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RESEARCH ARTICLE

The structure, modules, services, and operational process of modern electronic freight and warehouse exchanges

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Abstract

The study begins with a description about the services of freight and warehouse exchanges currently available on the internet, then, continues to point out their shortcomings. Based on this, it demonstrates the aims, structure and services of a logistically and economically ideal electronic freight and warehouse exchange system. The demonstration of the modules and operational process of this system is done with the help of other systems developed by the author himself. The closing section elaborates the expected effects of the previously described electronic freight and warehouse exchange system when applied in practice.

Keywords

electronic commerce (e-commerce) · electronic freight exchange · electronic warehouse exchange.

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1 Introduction

With the help of the internet, information can be sent to participants of business processes in the fraction of a second, which, by accelerating and optimising these processes, facilitates an easy overview and comparison of supply and demand.

For this reason, electronic marketplaces have emerged in numerous fields, such as freight exchanges in the field of highway carrier services [1]. Freight exchanges create a meeting point for freighters and consigners. Consigners can advertise their freight for shipment in the catalogue of the marketplace; similarly, freighters can make their bid for cargo holds, or they can pick the most suitable offer by using different search algorithms. This study aims to demonstrate the structure and services of a freight and warehouse exchange developed by the author.

2 Types of current freight and warehouse exchanges and their shortcomings

The internet facilitates a forum for logistic service providers to advertise their service supply, such as transport and storage on the worldwide web; whereas customers can choose the offer which best suits their needs. The most widespread form of freight exchanges on the internet nowadays can provide only a single advertising surface for both the consigner, who wishes to have its freight transported, and the freighter, offering the vehicle capacity of its transporting vehicle. More sophisticated freight exchanges can ensure the advertising of freight and cargo hold offers, as well as the filtering and evaluation of these by putting in a separate application. However, even these freight exchanges focus only on displaying and searching for offers in a catalogue format, and they do not ensure other forms of transactional solutions (e.g. how to advertise or choose offers).

Warehouse exchanges [1] – similarly to freight exchanges – sell free warehouse space either with a simple advertisement or by using an application which enables a search function. The most complex form these days is when both freight *and* warehouse exchanges occupy a single advertising surface, where one can display his freight, cargo hold, and warehouse space bids, as well as search among these offers in a catalogue format. Such exchange types enable to get hold of shipment- and warehouse

capacities for goods relatively easily, and to find a transport commission for vehicles of transport. Nevertheless, because underdeveloped transactional solutions set back the development of such exchange types, the overall structure of freight and warehouse exchanges is supplemented by the author by showing other modules and services too, in the forthcoming sections of the study. These could be important and useful items in the future.

3 The structure, participants and aims of freight and warehouse exchanges

When describing freight and warehouse exchanges, it is practical to handle the freight and the warehouse exchange as two separate modules, which display for the end-user on a single surface. Accordingly, the author has worked out two sample systems: an electronic freight exchange (further as: *E-carriage*) and an electronic warehouse exchange (further as *E-warehouse*) [1].

In contrast to current freight exchanges, *E-carriage* offers the following new services (in addition to advertising of and searching for offers in a simple catalogue format):

- calling for tenders to implement freight commissions;
- automatic offer sending;
- generating commissions;
- possibility to prepare multi-faceted statistics;
- keeping blacklists;
- data maintenance (archiving-deleting-adjustment) functions.

The *E-carriage* has four participants: consigners, freighters, contact persons, and the service provider. The aim of the electronic freight exchange is to advertise freight and cargo hold offers, to choose suitable offers based on complex optimum criteria, to generate commissions, and to provide additional functions. All participants can make a bid on this freight market, and they can also carry out a search in relation to advertisements of the other page. The structure and modules of the *E-carriage* is shown by Fig. 1.

Current warehouse exchanges display parameters of the warehouse only in part. In contrast, the *E-warehouse* displays each and every significant parameter of the warehouse space systematically and professionally. Electronic warehouse exchanges, too, have basically four main participants: customers with goods, warehouse service providers and their contact persons, as well as the system service provider. The aim of electronic warehouse exchanges is to offer warehouse capacities, to choose offers based on well-defined and complex optimum criteria, as well as the rendering of additional services. On this marketplace, it is the owner of the warehouse capacity who can make the bid, which is then chosen by the owner of the goods, using multi-criteria based, versatile optimum-search algorithm. The structure of the warehouse exchange is similar to the one shown by Fig. 1, with the difference that instead of freight capacity, it is warehouse capacity which stands in the centre of the business.

4 Major services of the *E-carriage*

Entering personal data, identifying users of the system. When a new customer who has not used the system before wants to register, his personal data and contact details must be entered. Also, you can specify here the filtering criteria which are necessary for the automatic offer sending, and you can also add your personal negative experiences (individual negative comments about exchange members you previously had business relations with).

Freight offers, entering transport commissions. This function is used by consigners to specify the details of their freight (e.g. point of shipment, destination point, freight weight and surface parameters, terms of payment).

Freight offers, searching for transport commissions with a catalogue. Freighters can do a search based on carrying capacity, surface parameters, route of transport, and a time window which is monitoring the date of the delivery. You can also search for back loads here. Freight offers are also available without the search function, when examining all offers at the same time.

Entering cargo hold offers. Freighters can offer their own transport capacities by displaying all relevant information (expected point of shipment and point of destination, type of the highway carrier or equipment, its carrying capacity and surface parameters) on the freight exchange.

Searching for cargo hold offers with a catalogue. Freighters can do a search based on freight weight, freight parameters, route of transport and a time window. You can take a look at the whole cargo hold offer here, too.

Automatic offer sending. After giving our personal data, the system allows us to enter filtering criteria which will help us to choose quickly from the latest offers. Such criteria are: received time of offer-, limitations on weight or size of the offer (cargo hold or freight).

Obtaining a transport commission through tender. Experiences show that only tenders for high- value freight are worth advertising on the freight exchange. Since the transportation market is saturated, freighters would not be allowed to call for tenders for their own cargo hold capacity. The organiser of the tender specifies the features of the freight in the subject of the tender (freight weight, size and value of the load surface), the point of shipment and the point of destination, as well as tender parameters (freight charge, warranty, due date, start and end date of the tender, other aspects). Usually, the tender is won by the freighter who offers the lowest fare; in case of more aspects, the order of importance comes as follows: fare, due date, and warranty details. Generally, it is worth considering other aspects, too, when evaluating tenders, such as:

- spatial dimensions of the service;
- range of service;

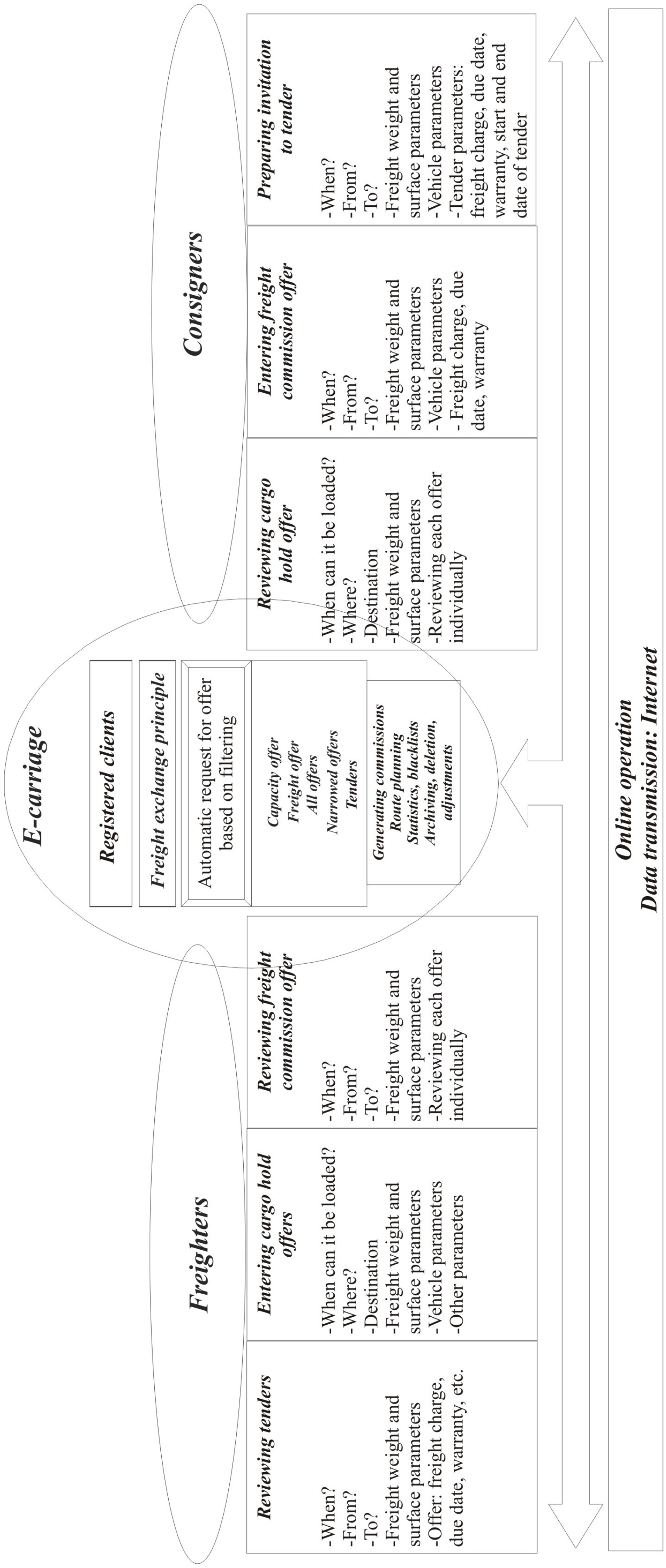

Fig. 1. The structure and modules of the *E-carriage* / electronic freight exchange

- if there exists an own vehicle fleet;
- references from the industrial sector in question;
- credit; the credence we give to the freighter in that he is able to see the assignment through.

Based on the above aspects, a multi-criteria and decision helping algorithm [2], [3], [4] helps us to choose the optimum service provider. To this end, as a first step, main and sub-aspects must be defined, to which weighted numbers are given. After this, taking every main aspect and sub-aspect step by step, we choose the value of the most favourable offer, and compare all other offers to this, see (2). The next step is to calculate the weighted performance value of each offer based on (1). The value we get will be between $0 \ldots 1$, this will determine the most favourable offer, namely, which has the highest [4] weighted performance value (E_k). It is recommended to prepare separate tenders for the different freight offers on the freight exchange, as this will help to choose the freighter who can best complete the assignment. Freight exchanges tend to have one consigner, who invites tenders, which in turn will be answered by the freighters' offers. More detailed information about tenders can be found in the author's publications [5, 6].

Generating commissions. Consigners can prepare their commission for the freighter who won the commission. This is valid both for freights advertised in the catalogue or at auctions.

Route mapping. Perhaps the most useful feature for freighters is that they can map their itinerary. Lineation of route, distance, journey time, and some additional information can be found here.

Reliability of consigner: personal negative experiences and blacklists. This function allows the display of consigners who had failed to pay, or unreliable freighters, either by leaving a personal note or operating a global blacklist.

Preparing statistics. Statistics characterise the functioning of freight exchanges.

Archiving, deleting, adjustments. Offers which are no longer valid must be archived and deleted from their original location. Adjustments can come in handy in case of deletions made by mistake.

$$E_k = \sum_{i=1}^{f} w_i \sum_{j=1}^{a} w_{ij} R_{kij} \tag{1}$$

$$\begin{aligned} R_{kij} &= \frac{T_{ij\,\min}}{T_{kij}} \text{ if } T_{ij\,\min} \quad \text{is the most favourable} \\ R_{kij} &= \frac{T_{kij}}{T_{ij\,\max}} \text{ if } T_{ij\,\max} \quad \text{is the most favourable} \end{aligned} \tag{2}$$

E_k – weighted performance value of alternative 'k'
f – total number of main aspects
a – total number of sub-aspects
w_i – weighted number of main aspect 'i'
w_{ij} – weighted number of 'j' sub-aspect of 'i' main aspect
T_{kij} – value of alternative 'k' as seen from 'ij' sub-aspect
T_{ijmin} – smallest value of alternative from 'ij' sub-aspect
T_{ijmax} – biggest value of alternative from 'ij' sub-aspect

5 Major services of the *E-warehouse*

Entering personal data, identifying users of the system. Similarly to freight exchanges, users' data must be entered. (Users: owner of the goods, warehouse service provider and its contact person)

Advertising free warehouse capacities. This function can be used by companies who have free warehouse capacity. Outdoor and indoor storage space must be separated, as by their nature, they require different data. In case of outdoor storage units, the following data must be provided: size of the storage space, its covering, strength of the cover, the provided logistic services, safeguarding, flammability of goods, service price, due date, payment warranty, availability date of free storage unit, warehouse location; opening hours. In case of indoor storage units, the following data must be provided: type of storage system, storage unit, parameters of maximum size and weight of the goods to be stored, number of holds, type of goods to be stored, goods excluded from storage, area and inner height of the storage unit, flammability of goods to be stored, the provided services, safeguarding, service price, due date, payment warranty, availability date of free storage unit, warehouse location; opening hours.

Searching for free warehouse capacities. Goods owners have two ways to choose the warehouse capacity they need: either they review all offers, or they apply some search filters. In case of outdoor storage units, the following search filters are available: warehouse location, size of the storage space, the strength of its covering, start date of usage. Because indoor storage units have more complex features, it is recommended to use more search filters: warehouse site location, storage system, storage unit, maximum size and gross weight of the storage unit, number of holds, and start date of usage.

Negative experiences, blacklists: Same as for freight exchanges.

Additional services: Here, cost calculations can be made in consideration of the size of the storage space, and the time span during which it will be used.

6 Rough operational process of the electronic freight and warehouse exchange

Fig. 2 shows a possible operational process of the electronic freight and warehouse exchanges. After registration, customers' personal data and their offers made are saved in the personal/transactional data. These offers are ready for search, and offers after filtering are available. The width of the arrow shows the expected difference between the amounts of offers. Among the offers that can be searched, one may also find tenders. In case of regular offers (i.e. excluding tenders), getting in touch is done in the usual way (telephone, e-mail, fax). Having once chosen the suitable offer, a commission is prepared, or one may also make his/her itinerary with the help of the route mapping function. Data stored can be used to prepare statistics/ blacklists. Old and no longer valid offers can be archived and deleted;

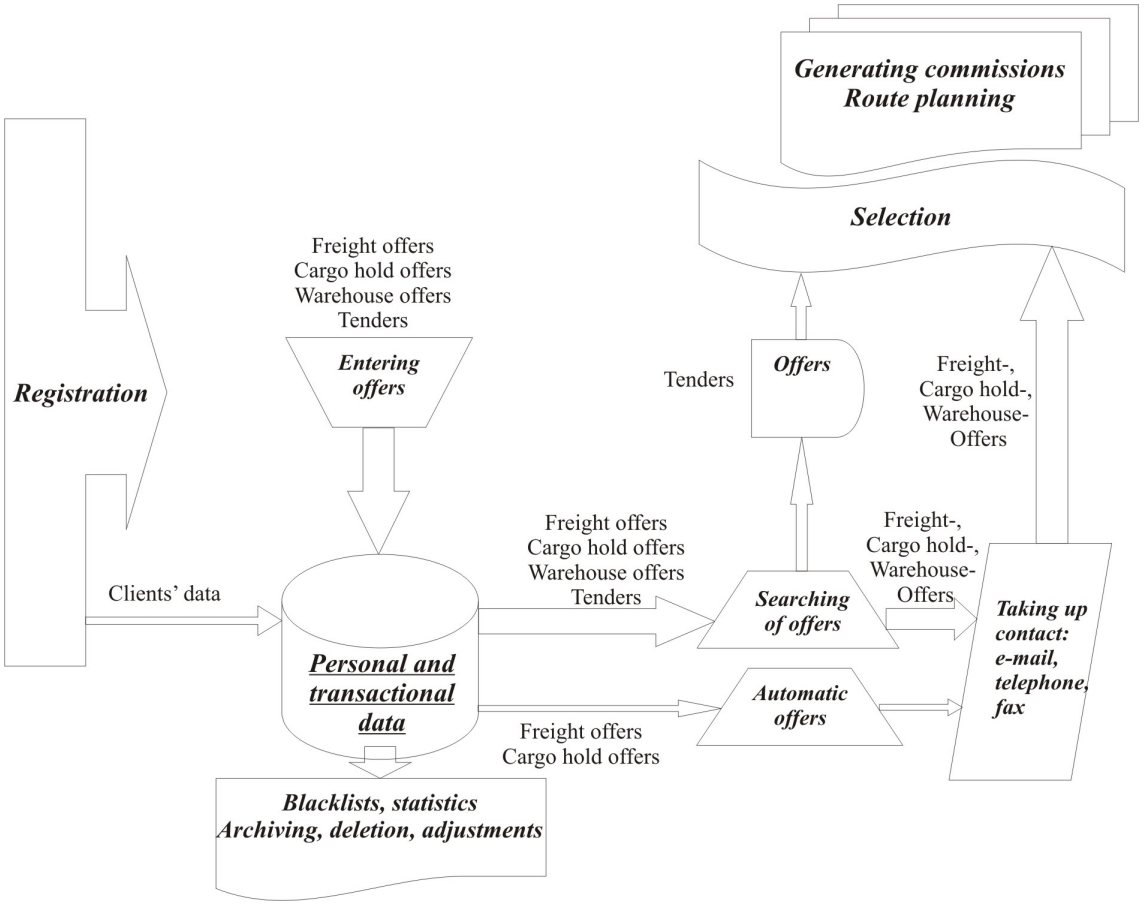

Fig. 2. One possible operational model of electronic freight and warehouse exchanges

deleted items can be restored.

It is clear from the above description, that the *E-carriage* and *E-warehouse* systems follow the whole business process through, starting from receiving the offers, searching and making a choice, up to the point of making the agreement itself, and thus they provide a solution more comprehensive than ever before.

7 Conclusions: main effects of electronic freight and warehouse exchanges on exchange participants

Increasing market competition. Currently in Hungary, the number of virtual market meeting points for freighters and consigners is inconsiderable. With the appearance of *E-carriage* as a new electronic transportation service provider, we will have more possibilities. This could entail an expanding of the services and a decrease in charges. The wide transactional services of the *E-carriage* will spur other service providers to develop similar solutions. Consequently, other markets will create their own system of carriage tenders, which will increase the competition between the freighters. However, such tenders are likely to be won by big freighters.

A decrease in freight charges. The tender basically benefits those who offer the freight, since – as surveys show – it can bring about a decrease of 8.9% in the fare, saving considerably on costs. A decrease of fares is obviously unfavourable for freighters, but it is expected that they will strive harder to obtain high-value, and thus high-price carriages.

More carriages, better organisation of carriages. Freighters will have a wider range of possibilities, because they can choose from a database including thousands of freight offers, and moreover, they can offer their own capacities. This means, they can pick their own customised commissions, and they can draw up a plan for forthcoming periods. There will be fewer "empty runs" and vehicle utilization will improve.

An extensive database of freighters appears. If sufficiently filled up, the system will have the data of thousands of freighters; therefore, customers wishing to have their goods transported will have a variety of options for choice to meet their requirements. A great advantage of public databases is that offers can be compared in a flash, which eliminates extremes in prices.

Increasing importance of electronic carriage mediators. Currently, service providers only ensure the channel between the freighters and the consigners. By introducing this new system, the provider of the market may become more influential in some services. He must monitor the implementation of tenders continuously. Their first and foremost task is to decide whether the freight value calls for a tender, or not. Then, they can determine whether freighters, who make their bids, can complete the commission. By maintaining blacklists, they can eliminate unreliable customers from the market.

The whole business process becomes simpler and faster. E-

carriage supports the whole business process from choosing the right offer to bidding right up to the preparation of commissions. Everything can be handled with a single application, and, once the bid is accepted, there is no need to prepare the commission using another system. The process of choosing shortens and becomes more dynamic.

Fulfilling the 6M principle will be easier. Using *E-carriage*, the appropriate goods will have a better chance to reach their designated place in time than nowadays. This is ensured by terms of payment specifications, as well as warranties against qualitative and quantitative damages both in case of catalogue freights and tenders. Tenders generating lower fares guarantee cost reductions. Simple catalogue systems can provide warranty, too; however, they cannot provide for a reduction in fares. The high number of freighters guarantees that the commissions will be fulfilled. This eliminates late arrivals, and as a direct consequence, standstill in production.

Standard of transport services will improve. Guarantees safeguard for any damages which might occur; and if so, they ensure that dropouts (goods damage and production standstill) are made up for. These factors and the competition will make freighters improve the standard of services they provide.

Competencies of customers can be built in. Due to the available preferences of customers regarding logistics services customers play an active rule in value proposition, users are able to actively shape these services (e.g.: electronic value added features in the CEP services) [7].

Major positive effects of E-warehouse solutions, in addition to the above mentioned:

- empty warehouse space can be filled up easily;
- the most suitable warehouse service can be chosen;
- offers are easily comparable;
- cost calculation can be made;
- enables a long-term forecast.

Should electronic freight and warehouse exchange systems become international, they could help us find storage- and warehouse space for our goods in many countries; as well as get hold of international transport commissions.

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