Extended Gate Concept for Maritime Automobile Terminals

Extended Gate koncept za pomorske automobilske terminale

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Summary

The article is focused on the role of a maritime automobile terminal in finished vehicle logistics (FVL). Different drivers that force the management of a maritime automobile terminal to find new solutions in accommodating the increased flows of vehicles are described. The analysis of the maritime automobile terminal at Koper indicates the need to further expand the storage area and its delivery zone to support regular clients from the automotive industry. The main research goal of the paper is to elaborate and describe the model where an external storage platform under port's operation might be used. On this basis the analysis of current inbound and outbound flows is elaborated. The model of Extended Gate Concept (EGC) for a maritime automobile terminal is presented as an option to serve increased outgoing flows of finished vehicles. With proper infrastructure development, established inland connections and secured information flow the presented EGC model can be adopted at the observed maritime automobile terminal. Nevertheless, obstacles hindering EGC implementation play a crucial role in the model implantation, thus the final consent should be given by the relevant stakeholders in FVL.

KEY WORDS

finished vehicle logistics
maritime automobile terminal
Extended Gate Concept
port of Koper

Sažetak

U radu se govori o ulozi pomorskog automobilskog terminala u logistici gotovih vozila (FVL). Opisani su različiti pokretači zbog kojih menadžment pomorskog automobilskog terminala mora tražiti nova rješenja za smještaj sve većeg protoka vozila. Analiza pomorskog automobilskog terminala u Kopru pokazuje da postoji potreba za daljnjim proširivanjem prostora za skladištenje i zone za isporuku kako bi se mogle podmiriti potrebe redovitih klijenata iz automobilske industrije. Glavni istraživački cilj ovoga rada je sastaviti i opisati model po kojem bi se moglo koristiti vanjskom platformom za skladištenje pod lučkom upravom. Tako je napravljena je analiza sadašnjih priljeva i odljeva vozila. Predstavljen je model Extended Gate koncept (EGC) za pomorski automobilski terminal kao jedna od opcija za upravljanje povećanim odljevom gotovih vozila. S pravilnim razvojem infrastrukture, uspostavljenim kopnenim vezama i osiguranim protokom informacija, predstavljeni EGC model može biti prihvaćen na predmetnom pomorskom automobilskom terminalu. Ipak, prepreke koje ometaju primjenu EGC modela igraju bitnu ulogu u njegovoj primjeni, zbog toga bi konačno odobrenje trebali dati relevantni dionici u logistici gotovih vozila.

KLJUČNE RIJEČI

logistika gotovih vozila
pomorski automobilski terminal
Extended Gate Concept
luka Kopar

INTRODUCTION / *Uvod*

In the last decades, the finished vehicle logistics (FVL) made important development steps in chain synchronisation to minimize stocks of finished vehicles, supply chain time and related costs respectively. A maritime automobile terminal has taken an important role in supply chain, because the production strategy is more global than ever. European car makers establish production plants in Asia and South America, whereas some non-European car makers have recently established production plants in Europe. Among them South Korean KIA and Hyundai are the leading brands.

Accordingly, a maritime automobile terminal represents an important link between land based production point and overseas market, where land and maritime transport has to be combined through a single transport chain. According to Mendonça and Dias [1] maritime automobile terminals serve also as significant buffer systems and provide economies of scope through different services related to general vehicle inspection, pre-delivery inspections (PDI), postponement customization and in some cases also vehicle dissembling services. Due to increased inbound and outbound volume of finished vehicles maritime automobile terminals are forced to find new measures to increase the system's static and dynamic capacities and utilisation.

The extended gate concept (EGC) is a modular concept mostly used in the container industry. Veenstra et al. [2] point out the difference between EGC and dry ports, where dry ports are not completely involved in a fluent logistics chain. The concept of dry ports role in sea-hinterland connection for container logistics are analysed by van Klink [3] and Roso et al. [4]. Fleming and Hayuth [5] further classify transport nodal points between intercontinental transport flows and continental axes. Those involved in intercontinental supply chains are organised in a fairly complex way and provide a range of additional services.

EGC can be a modular solution in industry vertical integration, where the nodal points might be operated by port operators or logistics providers or directly by car makers. EGC could be organised as a satellite platform for a maritime automobile terminal, where storage space, gate entry points and rail infrastructure could be better organised, in order to guarantee reliability and high productivity levels.

The actual situation and future potential development of automobile terminal at Koper was analysed to define trends and future limitations. Most probably infrastructural problems will set limits to the terminal's development in the future, especially due to further increase of other traffic through the port of Koper and problems with the delivery-zone development. Consequently, the analysis of potential external storage platform presents an overview on potential alternative solution in accommodating increased outbound flows of vehicles. Based on acknowledgments, the model of EGC is proposed which might be widely used along the finished vehicle supply chain.

THEORETICAL BASIS AND RESEARCH TARGET FOR EGC IN FVL / *Teorijska osnova i cilj istraživanja EGC u FVL*

BASIS FOR EGC MODEL / *Osnova za EGC model*

FVL process is not a complex process as in other supply chains. Basically, the vehicle represents the main transport unit, transported by deep-sea vessels or RO-RO feeder vessels and during the land transportation by trucks with specialised chassis and specialised series of rail wagons. At the same time a vehicle is mainly self-transported during the manipulation process, therefore no special manipulation equipment is requested in maritime or hinterland automobile terminals [6, 7].

Albeit quite simple at first sight, the logistics process of FVL is very complex and requires strategic coordination activities [8]. Van der Horst and de Langen [9] expose real-time coordination problems, horizontal miss-coordination and lack of information exchange, as well as opposite expectations from different groups of stakeholders. Although terminals merely play a time limited role in the FVL, Roson and Soriani [10] see terminals as sources to propose important changes in the entire supply chain.

Namely, vehicles arriving by sea are usually unloaded in the quay area (first point of rest). This poses space restrictions at the berth subsystem. Later a vehicle is shunted to the storage area, waiting for further services related to a vehicle's maintenance or loading on trucks or wagons for the inland dispatch up to hinterland point. The entire process from a vehicle's arrival in the system till departure is restricted by the corresponding time frame [11].

As a result of time limitations and vehicles' turnaround time the maritime automobile terminal faces space problems. The terminal is usually organised in three subsystems such as berth subsystem, storage subsystem and deliver-zone subsystem. All subsystems require adequate space allocations to absorb certain volume of inbound or outbound flow of vehicles. The main pressure is usually put on delivery zone subsystem and on storage subsystem. The first must accommodate the incoming flow of vehicles by rail or road, planned for further dispatch by vessels. At the same time this subsystem has to organize loadings and dispatch of vehicles arriving by sea. Consequently, the delivery zone has to manage static and dynamic capacities of subsystem where number of truck gates or the number of rail ramps plays an important role in managing the dynamic capacity of the system. On the other hand, the storage subsystem faces more pressure on the static capacity, where the storage area (open or close) has to accommodate the certain number of vehicles in the requested time frames.

EGC is an option for maritime automobile terminals, where a certain terminal runs close to the limited static and dynamic capacities. The EGC can absorb additional volume of incoming flow of vehicles from the hinterland and serves as a temporary buffer. Accordingly, the entire incoming and outgoing process can be regulated as to achieve full infrastructure and manpower utilisation. The same is highlighted by Veenstra et al. [2] who indicate the importance of synchronisation of terminal activities across the entire FVL, where EGC can play an important and strategic role.

RESEARCH OBJECTIVE / *Cilj istraživanja*

Although the role of a maritime automobile terminal in the FVL is evident, only a few research studies on integration of a terminal and productivity analysis have been conducted so far. Authors are mainly focused on FVL concept and only a few research papers analyse the role and possible optimization solutions for automobile and RO-RO terminals. In recent years the management of dry ports, as an extended arm for port terminals, is exposed as the subject of research, where the concept of extended gate is presented as an alternative solution for systems which face space restrictions and would like to manage allocation buffer for a more efficient port or maritime terminal performance (Table 1).

The research is focused on drivers that force the automobile terminal management to further extend the terminal area and define the potential solutions and options when a port

Table 1 Directions and strategies of automobile terminal development listed by authors

Tablica 1. Pravci i strategije razvoja automobilskog terminala; sastavili autori

Author	Directions and strategies
Hall (2004) [12]	Analyses specialisation of seaports for automobile business and exposes managing solutions for inbound flows
Fischer & Gehring (2005) [13]	Define planning approach for vehicle transhipment in a maritime automobile terminal using multi-agent systems
Mattefeld (2006) [14]	Analyses the management decisions for terminal operations in finished vehicle supply chain and underlines solutions for higher productivity in managing terminal area
Böse & Windt (2007) [15]	Analyse and define autonomously controlled storage allocation on an automobile terminal to facilitate storage operations
Roso et al. (2009) [4]	Further develop and analyse dry-port concept as a port's satellite in accommodating the increased volume of inbound and outbound cargo in containers
Zhang et al. (2009) [16]	Analyse storage optimization possibilities at a maritime automobile terminal and develop an intelligent decision for vehicle storage
Klug (2010) [17]	Exposes logistics implications of global production networks in car manufacturing and proposes new models for synchronisation in FVL
Venstra et al. (2012) [2]	Elaborate implementation and adoption of an EGC network in a port's hinterland platform for container industry and suggest avenues for solutions
Witte et al. (2014) [18]	Present a multi-dimensional approach for inland terminal challenges in European transport corridors on the basis of EGC

faces space restrictions. The key objective is, therefore, to find solutions to implement EGC in managing FVL through a maritime automobile terminal.

The maritime terminal at Koper port that is ranked as the 11th automobile terminal for handling light vehicles in Europe [19] is used as a case terminal for modelling and analysing EGC. Namely, the terminal meets with the significant increase of outbound flow of vehicles produced in Europe. Therefore, it is close to reaching the infrastructural and operational limits. The EGC might be a solution to further accommodate the increasing flows of vehicles produced in Europe for the Far East markets, but at the same time serve as an important inbound point for vehicles produced in Turkey, Mediterranean markets as well as those from the Far East.

ANALYSIS OF MARITIME AUTOMOBILE TERMINAL AT KOPER / *Analiza pomorskog automobilskog terminala u Kopru*

SYSTEM ORGANISATION AND INFRASTRUCTURE / *Organizacija sustava i infrastrukture*

The study deals with the analysis of the maritime automobile terminal at Koper that is confronted with strong increase in vehicles throughput in the last couple of years. The terminal is working close to infrastructural limits, thus different operational and decision-making situations appear as real-time issues. The actual situation can serve as a case study to analyse and build an EGC for maritime automobile terminals, especially for those dealing with almost the same problems and restrictions.

The port of Koper is classified as a multi-purpose port with different specialised terminals. The automobile terminal is one of 11 specialised terminals in the port. The port uses the same truck gate entrance point and also the same railway yard for all terminals. The automobile terminal uses 7 berths with total length of 800 m that represent the berth subsystem. Some specialised berths are equipped with 4 RO-RO ramps. The open storage area measures 750.000 square metres, whereas the terminal also operates a five floor car garage with storage area of 125.000 square metres. The open storage area can accommodate 44.000 vehicles at time. The static capacity of the car garage is approx. 6.000 vehicles. Consequently, the yard subsystem consists of over 50.000 square meters of land.

The delivery zone is the third subsystem that uses the truck gate point and railway tracks with 6 rail ramps. The subsystem is organized in three different points inside the port area. Namely, during intense traffic of incoming or outgoing vehicles the terminal uses the railway tracks of other terminals. In such case vehicles are later shunted internally to the storage area. The delivery zone for trucks is situated in a separate chosen zone, where vehicles are prepared for departures.

Table 2 Main technical data of automobile terminal in Koper port

Tablica 2. Glavni tehnički podatci o automobilskom terminalu u luci Kopar

Infrastructure	Capacity
Berths	7
Ro-Ro ramps	4
Railway ramps	6
Operative shore	800 m
Open storage areas	750.000 m^2
Covered storage areas	125.000 m^2
Open air storage capacity	44.000 units
Covered storage capacity	6.000 units
Total annual throughput capacity	600.000 units

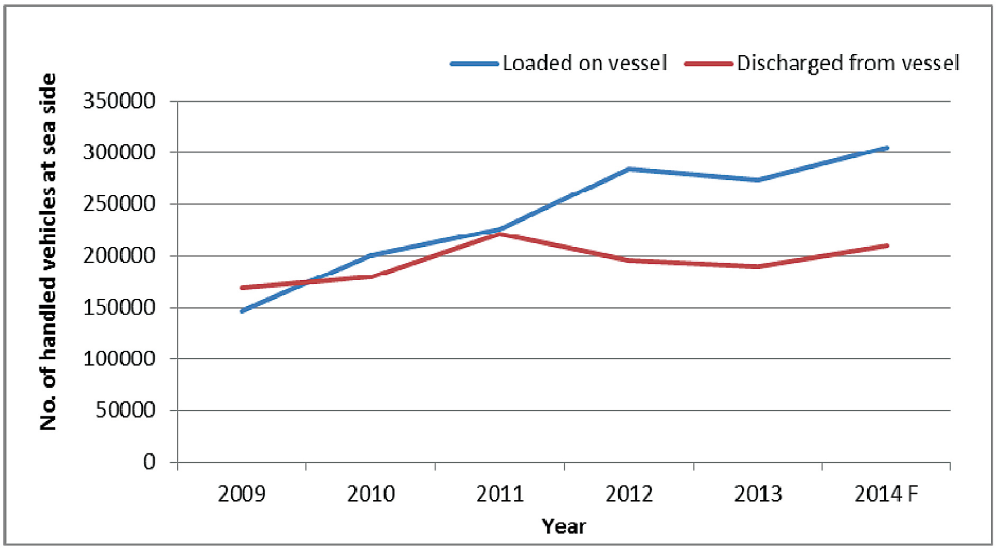

Figure 1 Handled vehicles at Koper port 2009-2014 forecast
Slika 1. Prognoza protoka vozila u luci Kopar 2009. - 2014.

System organization poses limitations to efficient operational work as several operational decisions must be taken in a very short period of time. Namely, the intensified throughput of other terminals, influence the occupancy of the main truck gate entrance point that operates two entrances and two exit lanes. An increased volume of traffic by rail also limits the operational work at terminal.

TERMINAL THROUGHPUT / *Propusnost terminala*

During the last 20 years the automobile terminal handled over 4,5 million vehicles. Nowadays, the terminal handles all important car makers. The European production is exported for the Mediterranean and Middle-East markets primarily, while imports originate mainly from South Korea, Japan and Turkey.

The terminal throughput growth was constant in the last 5 years. In 2013 the terminal handled 463.375 vehicles representing an increase of 47% over 2009 throughput. For 2014 a yearly throughput of nearly 520.000 vehicles is forecast. As shown in Figure 1 the export volume by sea increases with higher intensity from 2011 on. In 2013 it represented almost 60% of total throughput, whereas the situation in 2009 was quite the opposite. This puts higher pressure on the delivery zone subsystem, because vehicles planned to be shipped from Koper usually arrive in substantial volumes only a few days prior to the vessel's arrival to the port. The rail and truck gates are overwhelmed by the increased volume of vehicles to be served in short time.

According to the analysis the terminal loaded 273.295 vehicles in total on vessels in 2013. Compared to the loading volume from 2009 onward the terminal reached the increase of 87% in 2013 (Figure 2). The terminal loaded 172.817 vehicles on trucks and merely 4.591 on wagons in 2013. From the railway

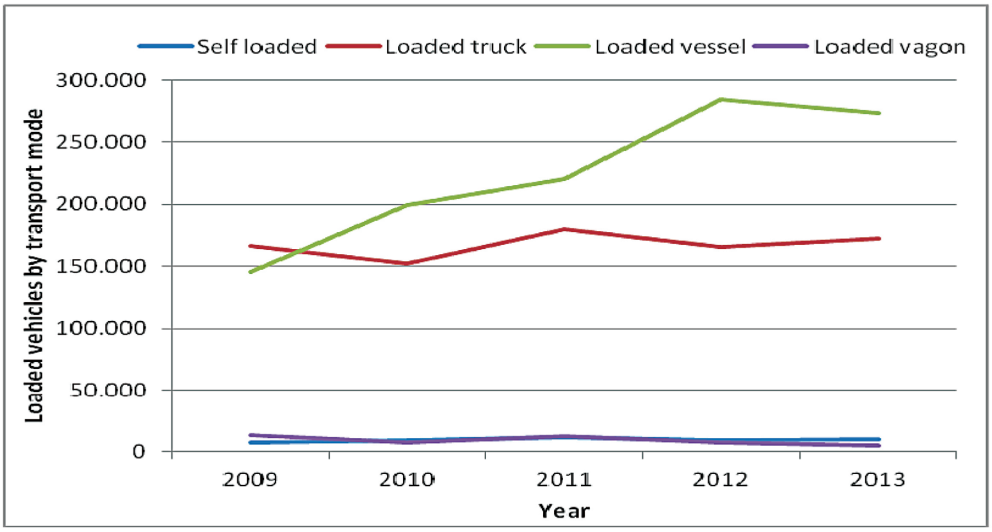

Figure 2 Number of loaded vehicles per transport mode
Slika 2. Broj ukrcanih vozila po vrsti prijevoza

perspective the delivery zone in the outbound direction is not under pressure, as only a small quantity of vehicles are dispatched from Koper by rail, while the truck gate must prepare vehicles per single voyage in advance (from 7 to 9 vehicles per truck) which requires a lot of paper and operational work. The opposite situation appears in the incoming direction, where the rail transport provides over 70% of all incoming vehicles to the port area by inland transportation.

The analysis indicates that the truck delivery zone is overloaded by the number of outgoing vehicles leaving Koper. As a matter of fact, approx. 97% of all vehicles discharged by vessels are transported to hinterland markets by trucks. In addition, the peak hours hit between 9 am and 3 pm, when over 80% of all manipulations are performed. As this is also the peak hour period for other terminals, congestion in the main exit point from the port area cannot be avoided. Besides, the incoming rail wagons are served at the same time, so the entire subsystem suffers from temporarily congestion and lack of manpower. The main activity is aimed at accepting trains in two different delivery zones and arranging internal shunting of vehicles to the long-term or just temporary storage place.

The analysis highlights the fact that the terminal management is facing short-term operational issues to accommodate the increasing flow of vehicles on a limited storage area, which works close to 85% of utilisation. The pressure on the delivery zone subsystem is even higher as the terminal has to serve the increasing number of trucks and rail wagons arriving from hinterland production places. Infrastructural problems will set limits to the terminal's development in the future, because it will face problems with the delivery-zone development due to space restrictions and further increase of other traffic through the Port of Koper. Consequently, the port and terminal management must take other models and infrastructural options into consideration.

EXTENDED GATE CONCEPT / *Extended gate koncept*
EGC ON THE CASE OF KOPER PORT / *EGC na primjeru luke Kopar*

A sensible option to further increase the number of handled vehicles without further developing the storage area and delivery zone in the port area is to develop a "satellite" automobile terminal that can serve as a temporary buffer for the incoming vehicles with overseas markets as their final destination (Figure 3). The concept is close to the model already used by container industry, but the distance has to be considered due to the main orientation towards truck transportation between the hinterland platform and maritime terminal. Venstra et al. [2] define the extended gate model as an inland terminal directly connected with a maritime terminal with high capacity transport means, hence indicating that they are oriented towards rail transportation. Due to lack of specialised wagons for vehicle transportation the primary option for "shunting service" between both platforms should be trucking. Anyhow, Venstra et al. [2] point out the need for securing the following elements for an appropriate model introduction:

- external platform must operate two subsystems, such as yard area and delivery zone for trucks and wagons,
- regular inland connections must be established to secure drayage process,
- real-time information availability and suitable IT solutions,
- secured legal responsibility.

Moreover, Guan and Liu [20] see that with further optimization of truck gate entrance the following positive implications might be achieved:

- reduction of congestion on the gate entrance and in the delivery zone subsystem,
- number of open lanes,
- service intension per truck,
- manpower engagement,
- the number and intensity of damages.

BUILDING A HINTERLAND PLATFORM /*Izgradnja platforme u zaleđu*

The use of a dedicated hinterland terminal permits to further develop a port or a maritime automobile terminal. An additional platform can accommodate new flows of vehicles that are planned for export by sea. It is important to find a suitable place close to the highway connections and with connection to the rail infrastructure. The rail connection is primarily important in

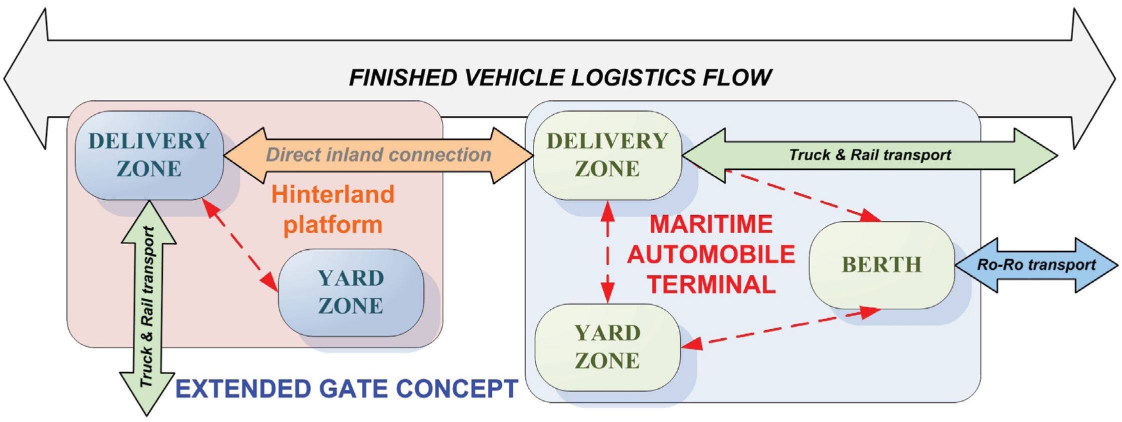

Figure 3 Extended Gate Concept for automotive terminal
Slika 3. Extended Gate koncept za automobilski terminal

Source: Prepared by authors

the direction from the hinterland markets. The entire logistics chain that should be supported is rail-terminal-truck-port-vessel.

According to the analysis of Koper port surrounding, within a range of 30 to 40 km, only two to three points fulfil requirements for the hinterland platform. As the highway is very close, no problems are expected to establish a trucking shunting service between a maritime automobile terminal and the particular new platform. However, in all cases the actual storage capacity is very limited, with no more than 2.000 positions for light vehicles. Taking into consideration that neither potential location has a rail ramp, additional investments in infrastructure are required.

From the location point of view the EGC for a maritime automobile terminal of port of Koper is possible but with limited capacities or with additional investments in the infrastructure. The hinterland terminal would not increase the actual capacity of yard zone significantly, but it can be the platform for a long-term development.

ESTABLISHING INLAND CONNECTIONS / *Uspostavljanje kopnenih veza*

The central idea of EGC is to relieve a maritime terminal of overcrowding number of vehicles that are waiting for the service in the port area. Consequently, it is important to establish well-coordinated inland connections between two platforms. The service from a hinterland terminal to the maritime terminal is of major importance, because such vehicles should arrive at the maritime terminal only a few hours before the vessel is due in the port.

This puts pressure on trucking service, as for 2.000 vehicles to be loaded on a vessel over 200 voyages (loading factor max. 9) should be made to reposition the vehicles from the hinterland platform to the berth subsystem at the maritime terminal. Considering that each truck could perform 3 to 4 voyages per day and that vehicles might wait for loading up to 24 hrs in the port area, approx. 25 trucks would be needed to organize such shunting service.

The management should manage the right number of trucks with automotive truck chassis and recruit additional truck drivers. The rail service would simplify the shunting process and educe operational work on both platforms, but it would be difficult to arrange timely delivery of higher number of vehicles. For 2.000 vehicles to be loaded on a single vessel min. 200 wagons would be required or min. 10 trains consisting of 20 wagons each.

The monitored model shows that such an inland connection is possible for vehicles with European status, thus the outbound volume for production in Europe can be served. On the other hand, the import volume from non-European production markets will face problems if the vehicles are not custom cleared before.

Moreover, the design of inland network and transport route must be elaborated, because irregularities in traffic and traffic accidents might cause operational and administrative problems for the maritime terminal management and other entities in the logistics chain. The option to design and realize a direct rail connection between two platforms appears to be costly and hardly feasible in a short-term period.

According to the obtained data, the existing inland connection might be the weak point in a potential implementation of EGC for automotive business through Koper port. Additional investments are needed to establish EGC, so the model cannot be developed in a short period.

LEGAL POINT OF VIEW ON RESPONSIBILITY ISSUES / *Pravno stajalište o odgovornosti*

Beside infrastructural and suprastructural factors the terminal management must also consider the legal view in building and managing EGC. The transport process between two platforms is the main issue. Usually, a forwarding agent or a trucking company assumes the responsibility for damages on vehicles during the transportation process. Namely, the CMR document covers the trucking responsibility to the terminal and the maritime Bill of Lading usually covers a carrier's responsibility up to the port of discharge or maritime automobile terminal. The terminal management should reach agreement on the responsibility transfer with car makers or shippers and with contractual parties that would provide shunting process (by rail or by road) respectively.

Veenstra et al. [15] closely analysed the inter-terminal transport responsibility for container logistics and according to their acknowledgment the responsibility is on a port or terminal operator. Thus the Port of Koper should assume the responsibility for inland transport in EGC management, but on contractual basis the port can delegate the responsibility to the chosen forwarding agent or the selected operator for transport. Consequently, the Port of Koper might nominate or use the already existing subsidiary company for rail transport and probably for trucking service as well.

From the legal point of view ports would enter into FVL as logistics providers and not just as pure port operators as they are today. Consequently the port would extend its responsibility, but at the same time this would not cause big structural and operational changes in FVL chain. Namely, logistics providers would be responsible for their logistics part till discharging vehicles at the external platform (today they unload at the port area). The main change would be port's responsibilities by acting as operator at two platforms and transport operator between them. Such role should be confirmed by vehicle producers or shippers as the owners of the "goods". Undoubtedly, the port enters in FVL as a wider specialised logistics provider and takes higher risks than today.

OPERATIONAL WORK / *Operativna izvedba*

Operational work must provide high degree of synchronisation, because the entire process is time-sensitive. Both operational offices (at the port and at external platform) must work as one operational platform, even though they are spatially separated units. The external platform is primarily responsible for:

- organizing acceptance and accommodation of inbound flows of vehicles by train and truck;
- performing quality check of accepted vehicles;
- organizing loading and departure of trucks to the port;
- organizing loading and departure of wagons to the port
- issuing all related documents end sending electronic data to the port.

On the other hand the port's office is primarily responsible for:

- coordinating activities with car carriers, shippers,

- trucking company and/or rail operator and external platform, to secure timely deliveries to the port area;
- providing trucking orders for trucking companies and for the external platform;
- providing orders for rail transport between both platforms;
- performing quality check at the entrance to the terminal;
- organizing loading to the vessel.

The entire operational work is based on an adequate information flow, due to short shunting time (up to 1 – 1,5 hrs) between the platforms. Moreover, vehicles should be moved to the port area just a few hours prior vessel's berthing.

SECURING INFORMATION FLOW / *Osiguranje protoka informacija*

Information flow is a very important element in establishing EGC, especially in the analysed case as transport distances are very short and vehicles should be loaded on a vessel immediately after arrival to the maritime terminal. The transfer from the hinterland platform to the port should not cause significant problems, because all details related to a single vehicle are already known to the terminal. Namely, forwarding agents declare vehicles and other commercial data prior to the arrival of the vehicle to the hinterland terminal. Some problems are expected in the opposite direction, because some data are hidden by the local shipping agents or local forwarding companies. Currently, such data are not regularly available to the terminal and as foreseen it will be difficult to obtain them also in the near future.

Among the analysed limiting factors the information flow appears to be the least difficult. Namely, different IT tools for organizing logistics chain in automotive industry are already on the market. In case the terminal management agrees with all parties involved to obtain all needed data in advance, there should be no trouble in securing an adequate information flow.

OBSTACLES IN EGC IMPLEMENTATION / *Prepreke u primjeni EGC-a*

Even though EGC can be classified as a good platform to accommodate higher volume of vehicles and achieve higher performance indicators at a berth subsystem and consequently higher satisfaction of RO-RO carriers, obstacles that can limit EGC implementation must be highlighted. Namely, the entire logistics chain would suffer from higher logistics costs, because additional manipulation of a single vehicle is needed, more trucking companies are requested and the same is valid for rail operators (their role on short distances is questionable), additional staff at port's side would be required, etc. Moreover, indirect costs must be considered too, such as quality checks and damages due to additional manipulations, discrepancies in documentation procedures, new IT tools and platforms, extra time consumption within a single logistics chain etc.

Undoubtedly, the EGC implementation brings a vast number of issues that should be analysed prior model introduction. All the stakeholders in FVL should give the consensus over the EGC establishment, because some of them might refuse the model with additional nodal stop, and would prefer direct delivery on plant-port route.

The port should compensate the EGC use through storage tariff implementation, where direct access (no stop at external platform) would result in shorter free storage time or higher storage tariff. On the contrary, the use of external platform would be stimulated by storage free time extension and lower manipulation costs.

Besides the carriers, the port is the only subject that should benefit from the EGC model implementation in FVL. Consequently the port has to build the environment where the EGC would be recognised as an appropriate model in using southern-gate route in the future as well.

CONCLUSION / *Zaključak*

The statistical analysis of actual inbound and outbound volumes of vehicles shows increased outbound flow through Koper port. The pressure on delivery-zone and storage area will increase in the future therefore an option to use an external storage platform appears as an alternative solution. On this basis the paper elaborates and describes the model where an external storage platform under port's operation can be used. The model of Extended Gate Concept (EGC) is described.

The maritime automobile terminal at Koper has an important role in managing lean FVL, because it acts as an intermodal node connecting RO-RO vessels with rail and truck operators, and secures temporary storage for car manufacturers at the same time. The management must secure synchronisation between all subsystems to absorb the certain volume of inbound or outbound flow of vehicles and support sea or land carriers with lean operational services.

When the maritime automobile terminal works close to the upper capacity limit, the management of the terminal must find solution to expand capacities at the terminal or to find external solutions. One of solutions is the presented EGC which is based on establishing an additional platform close to the terminal's position. It consists of two subsystems – storage subsystem and delivery zone subsystem. The new platform should have reliable inland connections by rail and road with a maritime automobile terminal, thus a direct access to highway and rail infrastructure must be provided. In addition, the terminal must have rail ramps for loading and discharging vehicles from wagons and enough static capacity for vehicle storage to provide "buffer" space to the maritime automobile terminal.

The EGC model presented on the basis of the situation at Koper port shows possibilities of building the modular solution, but requires additional infrastructural investments directly at a chosen platform and at connections to the public transport infrastructure. The port should find solutions for providing operational support in shunting vehicles between the two platforms and secure the real-time information flow. According to the analysis the two elements do not present important obstacles in model establishment. Anyhow, Port of Koper will be forced to find solutions to fulfil growing expectations of car manufacturers using the automotive terminal at Koper as their southern gateway. In case of space limitations, due to the fast expanding container business, and limitations at entrance point, the EGC might be an alternative solution in further developing FVL through the port.

Although the EGC presents the alternative for port's expansion all the obstacles hindering EGC implementation have to be considered. The port has to evaluate all expects presented by other stakeholders in FVL, because finally they would give the "green light" for such model to be used in practice. Due to exposed obstacles and limiting options to adequately position the external platform and potential problems in securing a reliable shunting process the port management should prioritize the enlargement of storage area inside the port area and upgrade the delivery-zone infrastructure. Anyhow, the EGC would be an option when internal resources are fully exploited.

The alternative to presented EGC operated by the port might be the establishment of external car terminal, operated by independent logistics provider. Exactly the same model and procedures as described in EGC should be implemented, where the port and logistics operator should have to synchronise the entire logistics and information flow.

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