IZVIRNI ZNANSTVENI ČLANEK – ORIGINAL SCIENTIFIC PAPER



# FLOW OF GOODS ACROSS CUSTOMS TERRITORIES

## Pretok blaga preko meja carinsko-administrativnih območij

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### *Abstract*

*Purpose* – The purpose of this paper is to explore systemic relationships within supply chains, which are created as a result of passing goods between customs territories. Specifically, this research focuses on how business entities can reduce the time consumed for the execution of mandatory customs controls at border crossings by applying the voluntary implementation of certain legally standardized institutes—in this case, the status of authorized economic operator (AEO).

*Design/methodology/approach* – The study hypotheses were tested at two levels. The fundamental hypothesis was tested using a survey of participants' subjective perceptions. To verify the supporting hypothesis, the survey was carried out using numerical techniques (i.e., an analysis of the queuing systems).

*Findings* – The research results show that acquisition of an AEO certificate can facilitate the acceleration of the flow of goods across customs territories. To achieve the optimum reduction of time delays caused by interruptions in the flow of goods resulting from controls conducted by authorities, it would be necessary to adapt the road infrastructure at the border crossings.

*Keywords:* authorized economic operator (AEO), customs clearance, road transportation, flow of goods, supply chain management, meta-system

### *Izvleček*

*Namen*. Članek je rezultat raziskovanja medsistemskih odnosov v oskrbovalnih verigah, ki nastanejo kot posledica prestopa blaga prek meja carinsko-administrativnih območij. Konkretno se raziskava nanaša na proučevanje vprašanja, ali lahko poslovni subjekti s prostovoljnim uvajanjem določenih zakonsko standardiziranih institutov, npr. statusa pooblaščenega gospodarskega subjekta (AEO), skrajšajo čas izvajanja obveznih carinskih kontrol na mejnih prehodih.

*Načrt, metodologija, pristop*. Raziskovalne hipoteze smo preverjali na dveh ravneh. Pri preverjanju temeljne raziskovalne hipoteze smo na osnovi metode anketiranja s stališča subjektivne percepcije vseh sodelujočih deležnikov ugotavljali, ali imetništvo instituta AEO resnično vpliva na višjo hitrost procesnega pretoka blaga. Za preverjanje podporne hipoteze pa je bila opravljena raziskava na osnovi numerične tehnike, tj. analiza množične strežbe, pri čemer je bil predmet analize prikaz vpliva infrastrukturnega omrežja na delovanje carinskih postopkov in s tem povezanega procesa cestnega pretoka blaga.

*Ugotovitve*. Rezultati raziskave kažejo, da pridobitev potrdila AEO pripomore k pospešitvi pretoka blaga prek meja carinsko-administrativnih območij. Za doseganje optimalnega skrajšanja zamud zaradi prekinitev blagovnega toka kot posledice kontrol, ki jih opravljajo oblastni organi, pa bi bilo treba prilagoditi cestno infrastrukturo na mejnih prehodih.

*Ključne besede:* pooblaščeni gospodarski subjekt (AEO), carinski postopek, transport, pretok blaga, upravljanje oskrbovalnih verig, metasistem

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## 1 Introduction

Increases in the volume of international trade as a result of globalization present a serious threat to the smooth flow of goods crossing state-administrative borders and, thus, indirectly affects the operation of supply chains. Congestion at border crossings represents a problem to both economic operators and customs authorities.

More than 20 years ago, Stalk (1988) noted the importance of time in the context of supply systems and its impact on competitive advantage. In today's global environment, time delays present even more complex problems in terms of logistics, economy, sustainable development, and many other aspects. A recent study conducted under the auspices of the Organisation for Economic Co-operation and Development (OECD) to examine the trading policy directly related the importance of time to the export and import of goods. The authors of the study (Nordas, Pinali, & Geloso Groso, 2006) revealed their findings about the growing importance of time in export and import activities in a document entitled "Logistics and Time as a Trade Barrier." They stated that delays can cause reduced volume of international trade. They also noted an increase in the amount of time-sensitive goods in the market and that modern and integrated supply chains manage these items on exact preplanned time frames (Nordas et al., 2006). In addition, the authors stated that the countries must reduce lengthy procedures for exports and imports, thereby decreasing the waiting time within the supply chain, in order to remain competitive. Therefore, exploring solutions to the time consumption problem during the crossing of customs-administration borders and the reduction of lengthy procedures associated with the crossing in the context of international supply chains would be of great value.

From a logistical point of view, the flow of goods is disrupted every time the goods are stopped. Every stop results in a period of waiting. Waiting presents delays in the supply process, which affects the ability of the supply chain to be competitive. Yet modern globalized society demands that business systems continually improve their efficiency and, at the same time, unconditionally requires them to comply with all the obligations prescribed by law (and justified with the need to meet the broader needs of society). Thus, the cooperation between customs authorities and economic operators has led to the development of the concept of an authorized economic operator. The authorized economic operator represents a new concept in customs control from which both parties can benefit. It also ensures the appropriate level of security, which, in turn, does not inhibit international trade. The collaborative relationship between customs and the authorized economic operator represents a change from the traditional government-to-business (G2B) supervisory relationship to a collaboration based on trust (den Butter, Groot, & Lazrak, 2007).

The requirement for obtaining the status of an authorized economic operator by the customs administration is that the economic operator must prove to customs that it can control the customs operations through its own business activities (den Butter et al. 2007) and that it is reliable in terms of its own customs operations and consequently receives certain benefits.

The fundamental goal of researching the time needed for crossing customs–administrative areas is to establish whether the adjustment in the organization of economic operators (in accordance with requirements and conditions of other key participants—in our case, customs) affects the reduction of customs complexity and enhances their performance. In particular, we want to examine the benefits of the authorized economic operator in relation to the shortened time spent for crossing borders in the process of the movement of goods by road.

First, we wanted to confirm the fundamental hypothesis that the authorized economic operator (AEO) status is one of the conditions for accelerating the process of the movement of goods by road and that the following equation is correct:

$$v(E+AEO) > v(E) \quad (1)$$

where $v$ is the speed of process flow of goods, $E$ is the economic operator, and AEO is the status of the authorized economic operator.

Second, we tried to confirm the supporting hypothesis that, for the optimal acceleration of the flow of goods by road in accordance with the AEO status, adjustment of the network infrastructure on the road border crossing is needed. We used the case of the Schengen border crossing at Obrežje.

The remainder of this paper is structured as follows: In the following section, we review the literature, with an emphasis on customs organizations as an active factor of supply chains. We then present the research design used and findings associated with the movement of goods through the road border crossings. The final section draws conclusions from the research and presents a discussion of the results obtained in the study as well as the discovered principles. Due to the novelty of the phenomenon, we present some directions and opportunities for further research.

## 2 Literature Review

### 2.1 Customs Organizations as an Active Factor of Supply Chains

Various participants are more or less actively engaged in the operation of supply chains, regardless of their objective in the collaboration. One of the participants in the international supply chains is customs, which is responsible for the control of goods entering or leaving each country. In doing so, the customs administration and other governmental authorities are trying to cope with the challenges posed by global changes in the field of supply chain functioning. Whereas safety, health, financial, and other threats

require a higher level of control, the enormous amount of goods prevents the full implementation of controls at the borders (Crone, 2006). The role of customs is manifested in providing a higher level of safety in the operation of international supply chains as well as in promoting social and economic development, based on the collection of various contributions, taxes, and fees (World Customs Organization [WCO], 2007).

Because of the dynamic and rapidly changing environment in which the customs authorities operate, they have to identify and understand the key international, regional, and national strategic drivers of change in order to prepare and respond to them accordingly. Gordhan (2007) stresses the following key strategic drivers that require changes in the operation of both sides—namely, the customs authorities and the economic operators:

- Growing scope of international trade: In practice, this represents a greater number of transactions and consequently increased workload for customs, usually with the same or even reduced resources. On the other hand, this significantly impacts the economic operators in terms of waiting times and prolonged processing, which can lead to congestion and delays in the shipment of goods.
- The liberalization of trade: Measures to facilitate and promote trade are being implemented, such as the reduction in the scope of border control. However, at the same time, these measures inadvertently create opportunities for illegal trade, which is in conflict with the interests of both customs and the economy.
- Changed traditional trade patterns and an increase in the number of participants—namely, the increased rate of the representation of developing countries in international trade and a significant change in the structure of trade.
- New models of supply chains: New innovative methods focus on the processes of the movement of goods. The role of customs is to handle shipments efficiently and accurately and, at the same time, as quickly as possible because any delays in movement result in increased costs and undermine the competitiveness of the participants.
- The emergence of international criminal groups: The consequences of the criminal activities of a transnational nature and their damage are serious and long term for both the state apparatus and the economy.
- Concern for the public health and environment: Regulations on these sensitive areas strongly affect the functioning of customs services as they have (or at least should have) an overview of the international transport of dangerous and harmful substances.

Based on the described drivers, we can assert that the role of the customs service has changed over time, shifting from the original role of the collection of duties into the operator of various systems at national borders. However, the basic function remains the same: controlling the movement of goods and accompanying documents across borders. With this, customs protect legitimate trade and society against the illegal importation of prohibited goods that could pose risks to people's lives and health.

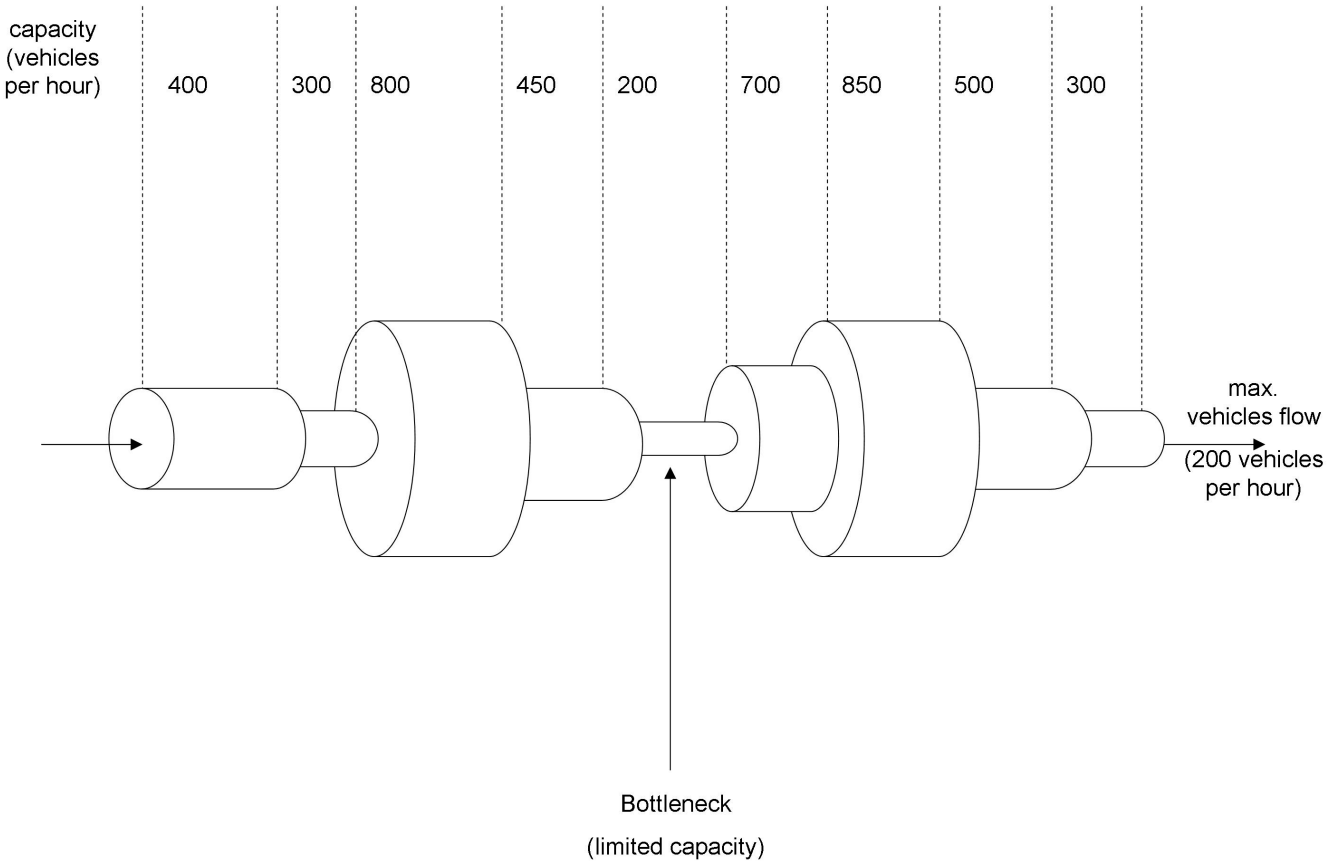
Experts have increasingly understood that customs have an important impact on the economy, as they promote or impede international trade. The borders of the European Union (and of the world) all deal with the passage of large volumes of diverse goods, where each additional inspection due to customs or security procedures results in time delays and significantly impacts the speed of movement of goods and, consequently, their quality and price. Each time delay is also an additional burden in terms of logistics, infrastructure, personnel, finances, and other resources.

The speed of the movement of goods is predominantly determined by the most time-consuming part of the process. This part of the process inhibits rapid performance by all other participants and thus presents a bottleneck at the border crossing point (Nordas et al., 2006). For example, in the border crossing system depicted in Figure 1, the capacity of customs procedures enables the inspection of 200 heavy goods vehicles in one hour, whereas other processes within the border system operate at much higher capacities. As a result, the customs activities impede the course of other processes. The line of vehicles at the border crossing moves at the pace of the slowest participant—in this case, customs.

Waters (2009) says that certain activities, such as removing the obstacles (unnecessary documentation, fees and taxes) at border crossing activities for ongoing improvements in the communication network and logistics infrastructure and activities of specialized support for routine tasks (freight forwarders and shipping agents), can greatly contribute to making the management of customs procedures more transparent. In order to improve the process of the movement of goods and increase fluidity of the customs system, the key objective of the customs organizations is to maintain effective control without inhibiting legitimate trade. Customs administrations can achieve this control in terms of their cooperation with economic institutions in the form of partnerships, where the interests of both sides are represented to the greatest extent possible (Mikuriya, 2007). Thus, we can identify related structures of the two systems with certain common and individual interests: the economic operator and customs. As previously mentioned, the collaboration between the participants and an effective management of the meta-system will significantly impact the improvement of overall international business activities.

Approaches based on the principles of cooperation and voluntary compliance with requirements, which also bring benefits, are more likely to support the improvement of the movement of goods and an increase in fluidity of the customs system than approaches that depend on enforced compliance and interfere with the work processes (Widdowson & Holloway, 2009).

**Figure 1:** *Bottleneck at the border crossing point.*




Adapted from Supply Chain Management: An Introduction to Logistics, 2nd ed. (p. 120) by D. Waters, 2009, New York, Palgrave Macmillan.

## 2.2 Studies Related to AEO

The status of an authorized economic operator (AEO) provides a good example of establishing trust and control in a collaborative G2B relationship with the intention of minimizing operating costs and the costs linked with bureaucratic procedures.

The AEO concept is based on information support, such as various tracking systems, exchanges of information, and surveillance cameras. The European Union determines this approach as the management and accounting system, which covers the financial aspects, flow management, information and communication systems, and legal control in the performance of transactions to ensure that the supply system can manage the risks (*Pilotno poročilo o pooblaščenih gospodarskih subjektih,* 2006).

The idea of this concept is reflected in the possibility of establishing a partnership between customs administrations and business organizations to maintain a high level of security in international trade (den Butter et al., 2007). The AEO represents a new concept of customs control-based benefits for both parties, which is attributed to the implementation of the "win-win" philosophy. Here, we refer to collaborative and trusted cooperation, where each party is involved in the winning outcome or benefits resulting from the collaboration.

An authorized economic operator can be defined as an economic operator which is reliable within the European Union in terms of its own customs operations and can therefore receive certain benefits in the European Union (European Commission Directorate-general Taxation and Customs Union, 2007). Based on this cooperation, the benefits of the economic operator are primarily indicated in the implementation of fewer physical checks of consignments and faster dealings with customs procedures. On the other hand, customs administrations' simplified procedures result in certain benefits hat lower the level of administrative obstacles. Customs organizations thus benefit from more precise identification and evaluation of threats present in the everyday movement of goods across the customs borders.

Those economic operators who meet the criteria and conditions of the AEO status create certain benefits in the area of customs controls and simplification in accordance with customs regulations (Jere & Podbregar, 2009).

AEO status can, based on its application, be granted by a member state of the European Union to any economic operator involved in any way in the international movement

of goods and that meets the "common criteria for control systems, financial solvency and compliance with the provisions" (Regulation (EC) No 648/2005). Legal aspects of the certification, including the explanation of benefits, are systematically presented in the article "The Authorised Economic Operator in the European Union," in which special attention is given to the definition of the practical effects in the implementation of customs procedures (Wolffgang & Natzel, 2011). The introduction of the report of the National Board of Trade of Sweden states that the procedures for obtaining the certificate are transparent and allow all companies to gain advantages in terms of reducing the scope of controls (Kommerskollegium National Board of Trade, 2010). They even wrote that the system of authorized import companies enables the operation of supply chains without the need to stop. In light of trade promotion, it is important that the processes not be burdened by complicated customs procedures or non-transparent rules and procedures (Kommerskollegium National Board of Trade, 2010).

The customs authorities can, following an application by an economic operator and in accordance with Article 14 of the Regulation (EC) 1875/2006, issue the following authorized economic operators' certificates:

(a) AEO certificate AEOC: Customs simplifications in terms of economic operators requesting benefits from simplifications provided for under the customs rules;

(b) AEO certificate AEOS: Security and safety with respect to economic operators requesting benefits from the facilitation of customs controls relating to security and safety when the goods enter or leave the customs territory of the community;

(c) AEO certificate AEOF: Customs simplifications/security and safety with respect to economic operators requesting benefits from the simplifications described in point (a) and the facilitations described in point (b).

Considering the fact that the mentioned types of certificates are different, the benefits of the individual partners are not uniformly defined for each type of AEO certificate (Gellert, 2011). The objective of the supply chain is to discover the most effective and competitive manner of delivery of the right product at the right place and agreed-upon time (Kavčič & Bratina, 2008); thus, the receipt of AEO status is, for the company, one of the ways of introducing improvements in the movement of goods.

The benefits provided to economic operators after obtaining AEO status influence the acceleration and simplification of the movement of goods and the related procedures, thereby enabling the reduction of the complexity of processes in the supply chain. Consequently, it is also possible to minimize physical stops due to administrative requirements, which—according to the results of certain studies (Hausman et al., 2005; Subramanian et al., 2005; Bolhöfer, 2008)—largely impact the success of logistics processes.

G2B interactions and AEO status definitely help in promoting international trade and maintaining security in the movement of goods and ultimately contribute to higher gross domestic product. The status of AEO is therefore directed to establishing a trusted partnership, in which the economic operators prove to be capable of managing their own customs control procedures.

The AEO status is relatively new and was approved in the European Union as recently as 2008. However, from the perspective of the rapid expansion and intensification of international trade as well as the development of new technologies, products, and services as a result of globalization, it is no longer a new phenomenon. Despite this, there are no specific studies or literature dealing directly with the time-related impacts of the obtained AEO certificate on the flow of goods. As noted, the majority of studies that deal with the concept of AEO are limited to indicating the legal basis for obtaining a certificate and to stating the benefits for the economic operator after receiving the certificate. In addition, all sources almost invariably indicate that the AEO certificate enables the provision of a greater level of security in the operation of supply chains.

## 3 Research Design

Testing of the study hypotheses was carried out on two levels. To check the fundamental hypothesis, we used a survey method that examines the subjective perceptions of all participants to determine whether the AEO status really speeds up the process of the movement of goods. To verify this approach, the exploration was carried out using numerical techniques, where the subject of the analysis illustrated the impact of the network infrastructure of customs procedures and related processes for the movement of goods by road.

Different techniques and methods were used to test the study hypotheses. One of them is the triangulation method, which provides complex insights into the problem studied by combining different sources of data, theories, methods, techniques, and disciplines (Jick, 1979). As the empirical part of the study was carried out on two different levels, we used the multi-method researching principle to confirm the fundamental and supporting study hypothesis. This principle is particularly suitable for exploring more complex and interdisciplinary problems (Collier & Elman, 2008; Toš & Hafner-Fink, 1998), which we have seen in the course of the present study.

### 3.1 Survey

We used questionnaires to elicit respondents' subjective assessments of whether the AEO status actually speeds up the movement of goods by road, as claimed by most studies conducted thus far (den Butter, Liu, & Tan, 2012; Wolffgang & Natzel, 2011). As the AEO status facilitates the performance of activities for both the economic operator and the customs authorities, the survey was conducted among representatives of both types of entity.

The invitation to participate in an online survey was sent to all the customs office representatives in the Republic of Slovenia (a total of 10 offices) and to the General Customs Directorate of the Republic of Slovenia. The invitation for the online survey was also sent to all Slovenian economic operators who are holders of the AEO certificate. As the purpose of the study was to find the actual realization of all benefits related to the ownership of the AEO status, AEOC and AEOS certificate holders were not considered in the target population; only holders of AEOF certificates were. As the invitation for the online survey was sent at the end of November 2011, we considered only those operators in the entire population of the AEOF certificate holders that had acquired the status by 22 November 2011. The website of the European Commission states that 36 AEOF certificates had been issued by 22 November 2012 in the Slovenian territory. Thus, we considered 36 AEOF certified economic operators and all 11 customs offices. The online survey received 20 responses from economic operators, representing a 56% response rate, and 10 from customs offices, constituting a response rate of 91%.

As the entire population of both economic operators and customs offices includes only a small number of respondents, sampling was not performed in the present study. In this way, we preserved the features of the entire population and ensured the validity of the given analysis (Zamani-Gallagher, 2011).

The survey was conducted using the Survey Monkey web application. The two survey questionnaires (one to economic operators holding the AEOF certificate and one to the representatives of the customs offices) comprised a self-completing survey with closed-ended questions. The two questionnaires have the same structure, which is based on providing the 10 benefits of the AEO status as identified by the European Commission (European Commission Directorate-general Taxation and Customs Union, 2007). Both questionnaires contained 27 identical questions and 2 unique questions. The two survey questionnaires were composed so that the analysis enables the verification of the actual realization of the individual benefit supposedly guaranteed by the AEO status. Although the results obtained in the study are subjective, their power is evident in the numerical evaluation of an individual subjective perspective. The respondents had to evaluate their own agreement with an individual statement. For this purpose, a 5-point Likert scale was used. According to de Velis, Neuman, and Shnell, a Likert scale is most commonly used for measuring factors such as opinions, beliefs, and behaviors (as cited in Bizjak, 2008, p. 54). Its specific feature is, according to Supek, that it directly addresses the respondents, who must answer all the statements (as cited in Bizjak, 2008, p. 54). A quantitative survey method was used to verify the fundamental hypothesis, while for the interpretation of the results and findings of the study, causal and descriptive methods were primarily used.

### 3.2 Analysis of the Queuing Systems

The numerical technique (i.e., the analysis of the queuing systems) was used to verify the supporting study hypothesis. Such techniques are most commonly used in the design and analysis of various communication and information networks and in the analysis of the broad field of logistics and other queuing problems. The main purpose behind the analysis of queuing systems is the collection of data, the mutual comparison of different systems, and the design of completely new systems (Hudoklin-Božič, 1999).

In the selected case of the Schengen border crossing Bregana (Croatia)–Obrežje (Slovenia), specifically at the point of entry into the territory of the European Union, we analyzed the utilization of the border-crossing system based on the changes in the points where queues occur. One-week measurements of flow times in the freight transportation by road were made at the Schengen border crossing Obrežje from 29 June 2009 to 7 July 2009 (Ministrstvo za infrastrukturo in prostor Republike Slovenije, 2010). We focused primarily on the impact of changes in the infrastructure network in relation to the pacing of procedures for crossing the border. The potential time savings in relation to the performance of these procedures result in a better utilization of the entire system—a finding made possible because we deal with the sequential dependence between successive procedures in the context of border crossings. Statistical methods, multivariate analyses, mathematical methods, and methods for the graphical display of data were used in the analysis of the border system utilization.

## 4 Findings

### 4.1 Survey Research Findings

Average evaluations of the answers from all the respondents are listed in two tables. Table 1 deals with the answers given by the economic operators, and Table 2 refers to the answers given by the customs office representatives.

Table 1: *Economic Operators' Evaluations of Listed AEO Benefits (average)*

| AEO Benefits | Score (1-5)[a] |
|---|---|
| 1. Fewer physical and document-based controls | 4.00 |
| 2. Priority treatment of consignments if selected for control | 4.10 |
| 3. Choice of the place of controls | 4.36 |
| 4. Easier admittance to customs simplifications | 4.25 |
| 5. Reduced data set for entry and exit summary declarations | 3.25 |
| 6. Prior notification | 3.33 |
| 7. Indirect benefits | 3.22 |
| 8. Improved relations with customs | 4.11 |
| 9. Recognized as a secure and safe business partner | 3.69 |
| 10. Improved relations and acknowledgement by other government authorities | 3.50 |

[a] 1 = strongly disagree, 5 = strongly agree

Table 2: *Customs Office Representatives' Evaluations of Listed AEO Benefits (average)*

| AEO Benefits | Score (1-5)[a] |
|---|---|
| 1. Fewer physical and document-based controls | 4.38 |
| 2. Priority treatment of consignments if selected for control | 2.75 |
| 3. Choice of the place of controls | 3.89 |
| 4. Easier admittance to customs simplifications | 4.67 |
| 5. Reduced data set for entry and exit summary declarations | 3.25 |
| 6. Prior notification | 3.50 |
| 7. Indirect benefits | 3.50 |
| 8. Improved relations with customs | 4.38 |
| 9. Recognized as a secure and safe business partner | 4.00 |
| 10. Improved relations and acknowledgement by other government authorities | 4.00 |

[a] 1 = strongly disagree, 5 = strongly agree

The tables indicate that both participants perceive easier admittance to customs simplifications to be the greatest benefit as 70% of economic operators believe that easier access and simplifications in customs significantly (score 4.25) speed up the process of movement of goods by road, while 30% of customs authorities think that this benefit has an even more significant impact (score 4.67).

The tables also demonstrate that both participants perceive the lowest benefit from reduced data set for entry and exit summary declarations as both the economic operators and the customs authorities rated this benefit as having a medium (score 3.25) impact on speeding up the movement of goods by road. At this point we should stress that medium impact on the speeding up the movement of goods by road is still a positive situation, especially compared with a low or no rate of speeding up.

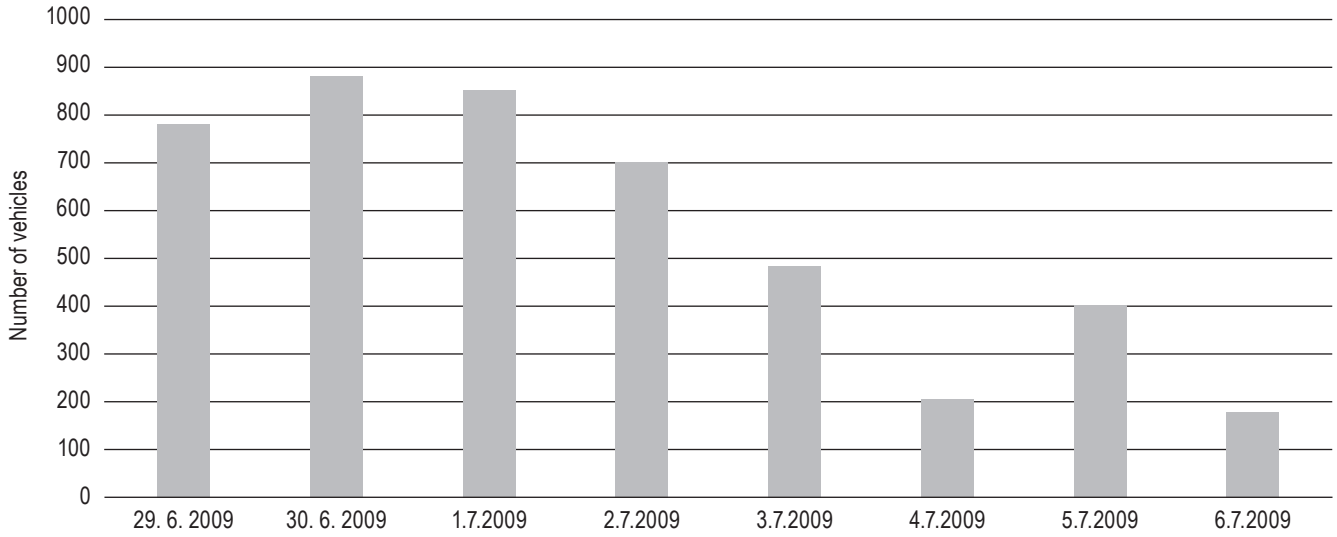
Thus, the analysis confirms the fundamental hypothesis of the study. We did not find any explicitly negative responses from the participants in the present study. We also noted that all of the 10 studied benefits of the AEO status have a medium to significant impact on speeding up the process of the movement of goods by road. Despite the fact that some of the questions are not equally represented in the context of individual benefits, the result of the study remains the same. This can be substantiated by an additional question, in which the population of economic operators (average score 3.22) as well as the population of customs authorities (average score 3.20) believe that having the AEO certificate has a higher-than-medium impact on speeding up the movement of goods by road. This finding further confirms the fundamental study hypothesis as the responses of all participants in the customs system confirm that the AEO status speeds up the movement of goods by road.

## 4.2 Analysis of the Queuing Systems Findings

The measurements at the Schengen border crossing Obrežje registered 4462 heavy goods vehicles (HGVs) entering the territory of the European Union.

In addition to the basic characteristics of transportation and the frequency of crossing the border, the recorded data obtained for all 4462 HGVs also included measurements of flow times related to performing various administrative and other activities. Border crossing by HGVs from Croatia to Slovenia includes freight forwarding, veterinary and phytosanitary inspection, customs, and police on both

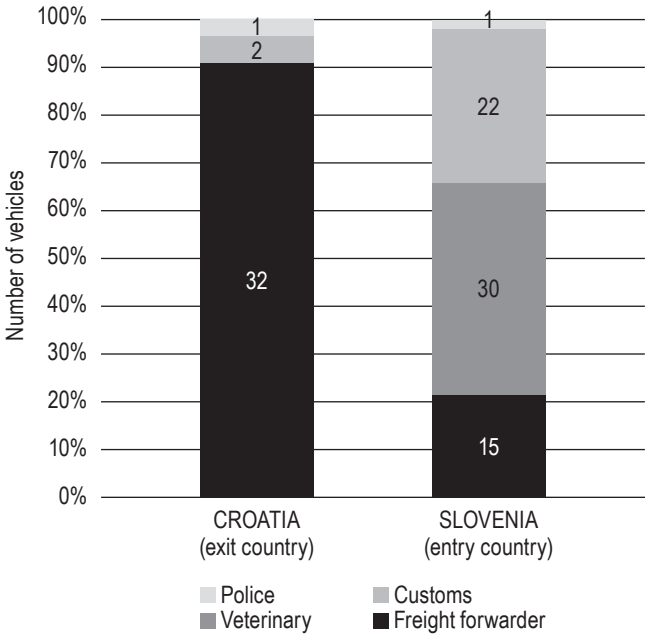
Figure 2: *Number of HGVs crossing the Schengen border crossing Obrežje.*




*Adapted from Pilotni projekt merjenja pretočnih* časov *tovornega prometa na mejnem prehodu Obrežje, by Ministrstvo za infrastrukturo in prostor Republike Slovenije, 2010, Ljubljana, Ministrstvo za infrastrukturo in prostor Republike Slovenije.*

the Croatian and Slovenian sides of the border. This activity comprises eight procedures, some of which significantly impact the flow times and delays of certain vehicles within the border area, while other procedures have a minor impact on flow times. At this point we need to emphasize the fact that not all HGVs are required to perform all eight procedures within the border area; the number varies depending on the transported cargo.

Figure 3: *The ratio between the average queuing times in the performance of individual activities.*




*Adapted from Pilotni projekt merjenja pretočnih* časov *tovornega prometa na mejnem prehodu Obrežje, by Ministrstvo za infrastrukturo in prostor Republike Slovenije, 2010, Ljubljana, Ministrstvo za infrastrukturo in prostor Republike Slovenije.*

Based on available data for crossing the *C*roatian–Slovenian border in the present study, we consider the unique data for all eight consecutive procedures within the border system. However, as we are analyzing the single-channel queuing system, we assume that both loaded and empty vehicles (either with or without the AEO status) are placed in one queue and will carry out the procedures sequentially.

In the analysis of the observed system, we used the basic version of the queuing system marked M/M/c, which presupposes that the distribution of the input movement and the time of queuing are distributed in accordance with the exponential rule (Hudoklin-Božič, 1999). First, we calculated the probability that servers are already occupied when each vehicle arrives, which means that the newly arrived vehicles have to wait. The probability that the servers are busy (C(c,ρ)) in the M/M/c system can be calculated using the following expression, which is defined as a function of the number of servers and their utilization (Cloud & Rainey, 1998):

$$C(c,\rho)=\frac{\frac{(c\cdot\rho)^c}{c!}\cdot\frac{1}{1-\rho}}{\sum_{n=0}^{c-1}\frac{(c\cdot\rho)^n}{n!}+\frac{(c\cdot\rho)^c}{c!}\cdot\frac{1}{1-\rho}} \quad (2)$$

where $c$ is the number of servers while ρ presents their utilization. Furthermore, the utilization (ρ) can be expressed as a multiplication between arrivals intensity (λ) and averaged serving time (*Ws*) divided by the number of servers $c$.

$$\rho=\frac{\lambda\cdot Ws}{c} \quad (3)$$

Once the utilization measure and the probability that the servers are busy were obtained, we calculated the average number of vehicles waiting to be served ($L_q$) using the following expression (Cloud & Rainey, 1998):

$$L_q=\frac{\rho\cdot C(c,\rho)}{1-\rho} \quad (4)$$

Within the illustration of the system performance, we calculated the average waiting time ($E$) in the line for each HGV using the expression from Cloud and Rainey (1998):

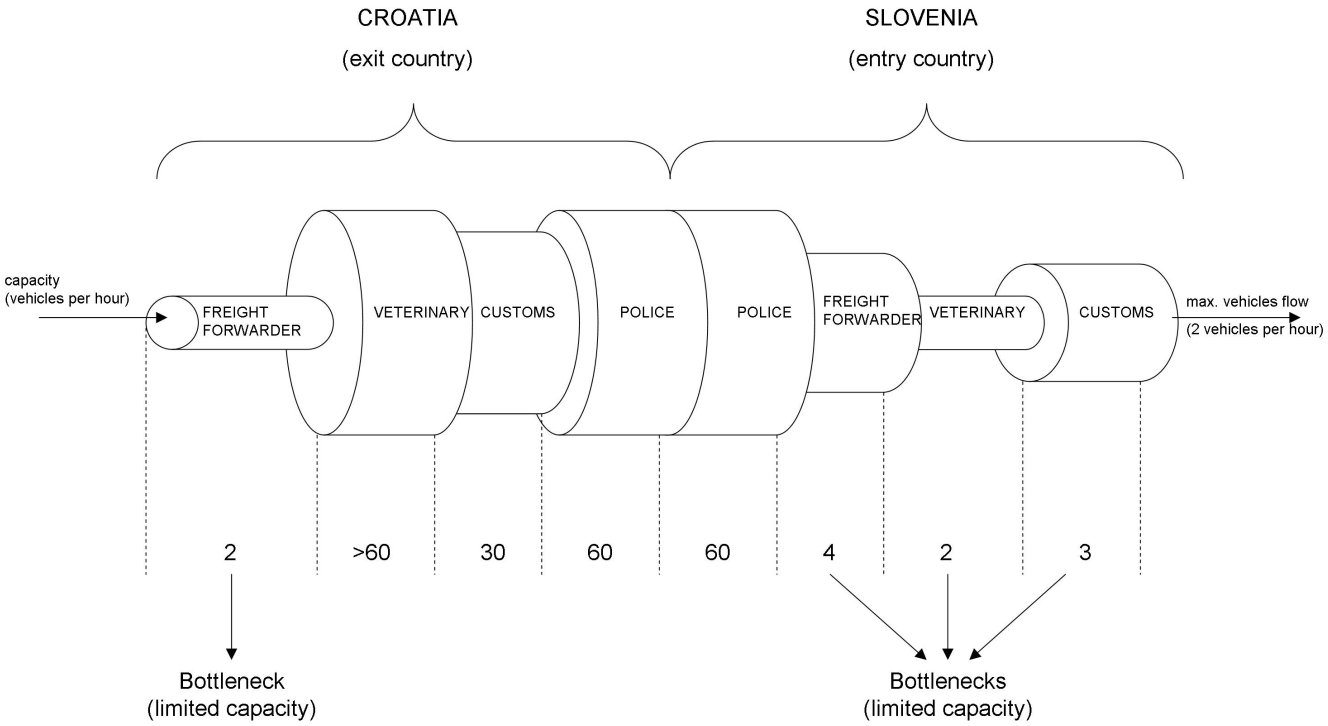
$$E=\frac{Ws}{c\cdot(1-\rho)} \quad (5)$$

The analysis shows that four service points present a sufficient number of servers to enable a balanced operation of the system.

Based on the performed analysis, in which we took into account four service points, we established that we can improve the actual state by 36% based on the 30% reduction of the time spent for the customs procedure. In fact, given an average queuing time of 23 minutes, the HGVs wait for an average 138 minutes (86% of the time is spent waiting, and only 14% of the time is spent performing their duties). Thus, a 30% reduction of time spent for the customs procedure would shorten the average queuing time to 18 minutes. In addition, the time spent waiting within the system could be reduced to 18 minutes if the customs procedure were reduced by 30%. Vehicles would spend 50% of their time waiting, while the other half would be devoted to performing duties after passing through the border system.

Based on the performed analysis, we also found that the analyzed system of border crossing requires synchronous adjustments in the infrastructure at border crossings. Thus, the increased intensity of the arrived vehicles opens up additional service points in the context of those tasks known to be the most time-consuming within the border crossing system.

**Figure 4:** *Bottlenecks and limited capacity for crossing the Obrežje border crossing.*




The results of the analysis carried out in the case of the Obrežje border crossing show the principles of the set supporting the hypothesis of the study. As established herein, the infrastructure at road border crossings must be adjusted in order to optimize the speed at which goods move by road in accordance with the AEO status. The present border system often uses only a single-channel queuing system, which our study has shown to be ineffective. Based on the calculations, we ascertained that the four-channel system proves to work quite well at a low input flow. We also note that it would be reasonable to establish special lines for empty vehicles and vehicles with the AEO status in the analyzed border system. In fact, if all vehicles are placed in the same line, the time needed for processing all the vehicles would depend on the weakest link in the line.

## 5 Conclusion

On their way from source to consumption, goods are—among other more or less necessary stops—also delayed by customs. Due to customs controls, the same movement of goods entails both economic operators and customs administrations. To perform its control function, customs must stop goods. On the other hand, the flow of goods, or the "trade river," is increasing every day due to globalization (Rushton et al., 2010; Waters, 2009), and stopping it presents a growing problem for customs.

The most burning issue refers to the traditional control systems as the growing movement of goods makes it impossible to perform a strict physical inspection of each consignment—an issue that creates inefficiency for all participants in the customs system. All participants in the movement of goods are aware of this and acknowledge that, without exception, conventional customs control impedes the processing speed of the movement of goods.

This situation led to the need to find an appropriate arrangement. A special case of unburdening the supply chains at the point of movement of goods from one customs administration to another can be found in the status of an AEO, which is the result of the customs initiatives of the European Union to allow the safe operation of supply chains according to established self-control while eliminating administrative barriers at the crossing of international borders (Burgermeestre, Hulstijn, & Ton, 2010). Despite the fact that membership in the AEO program is voluntary, effective self-control is compulsory. An economic operator must prove to be a safe and secure partner even during the process of acquiring AEO status, and this status must be properly maintained in all future operations.

The quantitative survey conducted in this study demonstrated that the participants in the customs system believe that having AEO status speeds up the process of movement of goods by road. Based on respondents' answers, we can conclude that the benefits arising from the AEO certificate have a significant impact on speeding up as well as a positive impact on the functioning of economic operators in the context of international trade. On the other hand, in the second part of the empirical study of the hypothetical case, we established that the infrastructure at border crossings does not permit full exploitation of all the benefits offered by the AEO status. The Obrežje border crossing mostly

functions on the principle of establishing a single-channel queuing system; only in the case of a high intensity of arrivals would another channel for empty vehicles be implemented. Thus, in this case, having the AEO status does not present any benefits as the queuing system treats those vehicles that are or are not AEO certified equally.

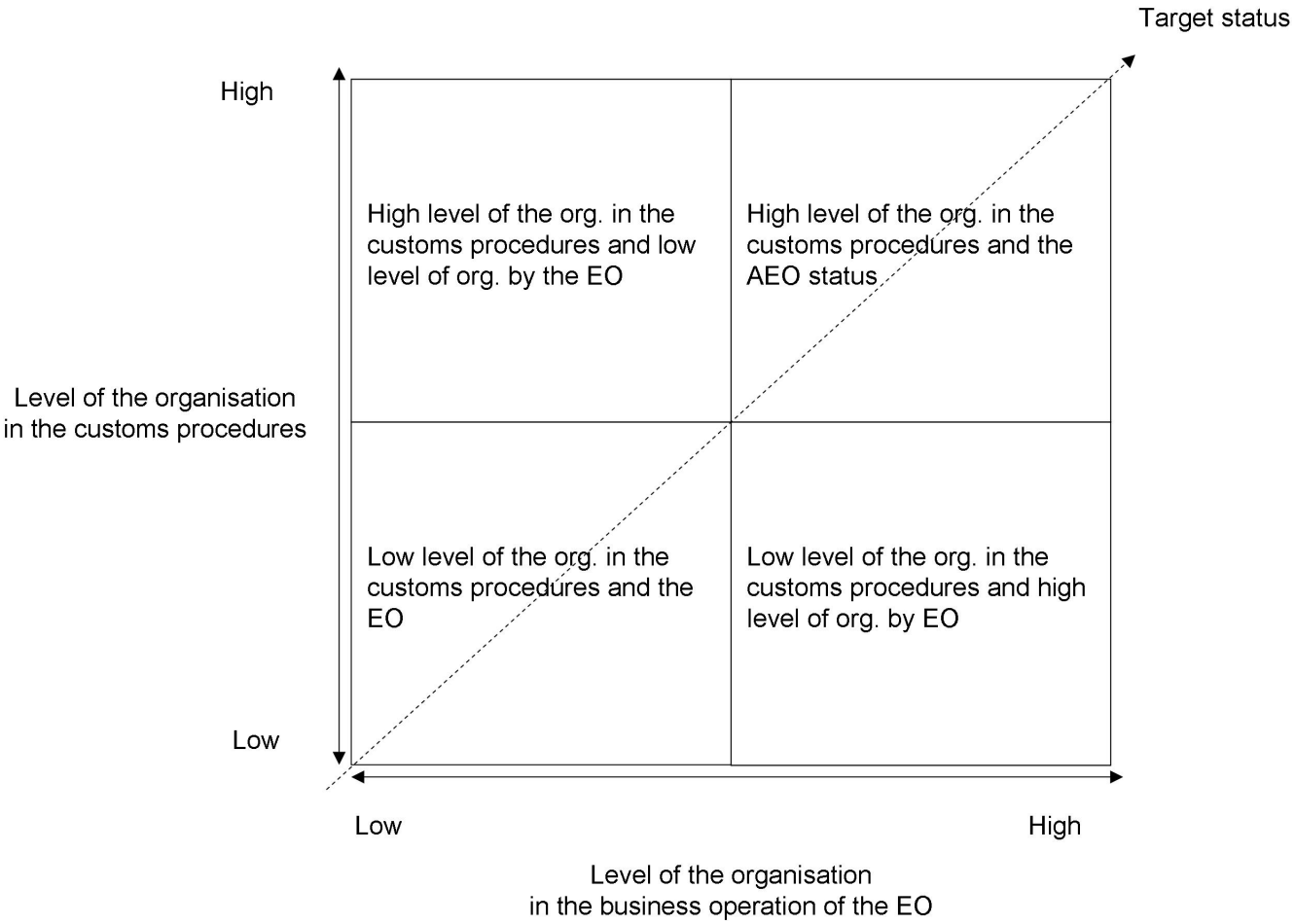
Figure 5 shows the correlation matrix between the degree of the organization of customs procedures and the degree of business organization of the economic operators. Based on the matrix presented in the context of traditional customs controls, we can say that the customs authorities have a high level of organization whereas the economic operators have a low level of organization. Rarely, especially in the context of customs controls in less developed countries, would we say that the customs authorities have a low level of organization while the economic operators have a relatively high low level of organization (especially those who export to more developed and demanding markets). However, the key target of the study is a high degree of organization of both participants in the customs system or the studied meta-system.

We noticed that two systems that regulate their relations by means of the resulting meta-system meet at the crossing of goods through the administrative customs territory. The inter-system or meta-system relations are formed according to the principles of cybernetics. The latter "deals with the abstract principles of the organization within complex systems" (Heylighen & Joslyn, 2001) and does not focus on the construction of the system, but only on its performance. Even François (1999) attributes the original meaning of cybernetics to the organization and coordination of the individual elements; regarding the relationship between the volume of information and the level of organization, he summarized Wiener's (1948) views, who believes that the amount of information in the system represents its own level of organization while the entropy in the system means a degree of disorganization.

In referring to the adjustments needed in the organization of the economic operator to acquire the AEO status, we do not consider only the indirect impacts on its own system, but also the impacts on the customs system. The customs system, while providing certain benefits to the holders of the AEO status, affects the business systems and at the same time its own system.

In the further exploration of the AEO phenomenon, it will be necessary to determine whether the introduction of

**Figure 5:** *Correlation of the level of organization in two systems: customs and the economic operator.*



this status actually delivers all of the promised benefits. It would be interesting to see whether the systems that have not been or will not be included in the meta-system of the AEO program achieve a lower level of efficiency and performance in terms of time consumption in the operation of supply chains in comparison to the economic operators with the AEO certificate. Wasting time is determined as an economic failure. Economic performance presents a mandatory requirement in the survival of business systems and, thus, the entire modern society.

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