

Efficiency in Transport Logistics: an Academic and a Practical Viewpoint

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Abstract The present article aims to define the term efficiency in the field of transport logistics. First the definitions to be found in the literature are scrutinized. An attempt is made to distinguish efficiency from effectiveness, performance and cost-effectiveness and to determine how they are interrelated with each other. Then, in the second part of the paper the practical side of efficiency is researched by examining a number of projects dealing with some aspect of transport logistics, trying to capture the characteristics that could contribute to efficiency. These features are found to be the application of telematics, the dissemination of information and improvement of management, the intermodality, the invention of new techniques and technologies and the presence of sustainability.

Keywords: efficiency, transport logistics, projects

1. Introduction

Evaluation of logistic systems is becoming more and more important, and efficiency is mentioned frequently, but what do we exactly mean by efficiency? How can we distinguish it from effectiveness and how does it relate to the performance of the company? What projects are launched to enhance efficiency? In the next section of the paper the authors try to discern efficiency from performance and effectiveness, keeping in mind the area of application, that is, transport logistics. After having discussed efficiency from an academic aspect, the practical side is also investigated by looking into numerous projects dealing with transport logistics. Our aim is to pinpoint those major areas or common features of these projects which seem to be significant in boosting efficiency.

2. The definition of efficiency

Even only using our common sense, we can be aware that efficiency, performance, effectiveness and cost-effectiveness are all terms closely interrelated with each other. In order to give the most appropriate definition of efficiency we have to start with looking at performance.

2.1. Performance

Due to its all-encompassing nature and extreme popularity, it is very difficult to find a single definition of performance [10], and indeed few authors give an explicit definition for performance but treat it as an axiom [23]. Webster's New World College Dictionary defines performance as "1) the act of performing; execution, accomplishment, fulfilment, etc. 2) operation or functioning, usually with regard to effectiveness, as of a machine 3) something done or performed; deed or feat 4) a) a formal exhibition of presentation before an audience, as a play, musical program, etc.; show b) one's part in this" [17]. The Dictionary of the Hungarian Language has a slightly different emphasis. First, there is no reference to the meaning listed in the Webster Dictionary under 4), as in the Hungarian language "performance" as translated to "teljesítmény" lacks this meaning. Then, the definition goes as follows: "the quantifiable, data-like result which can be reached by someone or something in the course of work or other professional activity in a given timeframe." (Dictionary of the Hungarian Language) Very significant part of the definition is the "data-like" nature of the result, which is characterised by different authors in a different way.

According to Leigh "only that can be considered as the performance of a company which contributes to the improvement of value/cost ratio", while Kaplan and Norton [13] regard performance as a merely financial category, and try to capture the "data-like" result referred to above by applying different financial indicators. Another aspect of performance is highlighted by Otley [19], who defines the notion as the effective realization of the aims of a company. This approach is reflected by Adams and Kennery [1] as well, where the above mentioned aim is also given: "the aim of the organisations is to serve the consumers more effectively and efficiently than its rivals do". Thus performance is characterised by effectiveness and efficiency. This view is shared by Chikán and Demeter [5] also, who quantify performance using effectiveness and efficiency.

Kaplan and Atkinson [12] determines three dimensions of performance: service, quality and cost; and then creates key performance indicators according to these dimensions which can help verify whether the performance reaches the expected standards. Whereas Folan et al [10] determine the three governing objectives of performance as the following: the action carried out must be 1) standardized, non-random 2) quantifiable and 3) it must retain a relevance to the performer. So again we see that the quantifiable, data-like character of performance emerges. Domonkos [7] identifies 7 dimensions of performance: effectiveness, efficiency, quality, productivity, labour quality, innovation and profitability. The most widespread view, however, sees performance as a result of only four components: cost-effectiveness, effectiveness, productivity and efficiency

[24]. From all the definitions above it seems to be clear that efficiency is one dimension of performance and this is where we want to proceed from in the next subsection.

2.2. Efficiency

Having established that efficiency is one dimension of performance we can go further by looking at this notion through the work of different authors. According to Marosi [15] “that organisation can be regarded as efficient which can achieve its aims successfully with a satisfying, or acceptable ratio of costs and results (or generally speaking, inputs and outputs).” The same idea can be detected in the work of Dobák [6] who says that “efficiency is the capability of a company to realise its stated objectives, and to use its available resources cost-effectively.” Webster’s Dictionary also defines efficiency in a similar way, according to which efficiency is “1) the ability to produce a desired effect, product, etc. with a minimum of effort, expense or waste; a quality or fact of being efficient 2) the ratio of effective work to the energy expended in producing it, as of a machine; output divided by input” [17]. The same view is shared by Borotvás et al[4] when they discuss that the essence of economic efficiency is whether certain investments can under the given circumstances provide for the best utilization of the resources.

The definitions cited above indicate clearly the two-sidedness of the notion efficiency. First, it can be viewed as a ratio, or even just as a relationship, between the inputs and outputs of a company. In this case efficiency is a quality of performance that can vary in a continuous (i.e. non-discrete) way and the stated objectives of the organisation are not necessarily present in the definition. This approach to efficiency is also mirrored by Drechsler [8] and Román [20], and to some extent by Kaplan and Norton [13] and Györfiványi [11]. On the other hand, a company can be viewed as efficient when it can reach its predetermined objectives, when it can create the desired effect. This approach is seldom utilised without the other; nonetheless, the Dictionary of the Hungarian Language defines efficiency by “effectiveness”, i.e. power to produce effects or intended results (Dictionary of the Hungarian Language).

Keeping in mind the definitions and usage of the term efficiency in the literature cited above, efficiency can be defined as follows: “The ratio of the products, services and other results produced during a given activity and the resources utilised for their production.” This definition has several advantages: with its help efficiency can be objectively measured by mathematical applications, for example data envelopment analysis (DEA) and it can easily be adapted to transport logistics[23] Thus, according to the authors of the present paper efficiency in transport logistics shall be defined in the following way: “The ratio of the services and other results produced by the logistics firm and the resources utilised for this production.” The authors believe that this ratio describes well that non-discrete feature of performance that we generally understand under efficiency.

2.3. Effectiveness, cost-effectiveness and productivity

In order to see clearly in the cobweb of notions surrounding performance and to distinguish them from efficiency, the authors wish to define three further concepts, the other dimensions of performance: effectiveness, cost-effectiveness and productivity. It is of utmost importance to define effectiveness, as it seems to be the counterpart of efficiency, and it is also often intertwined with it. In our view effectiveness determines how the given organisation can reach its predefined goals, i.e. this is the “other side” of efficiency. It has nothing to do with inputs, it only shows how the outputs, that is the results, match the predetermined objectives [23]. This approach is also backed up by Bauer and Berács [3] and also by Osborne and Gaebler [18]. As Webster’s Dictionary also states, effective “is applied to that which produces a definite effect or result” [17]. Consequently, effective is a company in the field of transport logistics if it can reach its predefined goals.

Cost-effectiveness, on the other hand, deals with inputs: it shows how economically the available resources have been utilised during the given activity [23]. According to Webster’s Dictionary cost-effective means “producing good results for the amount of money spent; efficient or economical” [17]. As we have been able to see, in the common language these notions are often explained with each other, however, it is vital that in the scientific field they are properly distinguished from each other. Thus we can say that a logistics firm is cost-effective if it utilises its resources economically for the production of its services.

Productivity shall also be connected to the input side of the production process, as it emphasizes how much input is needed for the production of one unity of output. Its most popular form is labour productivity, which expresses the amount of labour required for the production of output [4]. Figure 1. illustrates the difference between the different dimensions of performance.

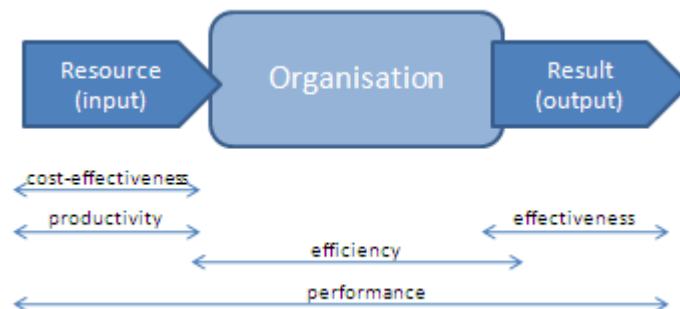


Figure 1. The place of “efficiency” within the different dimensions of performance
(Source: own edition as based on [23] and own research)

3. Projects contributing to efficiency

Having defined efficiency and its peer-notions, the authors of this paper reviewed a number of European level and national research projects with the sole objective in mind of pinpointing the factors that can or could contribute to efficiency when applying the results of these research works. Being perfectly aware that such a summary could never be complete, some themes have however emerged as fields which seem to be significant in efficiency enhancement. The application of telematics, dissemination of information and improvement of management, intermodality, invention of new techniques and technologies, the presence of sustainability are the sometimes overlapping fields around which the majority of projects can be clustered. While highlighting the different areas we were intent on giving examples which illustrate best the significance of the given theme, although the same project could be important in a different field as well.

One part of current national and European level projects have the aim of making a greater use of the possibilities lying in modern telematic systems. These contribute to efficiency through better localisation (tracking and tracing) of the vehicles or even the freight being transported. The most significant European research projects relevant to this field have various goals: creating a common and harmonised tracking and tracing in the road and railway sector (CESAR II), tracking and tracing on parcel level in the same transport modes using RFID (ParcelCall), surveillance and protection of the goods in the road sector (ASAP), enabling the transportation of the goods in a transport crate equipped with RFID (iBoS), creation of a virtual fleet for the small haulage companies to make them more competitive (TROP), port organisation, better navigation, sustainability (EFFORTS), the creation of a freight transport monitoring system and a transport chain management system for intermodal chains (D2D), use of freight information in the railway environment (FIRE), monitoring cross border train movement in real time (BRAVO), offering one-stop-shop freight managements for SMEs (GIFTS) and rail car asset management (F-MAN). Thus one element of efficiency could be that of the use of telematic systems which provide the companies with more reliable information on the place (and recently sometimes even the state) of the goods.

Another dimension of efficiency is the availability of information needed for more efficient operations. There are a number of projects which deal with the dissemination of information and with the efficient tools of information. Examples include projects with the aim of creation and dissemination of logistics best practice (BESTLOG), of dissemination of information (CENTRAL LOCO), of making available information and communication tools for secure and efficient information exchange in intermodal chains (SESTANTE), of managing and integrating information on the inland waterways (IP), of creating a global integrated transport logistics data network for intermodal chains (GILDANET). A closely related field is that of the enhancement of management, which is not only achieved by higher quality information but harmonised standards as well. Projects that can be mentioned in this field aim at the creation of an improved management and information exchange (FREIGHTWISE), the harmonisation of standards (D4D) or the invention of a terminal simulation system (TRAPIST) [22], [25].

Another echelon of improving efficiency is that of intermodality, the enhancement of which has long been a priority of the European Union. In order to achieve intermodality,

a number of new systems are being developed. Examples include umbrella projects covering different transport modes on European level, like the Vessel Traffic Management and Information System (VTMIS) integrating several systems, such as the Automatic Identification System (AIS) and the Long Range Identification and Tracking (LRIT systems) in maritime transport, the River Information Services (RIS) for inland waterways, the European Rail Traffic Management System (ERTMS) and the European Air Traffic Management System within SESAR (Single European Sky ATM Research) [9]. Of course, several smaller projects could also be cited as example here, but as they are in the reach of other themes as well, they are not mentioned here, but under the heading of “intermodal chains” within their given topic.

Novel techniques and technologies together with new IT solutions can also provide important steps towards more efficient transport logistics. The following European level projects invent new technical solutions and thus influence the efficiency as well: VRSHIPS-ROPAX, with the goal to examine ship technologies through the creation of a platform; BRAVO, to monitor cross border train movements in real time; FASTRCARGO, to create a new loading system in order to speed up loading/unloading at the railways; CARGOSPEED, to accelerate cargo and rail interchange, INTEGRATION, for integrated and improved ship-shore systems, INTERGAUGE, to create a new freight movement technology for railways and ISTU to invent an integrated standard transport unit for self-guided freight-container transportation systems on rail [22].

Table 1. Examples from the different fields (source: own edition)

	Road transport	Rail transport	Inland waterways	Ports and/ or maritime transport	Intermodal chains
Telematics	CESAR II	CESAR II		EFFORTS	D2D
	ParcelCall	ParcelCall			
	ASAP	FIRE			
	iBoS	BRAVO			
	TROP	F-MAN			
	GIFTS				
Information and management	BESTLOG	BESTLOG	BESTLOG	BESTLOG	BESTLOG
	CENTRAL LOCO	CENTRAL LOCO	CENTRAL LOCO	CENTRAL LOCO	CENTRAL LOCO
			IP	TRAPIST	SESTANTE
	FREIGHTWISE	FREIGHTWISE	FREIGHTWISE	FREIGHTWISE	FREIGHTWISE
			D4D		GILDANET
Inter-modality		ERTMS	RIS	VTMIS (AIS, LRIT, etc.)	not applicable
New technology		BRAVO FASTRCARGO CARGOSPEED		VRSHIPS-ROPAX	
	INTEGRATION			INTEGRATION	INTEGRATION
		INTERGAUGE ISTU			

Finally, paying attention to sustainability and external costs can also pave the way for more efficient operations especially now that the pressure is getting bigger on companies to incorporate these aspects into their management. Operating in a sustainable way can also amount to comparative benefit. Environmental awareness is in the focal point of more and more research studies [14]. Two, separate projects have dealt with this aspect of transport logistics as well. A Hungarian research project looked into the evaluation of transport alternatives from the point of view of sustainability, meaning that economic, environmental and social factors were taken into account with the same weights. Using a multitude of indexes the Simongáti introduced a model covering all these three features, calculated the SPI (Sustainable Performance Index), and showed how sustainability can easily be included into the managerial decisions [21]. A European level research project, RECORDIT aimed to help in the calculation of internal and external costs of intermodal transport thus propagating the choice of this transport model [22].

The present article has set the aim of defining the different notions clustering around efficiency in transport logistics. The authors have shown that next to effectiveness, cost-effectiveness and productivity, efficiency is one dimension of performance. Then the definition of efficiency in transport logistics for scientific purposes has been provided as the following: "The ratio of the services and other results produced by the logistics firm and the resources utilised for this production." It has been noted that this definition is particularly appropriate for the mathematical evaluation of efficiency. It has been shown that effectiveness is a peer-notion, and an organisation in transport logistics can be seen as effective if it can reach its predefined goals.

Then, reviewing numerous projects in the field of freight transport and transport logistics it has been identified that the application of telematics, the dissemination of information and improvement of management, the intermodality, the invention of new techniques and technologies and the presence of sustainability are the main areas around which the majority of efficiency boosting projects cluster. Future research work will include the evaluation of logistics organisations using the definition of efficiency delivered above, with special attention to the EU level and other projects which can contribute to their efficiency.

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