point can help to reduce the congestion in the Freeport.

When navigation is supported by the kiosk, smart screens, and mobile application, the site can be more productive due to automated/digitalized access control solutions, less congestions or lost visitors and no traffic jams at the gates and tenants during peaks.

The efficiency of the system can be compared to the previous period when human labour was involved to control access to the site of FBL.

The knowledge gained is continuously shared at various events where this pilot action is promoted. As a result of active communication and knowledge transfer, some are already interested in such solutions and intend to implement and use the system in similar locations.

The FBL will promote the implemented system at workshops, discussions, and other events whenever possible, and will continue to do so in the future.

3. TRANSFERABILITY

This smart system is developable and fully scalable. The core functions (mobile navigation, licence plate recognition, system communication) that were developed for the pilot project are easily adaptable and readily transferable to any site. Even partial dissemination is possible.

Direct discussions, field visits, on-site demonstrations are planned to share the experiences with interested logistics sites like the Saxon Inland Ports Upper Elbe and Ústecký kraj.

The Hungarian Federation of Danube Ports (HFIP) and Association of Hungarian Logistic Service Centres (MLSZKSZ) are involved in the marketing and demonstration of the developed solution for its members.

Also, the European Federation of Inland Ports (EFIP) can be involved to promote this developed system of FBL for its member ports.

Due to COVID-19 restrictions, field visits are not recommended. However, communication and marketing activities are already in progress. There were workshops and leaflets, brochures are produced and will be handed out on events both in English and Hungarian language, in parallel with which online marketing activities take place. There are in-depth discussions online as well with potential stakeholders.

Limitations of adaptation:

- The system can be used only by “closed” logistics centres that are not situated on public roads and access to the site has to be controlled.
- The system shall be implemented as a boxed solution for those sites that have no current system in place. Any existing system, automated process for the management of the flow of traffic may limit the effectiveness of this system.
- The soul of the developed system is the license plate recognition at the access gates. If this is not yet available on the new location or its operation is vastly different from that used by the developed system, it may be more difficult/time-consuming to adapt the new system to the existing one.
- The complexity of the site may require a different approach than the navigation application used in the pilot project to digitize the position of the map/data.
- If cameras and screens need to support orientation on-site, the transport, procurement, and installation of these can be very expensive.
- If overly complex statistics are required, further improvements are needed.
- When all tenants should test, implement, and use the new system before launching it, a longer trial period and UAT (user acceptance test) may be required for general acceptance.

Besides other similar intermodal logistics sites and those tenants, freight forwarders/road vehicles can also benefit from this system and lessons learned when a similar system is needed to be installed.

The developed transferable smart system is targeted to Czech -Saxon intermodal sites of the consortium, but also to any intermodal logistics site that needs a similar solution or identifying similar challenges as FBL.

Currently, the owner of a Hungarian, newly developed site and the Port of Baja along the Danube are discussing the possibilities of implementation /transferability.

All river ports in the CE region that are connected to road transportation may be interested to learn about the outcome and product that this Pilot Action delivered.

The table below shows the stakeholder matrix.

Level of influence and power	**Keep satisfied**	**Key players**
+	1. Czech - Saxon intermodal sites 2. Port of Baja 3. Organizations already interested 4. Tenants of FBL	1. MASPED Logistics Ltd. 2. MCC Ltd. 3. Ekol Logistics 4. Láng Ltd. 5. Arcelor Mittal 6. Ghibli Ltd.
	Monitoring	**Keep informed**
-	1. Similar logistic centres 2. All river ports in the CE region	1. Ministry for Innovation and Technology 2. MLSZKSZ 3. EFIP 4. HFIP
	-	+

Level of interest and commitment

1. Table Stakeholder matrix

Source: Own editing

It consists of the following four groups:

- **"Keep satisfied"** means those who may be considered as potential target groups and who may have already expressed their intention to transfer the pilot to their environment.

- “**Key players**” means those who were already involved from the beginning of the pilot implementation. They helped a lot by business requirement specification and system development.
- “**Monitoring**” means those who monitor the implementation and subsequent operation and may be late adapters. We can reach them through various promotional events.
- “**Keep informed**” means those who should be kept informed of the pilot's progress, as they can greatly help to promote and disseminate it.

Those who would adapt the smart system should check the following before transferring the system:

- how many tenants, gates they have;
- volume of traffic;
- size and complexity of the logistics centre;
- security risks;
- guarding and protection costs, etc.

4. ANNEXES

Outputs of the pilot action.pdf