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Abstract: Increasing interest in perishable cargo transport and logistic services is connected with international trade growth, as well as technology and markets development. Shippers, carriers, forwarders, and logistic operators pay more attention to the quality and complexity of delivered food services within a supply chain. In particular, it refers to seaports functioning where perishable cargo is handled and different logistic services are delivered. The aim of the study is to focus on and explore the concept of comprehensive service development in seaports related to perishable cargo, and to determine the stages for developing this service in container terminals and ports refrigerated warehouses. This study is the preliminary step for a comprehensive service for perishable cargo development in seaports for the current literature. The levels of the comprehensive service development were determined. As a result, an algorithm for the implementation of a comprehensive logistics service for perishable goods in seaport was proposed.

Introduction

Transformation in economics have influenced the seaports' operation conditions. The globalization of the world economy, international economic integration, and the growing competition in the port services market caused changes in shaping the relationships between ports and their external environment (Pluciński 2013). The observed logistics integration and network orientation in the seaports have redefined the functional role of ports in value chains, and have generated new approaches to distribution and freight port hierarchy (Notteboom and Rodrigue 2005). The initiatives taken by seaports are

aimed at the extension of the economic functions, especially the distribution and logistics functions, as well as the provision of services with increased added value. This is connected *inter alia* with the tightening of seaports customers' requirements, who currently choose the seaport from the perspective of the entire land and maritime transport chain (Klimek and Dabrowski 2013, Kotowska 2015), paying special attention to the services cost and operational time, as well as to the reliability and comprehensiveness of services.

The primary task of the seaport is a *versatile service* of transport means, goods, and passengers at specialized and properly equipped terminals (Szwankowski 2000, Grzelakowski and Matczak 2006). One of the cargo types serviced in seaports are perishable goods, which are handled in seaports both in the refrigerated warehouses and container terminals (Filina-Dawidowicz and Postan 2015). According to Arduino et al. (2015), nowadays the strong competition between bulk and containers transportation of perishable goods is observed that influences the way of cargo delivery, and consequently ports terminals development.

On the basis of the conducted observations, it can be stated that the role of seaports in perishable cargo servicing is being reevaluated. The increasing competition still puts the question to the ports: what will be the most efficient ways to improve the competitive position? Nowadays, the location, available area and access to the port, possessed infrastructure and equipment, maintenance costs, and intermodal connections are mentioned among the main factors affecting the port's competitive position. Striving to strengthen this position, the ports make investments which include, among others, infrastructure and technical equipment development as well as management and information systems implementation aiming at reducing the maintenance time, minimizing the cargo damage risk, capacity improvement, etc. For these initiatives, various funding sources are explored (Mańkowska 2014).

The available analysis revealed that besides improving the quality of cargo service and the expansion of range of services, the main development directions of seaports specializing in the maintenance of perishable goods include comprehensive customer service implementation and improvement (Filina-Dawidowicz and Postan 2015). A study conducted in Polish seaports shows that according to the container terminals' opinions, the comprehensive service for this cargo is important and influences the customers' satisfaction (Filina-Dawidowicz and Gajewska 2016), however, this service has to be improved. According to Solak Fişkin et al. (2015), the development of new services in intermodal transport is still needed. For this reason, it can be stated that the development of new services connected with the existing services in one comprehensive service may be the option that determines ports' competitive advantage.

The conducted literature analysis shows that the issue of perishable goods comprehensive service in seaports has not been sufficiently examined. Therefore, the objectives of this paper are to present the concept of comprehensive service for perishable cargo in seaports, to investigate its development stages, and to describe the implementation algorithm for this service development.

1. The concept of comprehensive service for perishable cargo at seaports

On the port territory, different services may take place. These services can be disposable, connected with planning and organization of cargo, vessels, and means of land transport, as well as technical, dealing with operations performance, such as overloading, storage, movement, etc. (Misztal 2010). The range of services provided in seaports can be very wide, and, besides typical handling and storage services, they include, e.g., co-packing, sorting, consolidation, co-manufacturing, e-fulfilment, pooling, etc. (Klimek and Dąbrowski 2013). One of the approaches to divide services for perishable cargo at the port container terminal and refrigerated warehouse is presented in the study of Filina-Dawidowicz and Postan (2015), where the groups of basic, additional, specific, and logistics services are highlighted.

The idea of comprehensive service relating to the perishable cargo in seaport consists of performing the activities required by a customer simultaneously in one place by one operator responsible for the execution of these activities within one complex service. It means that the client does not purchase individual services from the separate providers, but receive the whole services necessary to ensure the proper logistics cargo service from one operator. The concept of comprehensive service considers:

- a wide range of services (basic and complex) conducted consequently and/or parallel in seaport,
- one agreement for a comprehensive service,
- one price for the set of services, and
- one responsibility for a comprehensive service assumed by the provider who carries out unified supervision over the implementation of services.

The advantages of comprehensive service development in seaport may be as follows:

- the decrease of service time, connected *inter alia* with organizational changes, the implementation of solutions and procedures that improve service process organization, as well as the minimization of the number of formalities during the implementation of separate services by many contractors;
- reduction of logistics costs;
- the improvement of the quality of seaport services that influences the increase of customers' satisfaction and makes the process of ordering the services more efficient and comfortable for customers;
- the improvement of information flow between stakeholders, e.g., customs, veterinary board control, port authority, shipping agencies, etc.; and
- increasing the effectiveness and efficiency of the entire transport and logistics chain, allowing to improve deliveries under "Just in time" strategy, etc..

Since different stakeholders are involved in a perishable cargo service in seaports, their activities have to be integrated. The structure of the participants in port's services include:

- customers (e.g., shipping companies, rail and road carriers, forwarders, cargo owners, etc.);
- port organizations (e.g., port authority, terminals operators, ports logistics centers providers, warehouses operators, etc.); and
- other institutions (e.g., customs, border veterinary control, other companies providing services, such as containers repair, cargo insurance, goods advertising and distribution, etc.).

The implementation of a comprehensive service in seaport requires:

- the infrastructure necessary for the execution of different services (e.g., quays, storage areas including separated yards equipped with plugs for refrigerated containers, warehouses, offices, roads, railways, x-ray, scales, etc.);
- equipment (e.g., containers gantry cranes, rail cranes, reachstackers, forklifts, as well as systems of temperature control and others, GPS, RFID, etc.);
- efficient management centre supported by IT platform (allowing free flow of information and the integration of all processes provided at seaport);
- participants' network, joining different institutions and companies; and
- highly qualified personnel involved in providing a comprehensive service.

The listed conditions have to interact and be integrated into one system. While modeling the relations between the system's elements, a process approach is recommended.

The concept of a comprehensive service performance in seaport is presented in Fig. 1. Using a comprehensive service management centre, customers select a service or a package of the needed services, transmit necessary data, and book a comprehensive service from a provider. Then the provider contacts all the subcontractors and other required institutions through the system, agree, and instructs the realization of the contracted services. After accepting the order by the provider, the customers are in constant contact with the management centre to receive the relevant data, control the service time, and track online the cargo servicing steps. The comprehensive service fee is paid by customers according to the provider's tariff on the basis of the signed agreement.

The comprehensive service management centre is the stem of this concept. It provides complex service management, allowing to collect, process, and distribute real-time individual and collective data to appropriate participants, as well as coordinates processes, integrates stakeholders, and ensures network connection by using systems, e.g., GPS, GNSS, etc. Every user has their own account in the management centre, and can transmit and receive the necessary data.

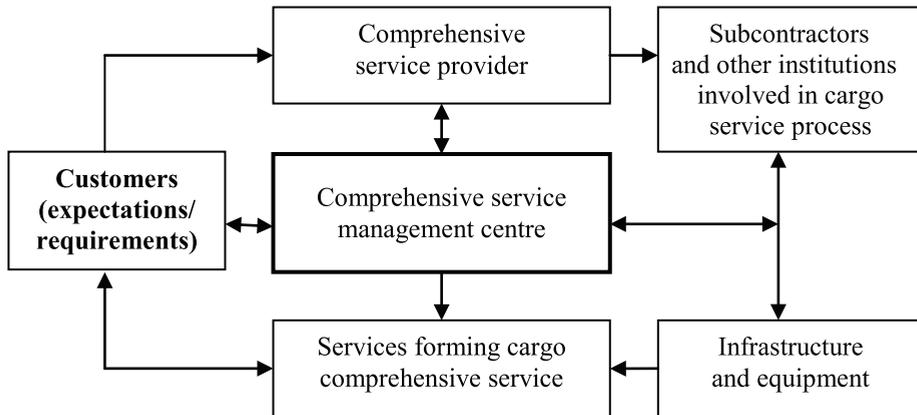


Fig. 1. The concept of a comprehensive service performance in seaport

Source: own elaboration.

The similar management approach was introduced in Szczecin seaport, which as the first in Poland implemented the Single Window system at the container terminal. The system is a platform where cargo declarations, information about cargo, relevant documents checked by forwarders, customs, importers, and inspections held by relevant institutions, such as border veterinary, sanitary, and phytosanitary inspections, etc., are located. One Stop Shop is another example introduced by Szczecin seaport authority in cooperation with the customs, DB Port Szczecin, and other institutions. Its idea is to check goods simultaneously in one place by all the interested inspections. The forwarder representing the importer's interests and the port operator's representative participate in the control (Port Szczecin 2016).

The concept of perishable cargo comprehensive service considers the integration of all these systems under one comprehensive service management centre that facilitates and accelerates the implementation of individual processes. This system has to be open for new services, new subcontractors, and other users, as well as it has to enable the deployment of innovations and know-how. As the example, the implementation of applications on smart phones that helps easily pre-book the services may be considered (Sándor and Csiszár 2013).

The range of services forming a cargo comprehensive service has to be flexible. Customers decide what kind of services they will purchase. One of the important issues is the appropriate selection of services, that on one hand will meet customers' expectations, and on the other, enrich the port's offer of value added services. For this purpose, the services' needs may be estimated by carrying out a survey among the customers. On the basis of the analysis of the respondents' answers and the profitability assessment of services implementation, it will be possible to select the required services and provide the best match of the seaport offer to the clients' expectations.

While forming services offer, it is suggested to divide the services into independent modules. Each module may have several services. This approach will facilitate services shaping and management (1, 2).

$$C_s = \sum_{i=1}^n M_i, \quad (1)$$

$$M = \sum_{j=1}^m S_j(t, p, q, r), \quad (2)$$

where:

C_s – comprehensive logistic service,

M – service module,

n – number of services modules offered by seaport,

m – number of services in the particular module,

S – individual service,

t – service time,

p – service price,

q – expected quality of service,

r – the number of participants involved in service execution.

Initially, the introduction of new services may cause service time increase. It is understandable because a seaport may not have sufficient experience in this field. Enriching the experience and professional level of personnel, as well as planning parallel actions by management centre will help to reduce this barrier.

2. Levels of the comprehensive services development

Taking into consideration the generations of ports development (Semenov et al. 2008) and seaports transformations (Marek 2012), the levels of comprehensive service development in seaports can be determined (Table 1). The lowest level is I, and each higher level is replenished and expanded with additional functions.

Nowadays, the IVth level of comprehensive service is implemented in the majority of seaports. Level V is under construction. It considers the integration of all supply chain participants, centralized management of all processes, the implementation of large scale innovations, and building up the services on the highest level.

Table 1. Levels of comprehensive service implementation in seaports

Indicator	Levels of comprehensive service implementation				
	I	II	III	IV	V
Seaport role	the place of goods delivery and trade	integrator of roads and sea routes	binding link of integrated transport chains	the transport network node, centre of logistics and distribution services	integrator of supply chains, services, and stakeholders
Infrastructure and equipment	typical handling and storing	specific for different transport modes and cargo types	needed for service quality and range growth	specific for logistics and distribution services	wide and advanced range, logistics, and industrial centres development
Services	basic handling and storage	basic, specific for cargo	additional services development	logistic services development	wide expanding range of services
Integration of services	separate services	attempts to integrate individual services	service packages creation	integration of all services within a terminal/port	full integration within a supply chain
Service management approach	individual decisions	separated responsibility	separate tasks management	centralized management	centralized, opened for innovations
Information flow	limited information scope, slow flow		improved, two-way	comprehensive, real-time, two-way	comprehensive, centralized, real-time, two-way
IT implementation	not available	single individual solutions	selected groups of technologies	advanced information and communication technologies	complex and advanced, integrated systems
Participants	limited number	moderate number	increased number of services providers	wide range of services providers	wide range, easy access for new users
Customers' influence on the range of services	limited	moderate	increased	high	high

Source: own elaboration on the basis of Marek (2012), Semenov et al. (2008), and Pluciński (2013).

3. The implementation algorithm for the comprehensive service of perishable cargo in seaport

The development process of new services include several stages, such as problem identification, idea generation, concept development and evaluation, business analysis, concept development and testing, market testing, commercialisation, and post evaluation (Shekar 2007). These stages may be supplemented by service strategy development, opportunities identification, needs analysis, and detailed investigation of the processes provided in the organization.

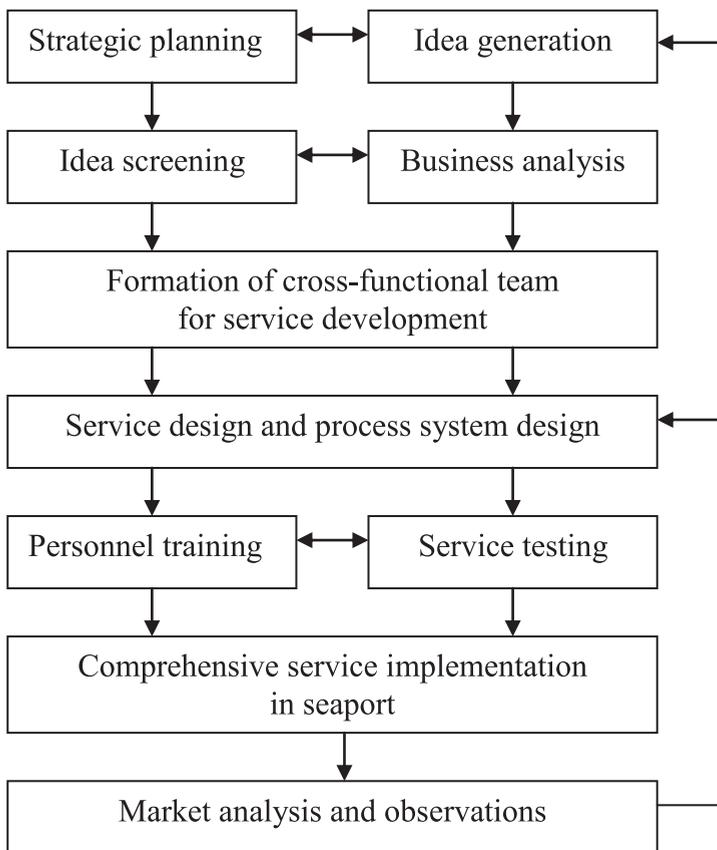


Fig. 2. Implementation algorithm for the comprehensive service of perishable cargo at seaport

Source: own elaboration based on Alam and Perry (2002).

The process of comprehensive service development has to take these stages into account. The algorithm of comprehensive service implementation for perishable cargo

in seaport is shown in Fig. 2. The presented stages may be conducted both in a sequential and parallel way. The stage of service design and process system design in this case have to include the development of comprehensive service management centre, IT platform expansion, organization of all necessary processes (services) conducted with technical and human resources involved.

In the implementation process of a comprehensive service in refrigerated warehouses and container terminals, common stages can be distinguished. This service can be implemented separately on the container terminal and port refrigerated warehouse. Minor differences will arise connected with the work specificity and range of services forming the comprehensive service within these objects. Considering the infrastructure available in the refrigerated warehouses, it can be assumed that it will be easier to organize delivery of services from logistics services group. Refrigerated warehouses have a more convenient possibility to provide cargo distribution or other specific logistic services, such as food labelling and packaging, loading units forming, polonization, etc.

When possible, the most efficient solution is to organize cooperation between a container terminal and a refrigerated warehouse, that will allow to supplement and exchange services for perishable cargo within the seaport territory. It is reasonable to take into account the tendency of the cargo mass transfer from bulk to containers, and thus undermine the position of refrigerated warehouses. However, this solution involves expensive investments to the common management system application.

Conclusions

The subject undertaken in the article is up to date and in line with modern trends of maritime economy development. Its purpose was to develop the framework of development of a comprehensive service of perishable goods in seaports. The main contribution of the article is the determination of comprehensive logistic service concept and elaboration of stages and an algorithm for comprehensive service implementation at seaport. The main benefits of the proposed solution may affect service time and costs reduction, as well as the improvement of food supply chain. However, the implementation of this service requires investments into the arrangement of a management centre, development of an IT platform, extension of a range of services, and the application of modern technologies.

The presented research results may be interesting not only for ports customers, but, above all, for seaports that through the implementation of a comprehensive service will be able to increase the service quality and improve the realization of complex logistical tasks in port, and, consequently, raise its competitiveness level.

Determination of the individual services forming particular modules, modelling the range of services within a comprehensive service in Polish and foreign seaports, and the extension of the concept to all food supply chains will be the subjects of further research.

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ETAPY ROZWOJU KOMPLEKSOWEJ OBSŁUGI ŁADUNKÓW SZYBKO PSUJĄCYCH SIĘ W PORTACH MORSKICH

Słowa kluczowe: obsługa kompleksowa, ładunki szybko psujące się, porty morskie, etapy rozwoju obsługi

Streszczenie: Wzrastające zainteresowanie usługami transportowo-logistycznymi ładunków szybko psujących się jest związane z rozwojem handlu międzynarodowego, technologii przewozowych i zmianami rynku. Przewoźnicy lądowi i morscy, spedytorzy, jak również operatorzy logistyczni zwracają coraz większą uwagę na jakość i kompleksowość usług świadczonych na rzecz żywności w ramach łańcuchów dostaw. Dotyczy to przede wszystkim portów morskich, w których przeładowywane są ładunki szybko psujące się i świadczone są rozmaite usługi logistyczne. W niniejszym artykule uwagę skupiono na badaniu istoty rozwoju kompleksowej obsługi ładunków szybko psujących się w portach morskich i określeniu etapów rozwoju tej usługi na terminalach kontenerowych i chłodniach portowych. Niniejszy artykuł stanowi uzupełnienie dostępnej literatury o badanie wstępne w zakresie rozwoju kompleksowej obsługi ładunków szybko psujących się w portach morskich. Określone zostały poziomy rozwoju kompleksowej obsługi portowej. W wyniku przeprowadzonych badań zaproponowano algorytm wdrożenia kompleksowej obsługi logistycznej ładunków szybko psujących się w porcie.

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