REDUCING WASTE IN TRANSPORT OPERATIONS

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Abstract: Road transportation is economically and environmentally inefficient in both developed and developing countries. Due to the heavy environmental and societal impact of road transportation, it is necessary to encourage the improvement of efficiency in road transport. A group facing increasing pressure and extensive waste in their operations is motor carrier operators. A major part of the literature on the subject of road transport operations either proposes an advanced transport route and network optimisation models or advanced leading edge technology as solutions to overcome the prevalent waste, but those solutions are not feasible to the motor carrier operators in developing countries or small operators in developed countries. The challenge is to reduce waste in their operations, primarily without investing in new technology. The ongoing study underlying this paper was inspired by the way Japanese automotive manufacturers managed to reduce operational waste and be competitive using less material and less equipment then their competitors outside Japan. The data in this paper is based on an interview study and one in-depth study of a carrier improvement programme. This paper sets out to outline a model for waste reduction without adding new technology.

Keywords: *transportation; inter-modal; information sharing; information systems; environment; smart freight.*

INTRODUCTION

Transport operations have been crucial to human survival in all post-gatherer societies and continue to be a requirement of a developed civilisation (McKinnon and Ge, 2006). Environmentally effective logistics systems are crucial to environmental sustainability (Litman and Burwell, 2006) and freight transport's direct impact on the ecosystem is testified by its large carbon footprint, amounting for over 14% of global greenhouse gas (GHG) emissions (Stern, 2007). Despite technology advancements, the supply chain continues to be the environmentally weakest link, particularly in transport (The Economist Intelligence Unit, 2008). Despite policy support and industry investments in favour of modal shift and inter-modal freight transport, the unabated growth of road transport continues (Behrends, 2009). In Megacities, the number of transports, on average, doubles every seventh year and this development is predicted to continue. In newly industrialised and developing countries, fuel consumption is typically not in parity with the economic growth, e.g., Iran faces on average a 5.5% annual increase in fuel consumption (Encyclopedia of the Nations, 2010).

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Independent of location in the world, transportation is considered wasteful and inefficient (McKinnon and Ge, 2006; Nanos-Pino et al., 2005; Sternberg and Stefansson, 2010). Looking specifically at transport operations, long waiting times for truck drivers (Ha et al., 2007; Sternberg, 2008), driver motivation issues and union related issues (Kerkvliet and McMullen, 1997), inefficiencies in loading and unloading (Tjokroamidjojo et al., 2006), slow administration (Sternberg, 2008) and inefficiencies related to slow modal shift (Woodburn, 2006) are some of the issues discussed. Other frequently noted inefficiencies are related to security-related procedures in logistics operations (Sternberg, 2008). The Motor Carrier Efficiency Study (MCES) literature review was a study financed by the U.S. Department of Transportation with the aim of identifying inefficiencies in motor carrier operations. The study identified inefficiencies belonging to five different categories: equipment/asset utilisation, fuel economy and fuel waste, loss and theft, safety losses (i.e., crashes) and administrative waste (data and information processing) (U.S. Department of Transportation, 2008). The study pointed out that there are potential economic gains, both for the carrier and the society in general, in overcoming inefficiencies, i.e., reducing waste. According to Blücher and Öjmertz (2008), *waste* is often used instead of the term—or as a result of—*inefficiency*. Inefficient is defined as 'not producing desired results; wasteful', and ineffective is defined as 'lacking the ability or skill to perform effectively; inadequate'. In traditional improvement work, the focus is often on optimising the value adding processes, but there is more potential gain if one reduces the operational waste. Hence, it is important for carrier operators to understand waste in their operations, as a first crucial step in order to improve efficiency and thus reduce the environmental impact of transportation. In this paper, all activities carried out by a transport operator that do not involve the physical movement of goods are considered waste.

A major part of the literature on the subject of road transport operations either proposes advanced transport route and network optimisation models or advanced leading edge technology as solutions to overcoming the prevalent waste (Crainic et al., 2009), but those solutions are typically not feasible to the motor carrier operators in newly industrialised or developing countries nor small operators in developed countries. Hence, the challenge and research question this paper sets out to explore is: *How can methodological improvements reduce waste in carrier operations?*

The studies underlying this paper were inspired by the way Japanese automotive manufacturers managed to reduce operational waste and be competitive using less material and less equipment then their competitors outside Japan (Liker, 2004). This paper sets out to outline a normative model for waste reduction without heavy investments in, e.g., information systems. It does not go in depth into technical possibilities, e.g., increasing tire pressure, how to decrease waste in truck transport operations.

LITERATURE FRAMEWORK

The goal of this section is to establish a common terminology for the paper and explain the terms and definitions that are used throughout the analysis. This paper gives an introduction to logistics management, green logistics and smart logistics systems.

Several studies have shown that reducing environmental impact is generally cost-saving and financially sustainable for companies (Wu, 1994). Truck transports have the largest share in the pollution from

transports. According to Opportunities for Rationalising Road Freight Transport (McKinnon, 1995), 'the amount of lorry traffic is influenced much more by changes in the organization of production and distribution than by variations in the physical mass of goods in the economy'. In this paper the operational level is in focus, e.g., how the carrier operators can improve the way they carry out their operations.

A framework for waste in carrier operations

Previous research (under review for publication) has suggested a waste framework of three main categories and six sub-categories:

Resource utilisation:

- *Waste in utilisation of vehicles in operation:* This category includes waste related to capacity planning, low utilisation of fleet, poor pairing of equipment, poorly planned maintenance operations, etc.
- *Waste during loading and unloading processes:* This category contains waste of waiting and inefficient movement during or in relation to the loading and unloading processes.

Driving and fuel usage:

- *Waste from damages:* Waste from damages includes damages to transported goods (leading to reduced compensation and uncompensated re-deliveries) and damages to equipment, e.g., trucks and trailers.
- *Waste from fuel usage:* Non-optimal driving style and behaviour lead to waste from fuel usage.

Administrative processes and information flow:

- *Waste associated with administrative processes and pricing:* Non-value creating, non-necessary administrative processes are categorised as waste associated with administrative processes. That includes excessive handling and carrying of printed documents. Waste from pricing is associated with taking on assignments not fully covered.
- *Waste related to information flow and planning:* Lacking information on routes/destinations, lack of IT-support and communication between traffic control and drivers results in waste related to information flow and planning.

The outlined framework is used as a point of departure of this paper.

Reducing waste in transport operations

Previous literature on empirical studies in logistics and supply chain management has often neglected the transport operators when studying logistics setups. Typically, the motor carrier operators are left out of logistics improvement programmes, due to the relatively low cost of truck transports (Zylstra, 2006), yet, due to the relatively large amount of goods a motor carrier transports and the small margins common to the sector, a small change in the operational costs can lead to major differences in profits (Kärkkäinen and Ala-Risku, 2003).

Loading and unloading operations, being one of the most inefficient activities carrier operators perform (U.S. Department of Transportation, 2008) has been gaining increased interest. Fugate et al. (2009) suggest several collaboration measures that can be carried out to improve efficiency of loading and unloading operations, e.g., information sharing, synchronisation of production and transportation and harmonisation of shippers' and carriers' equipment.

Looking at the driving operations of motor carrier operators, excessive fuel

consumption and damages have been reported as large sources of waste (U.S. Department of Transportation, 2008), with fuel consumption typically accounting for 28% of total expenditures in short-haul operation and damages sometimes being in parity with the net operating profits of carrier operators (Larsson and Westerberg, 2009). Gustafsson (2007) summarises several of the studies on the reduced fuel consumption by MCS implementations. She also found that programmes on fuel reduction tend to lose momentum after a few months. Driver incentive programmes have been documented to have a positive effect on waste reduction, but union regulations often oppose such programmes and other measures to decrease waste (Gustafsson, 2007; Kerkvliet and McMullen, 1997), yet that is typically not an issue in non-developing countries. Information exchange is a typical issue in carrier operations and a lot of literature suggests information systems to improve efficiency (Lumsden and Stefansson, 2007).

METHODOLOGY

This paper departs from the empirical need of new theories and methods to reduce waste in transport operations and derives new theories from both empirical data from carrier operations and existing theory on how to reduce waste. Hence, an adductive approach has been chosen (Kovács and Spens, 2005). The research behind this paper consists of three parts: a literature review, an interview study and a case study.

The literature review of Lean and motor carrier operations resulted in the study design, serving as the framework for the data collection. Open interviews, with interviewees encouraged to speak freely about the subject of waste in carrier operations, were conducted with five different categories of experts, related either directly to the carriers' operations or being experts on Lean and waste related to service operations. The experts were chosen with the aim of getting both the lean and transport operations perspective. The reason for choosing open-ended interviews with a limited number of experts was due to the novelty of the area and the exploratory nature of this research. According to Silverman (2006), this type of qualitative method is relevant since interviews that are carried out well study both meanings as well as causes. When selecting the interviewees in each category, the focus was on getting in as many relevant perspectives as possible, since production and transportation are related but do not *per se* belong to the same discipline (Stock, 1997). All interviews, except for the interviews with the Carrier Service Buyers, were carried out in person. Meeting notes were sent back to the interviewees for verification in order to increase reliability of the collected empirical data (Yin, 2003). The Carrier Service Buyers were interviewed through phone, with notes taken and sent back for verification. The experts were characterised as follows (n for numbering):

- Carrier Operational Manager (COMn): Three CEOs for motor carriers.
- Lean Expert (Len): Four Lean experts from industry, research institutes and academia.
- Business Analyst (BAn): Three business analysts, one of them being a sales manager for a major truck retailer, the other two working with a transport research company.
- Truck Manufacturer Manager (TMn): Three managers working for a major truck manufacturer.
- Carrier Service Buyer (CSBn): One logistics manager and one transport manager, working for two different companies related to small shop retail and restaurant distribution.

The interviewees were encouraged to speak freely on available measures related to improving carrier operations. In order to further develop a waste framework for carrier operations, the researchers did an in-depth study of a mid-sized carrier operator (80 trucks in regional distribution). Out of 15 carrier operators studied in terms of efficiency and routines, the case was chosen due to the carriers' rudimentary technology level [mobile phones, no DSS (Decision Support System)] and paper-based planning and transport execution as well as its programme for continuous improvement carried out for the past 8 years.

EMPIRICAL STUDIES

This section outlines the interview study and the case study underlying this research. The waste framework mentioned in the literature review was used to categorise the measures studied.

Measures to reduce waste in transport operations

The experts mentioned several ways to reduce waste in transport operations, as described in Tables 1–5. Due to space constraints it is not possible to further elucidate on the empirical data underlying this research. Measures suggesting a heavy investment were omitted, in order to fulfill the purpose of this paper

The experts only outlined the implementation of information systems (requiring technical investments) as the only way to reduce waste associated with information flow. Experts also commented that waste related to administration and pricing is also very difficult to tackle without information systems.

Case study

The studied improvement programme had been in place at the carrier operator for 8 years and resulted in an over 50% reduction of both delivery errors and accidents, as well as a 4-litre fuel consumption decrease per 100 km. The operating manager described the following steps as being crucial:

- Driving bonus system: Each driver gets a quarterly bonus if he does not damage goods or equipment
- Quarterly employee feedback discussion with the manager
- Yearly driver education on energy efficient driving and customer requirements
- Cash bonus when drivers detected an erroneous unloading destination on a transport order.
- Buy trucks with a transmission with increased interchange

The company believes in making the workers take responsibility of their work, says the CEO. The manager also suggests that in case an in-house work shop is used for maintenance and repairs, it should be split into a separate company and the transport execution should pay that company based on availability in order to improve routines.

Table 1 Measures to reduce waste due to resource utilisation

COM	LE	BA	TM	CSB
Repairs of trucks during weekend/ night-time increase availability.	Simple measures improve planning performance, e.g., increase transport planning time window.	Careful planning of bulky goods improve utilization.	Maintenance plans increase fleet availability. Repairs of trucks during weekend/night-time increase availability.	Open discussions with customers on how to coordinate goods flows.

Table 2 Measures to reduce waste in loading and unloading processes

COM	LE	BA	TM	CSB
Create agreements with other operators on measures to speed up authorization processes at loading and unloading sites.	Create agreements on responsibilities of goods during different processes.	Negotiate opening hours of terminals.	Provide correct technical support, e.g., unloading equipment, to enable fast loading and unloading.	Clear routines on transports of, e.g., perishables in order to avoid redeliveries due to damaged goods.

Table 3 Measures to reduce waste from damages

COM	LE	BA	TM	CSB
Minimise number of temporary staff (they cause more damages). Education programmes, e.g., together with insurance companies reduce damages.	Education programmes reduce damages.	(Not discussed)	(Not discussed)	(Not discussed)

Table 4 Measures to reduce waste from fuel usage

COM	LE	BA	TM	CSB
Measure and do statistics of fuel consumption.	Measure and do statistics of fuel consumption. Education on energy effective driving.	Education on energy effective driving.	Measure and do statistics of fuel consumption.	(Not discussed)

Table 5 Measures to reduce waste associated with administrative processes and pricing

COM	LE	BA	TM	CSB
Do not focus too much on resource utilization; rather, on profitability of assignments.	Implement flow organization instead of functional organisation. Regularly question manual routines.	Regularly question manual routines.	Check profitability of assignments and verify payments.	Follow routines on, e.g., consignment notes, in order to avoid extra administrative processing.

ANALYSIS

The aim of the analysis is to triangulate the findings from the literature, the interview study and the case study, in order to give some normative indications on measures to decrease waste in carrier operations. Due to the different types of carrier operators, different environments, legislations, etc., this research needs further testing and validation in newly industrialised and developing countries.

Framework of measures to decrease waste

Based on the previously outlined framework research (under review for publication), suggested measures have been compiled into the suggested framework.

Resource utilisation:

- *Waste in utilisation of vehicles in operation:* Optimise routines for maintenance and service in order to reach high availability of resources as suggested by the empirical study. Developing relations with frequent customers in order to develop improved routing was suggested by both literature and interviewees.

- *Waste during loading and unloading processes:* In order to develop improved loading/unloading routines, cooperation between different actors was suggested by both literature and interviewees. Clear routines and responsibilities were pointed out by several interviewees as crucial to avoid waste during loading and unloading processes.

Driving and fuel usage:

- *Waste from damages:* Both the interviewees and the case study pointed out education and monetary incentives as key measures to decrease waste from damages on goods, vehicles or other equipment.

- *Waste from fuel usage:* Education and, if possible, follow-up on fuel consumption as well as simple technical modifications were suggested as measures to reduce operational waste related to fuel usage.

Administrative processes and information flow:

- *Waste associated with administrative processes and pricing:* Carrier managers recommend not taking on non-profitable assignments, but rather to let a truck stand still. Lean experts, business analysts and the case study suggested flow based administration and continuous improvement to improve operations.

- *Waste related to information flow and planning:* Information systems necessary—requiring investments.

CONCLUSION

Achieving environmental and financial sustainability is a huge challenge for the logistics industry and in particular for the transport operators, who face increasing pressure to improve environmental sustainability and at the same time face decreasing operating margins in a highly commoditised sector. Of course this paper has not outlined a solution to these issues, but rather it suggests simple measures and continuous improvement to decrease operational waste in transport operations. This paper gives a normative managerial contribution by aspiring to inspire carrier operating managers to review internal efficiency of transport operations. The theoretical contribution of this paper is a basic framework for measures to improve carrier operations without monetary investments.

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