IMPROVING THE UTILIZATION OF TRUCK CAPACITY & CHANGING MODAL SPLIT IN REGIONAL FREIGHT TRANSPORTATION – A CASE STUDY FOR UPPER AUSTRIA

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ABSTRACT

The rapid growth of the transport sector is significantly affecting the economic region of Upper Austria because of it's strongly export oriented industrial structure. Road freight transportation dominates the Modal Split in Upper Austria and road infrastructure is pushed to its limits. Congestion and its negative effects increase. In public discussions, transit freight transportation is judged to be essentially responsible for the resulting problems of overloaded road infrastructure by trucks, congestion, bottlenecks, etc. However, in reality it is regional freight transportation (defined as having its destination or origin in Upper Austria) which accounts for 76% of total freight transportation volume in Upper Austria. There is still a lack of investigation into the potential improvements and opportunities associated with regional freight transportation. Through the optimization of truck utilization by using synergy effects as well as finding possibilities for shifting within the modal split, regional freight traffic can contribute to a reduction in traffic volume and in reducing emission of harmful substances.

Keywords: Transport management, Truck utilization, Empty running, Modal shift

INTRODUCTION

The first part of this paper attempts to show the developments in freight transportation with some statistics from various international and regional studies followed by showing the findings of a survey done by the authors between 2007 and 2009. The second part of the paper offers recommendations and possibilities to improve utilisation in road freight transportation and modal split.

Road freight transportation dominates the modal split both in the European Union and in Austria. This development can generally be explained by the so called “structure effects” like the goods-, logistics- and integration effect (Aberle, 2005; Kummer 2007). There is a tendency to smaller consignments, concentration on core competences, lesser depth of added value and the expectation of on scheduled deliveries. Transportation flows are dynamically affected by “modern” logistic concepts within the process of procurement, production and distribution. Additionally existing failures in traffic policy in general as well as national controlled rail operators have favoured this development. Due to the current dominant position of road freight transportation a migration to rail or multi-modal traffic is unlikely (Aschauer et. al, 2009).

Freight traffic in the EU 27 grew by 2.8% p.a. from 1995 to 2006 (Mahieu, 2009). More than 60% of transportation flows are transported less than 50 km whereas only 17% of the total amount of road cargo was transported more than 150 km. Goods transportation is dominated by short distance shipment. EUROSTAT found that the Austrian freight transport performance grew from 12.514 million tkm to 14.437 million tkm during the last decade. It is important to mention that the shipment of semi finished and finished products are only responsible for one-fifth of the transported volume but accounts for one third of the total ton kilometres in Austria (Pasi, 2008). For Austria the growth rate of freight transportation between 1999 and 2005 was 2.2%. 54% is domestic freight traffic followed by 23% bilateral freight traffic. 23% of total freight volume is transit traffic. Therefore 77% of freight traffic volume is “home made” meaning that the origin and/or destination is in Austria.

The federal state of Upper Austria, on which this case study focuses, is one of the main industrial areas in Austria. With its northern border to Germany and the CEE countries in the eastern proximity, a high freight traffic volume has developed based on long-term commercial relationships. The tri-modal traffic infrastructure (road, rail and IWW Danube) was a prerequisite for the development of export orientation however, nowadays it is not efficiently used. The region is responsible for over 27% of Austrian´s exports and has a forecasted total transportation volume of about 144,9 million tonnes per year in 2010 (Höfler, 2006). In 2001 freight traffic volume was about 117 million tonnes. Regional freight traffic (destination and/or origin in Upper Austria) has a share of 76% or ca. 89 million tonnes. Over three quarters of freight shipment is a direct result of the Upper Austrian economy. The government of Upper Austria predicted an increase from 117 million tonnes in 2001 to 176 million tonnes in 2020 (Höfler, 2006). This development is expected to lead to severe capacity problems in Upper Austria on the main road traffic infrastructure. Because of political and fiscal limitations the expansion of the (road) infrastructure is not realistic in the short term. Therefore organisational measures have to be taken more into account.

Truck utilization

Average loading weight in truck transportation was 13.1 tonnes in the EU in 2005. Empty load running fluctuates between 45% (Cyprus) and 17% (Denmark) whereas Austria with 27% can be found in the middle region of the member countries.

The share of empty load running is higher in trucks operated by the industry than in trucks operated by hauliers (Pasi, 2007). The findings of the World Economic Forum (2009) are that 24% of goods vehicle kilometres are running empty and when carrying a load, vehicles are typically loaded at 57% of maximum gross weight. For example in Germany empty running in road freight transportation is about 19.7%. A study focusing on trucks operated by the industry in Upper Austria in 2009 shows that empty load running accounts for 48% of goods vehicle kilometres (Starkl et. al, 2009).

McKinnon (1996) developed nine factors which have contributed to the trend of trucks running at low utilization or even empty: (1) deregulation of the road haulage industry, (2) externalization and outsourcing of road transport to third party providers, (3) cyclical activity in the economy, (4) increase in average trip length, (5) change in trip structure, (6) greater balancing of inter-regional flows, (7) greater use of clearing houses/load matching services, (8) increase in the recovery of packaging material and return of handling equipment and,(9) greater effort by hauliers and shippers to exploit opportunities for return loading. All these factors also have affected the development of regional road freight transportation and truck utilization.

FREIGHT TRANSPORTATION IN UPPER AUSTRIA

Methodology

This research project aims to find solutions to reduce regional road freight traffic through better truck utilization and through possibilities to shift cargo from road to rail or inland waterway within Upper Austria. The research work is divided into two parts:

1. Optimization of truck utilization and reduction of empty running of lorries. This part of the research work should be reached by an empirical survey with the responsible industry (loaders) in Upper Austria. The aim in this part is not to find possibilities to optimize utilization in transportation via changes in the logistics concepts within the company but to find possibilities for inter-company (between the different loaders) co-operation for better truck utilization.

2. Identify potential freight flows for rail or inland waterway transportation. Based on the findings of the survey, opportunities for shifting cargo from road to other modes in transportation should be developed.

There is a lack of data in Upper Austria about the transportation management and organisation as well as volumes of the leading loaders. Therefore the methodology to find out more about the main companies was based on the following approach:

Firstly, the data of traffic counting points on the main road infrastructure in Upper Austria (based on an average working day in 2005) was taken to get an overview of the traffic volume within the 18 districts of Upper Austria. Those districts with the highest traffic volume were analysed on the settled industry producing semi-finished and finished goods there. With data from former studies and business volume of the companies, a ranking was developed on the basis of an ABC analysis.

After developing a questionnaire, (including questions about organisation, transportation management, delivery destinations and procurement origins, knowledge about the different transportation modes, willingness to co-operation etc.) personal interviews were conducted in 24 companies and 52 companies were surveyed via an internet questionnaire. These 77 (predominant large and medium sized companies) are part of those 150 (out of 2000) firms which are responsible for over 80% of total turnover in Upper Austria within the production sector. The ranking was built excluding freight forwarders, hauliers and any other service industries.

The interviews were performed between spring and autumn 2008. Generally the willingness to co-operate was poor because talking about delivery destinations and procurement origins with transported volume has often raised confidentiality issues; Furthermore, firms often do not have enough information about their transportation key performance indicators because it is not part of their core competence.

Main findings of the survey

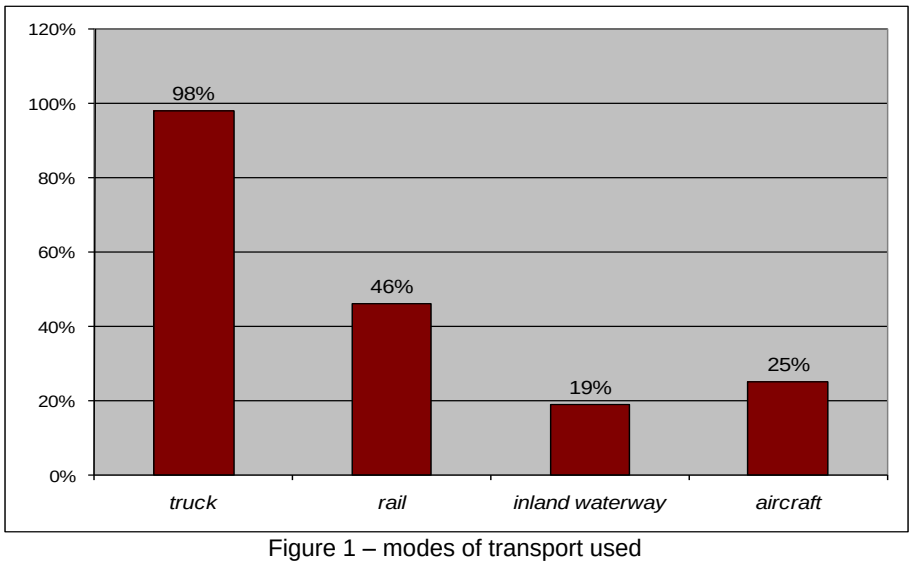

Figure 1 – modes of transport used

Truck transportation is used by all firms interviewed. Less than half of them use rail as a mode of transportation even though the larger companies were surveyed. This implies that there is a huge potential for shifting transportation volume to rail. 19% of the firms interviewed use inland waterways for transportation. Aircraft transportation is used by 25% of the firms but mainly for express cargo.

Another interesting finding is that only 20% within inbound transports and 21% in outbound transports are carried out by full truck loads (FTL). This means that 80% in inbound and outbound transportation in regional freight forwarding is less than a truck load (LTL). The bundling of inbound transportation flows at least by the haulier is done in 61% of the cases. This implies that still one third is not bundled. Outbound transportation flows are bundled in 74% of the cases.

INCOTERMS have a specific influence on the management of truck utilization. If firms use EXW (ex works) with inbound transportation they have the opportunity to influence mode of transport, truck utilization, etc. However, this makes procurement more complex and there is a need of transport know-how in the purchasing department.

Usage of types of Incoterms like DDP or DDU means less managerial effort with the transport but less power to influence utilization of the truck. The survey result is that both groups of Incoterms are widely used. 87% use the group of DDU/DDP and 71% also use EXW which means that they would theoretically have the possibility to influence and plan FTL or use other transportation modes. Only 55% of the interviewed companies expressed a readiness to switch entirely to EXW which implies that there is a tendency to have control over transportation flows in the future. However, many firms still try to "outsource" transportation in order to reduce managerial effort.

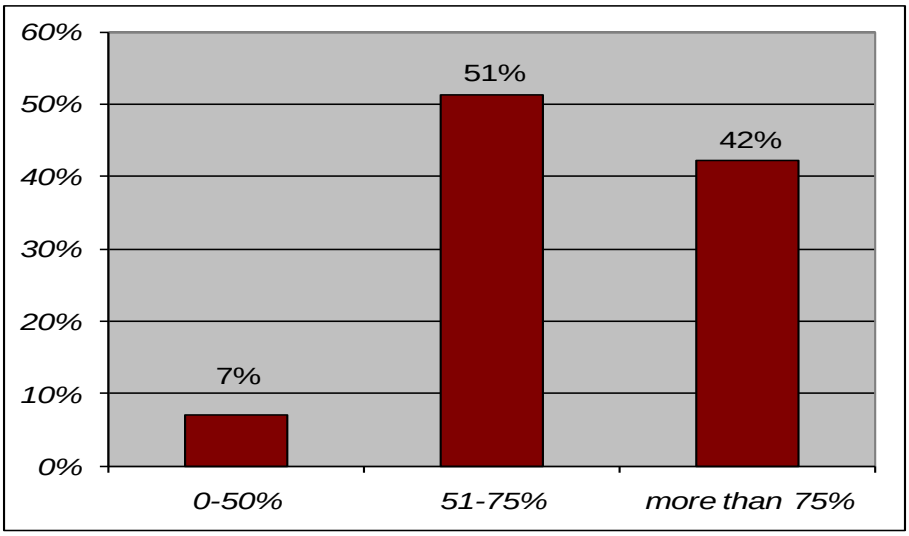

Figure 2 – loading factor of inbound transport

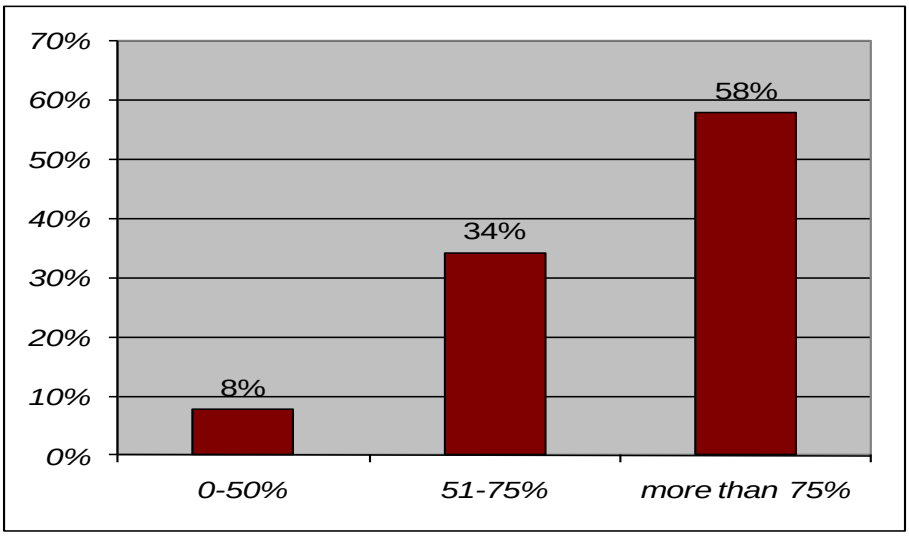

Figure 3 – loading factor of outbound transport

In about 70% of the cases, transport service providers take 80% of the transportation for the interviewed loaders. The following two diagrams show the average truck utilization of inbound and outbound trucks operated by transport service providers. 42% (inbound) and 58% (outbound) are loaded to at least three quarters of capacity but the results show that there is still enough potential to increase the loading rate in regional freight traffic.

Logistic strategy trends like just-in-time or the tendency to reduce stock and optimized time-planned deliveries have a huge effect on mode choice and how efficiently it is loaded (Taylor, 2001; McKinnon, 1996; Höfler, 2006). Small delivery windows make it very difficult to build up inter-company co-operation for bundling of transportation flows in inbound and outbound traffic.

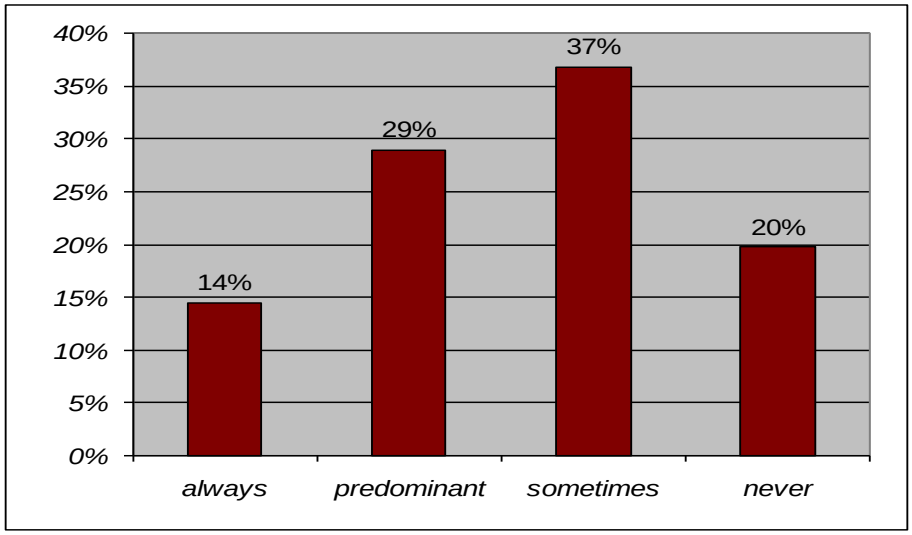

Figure 4 – time slots inbound

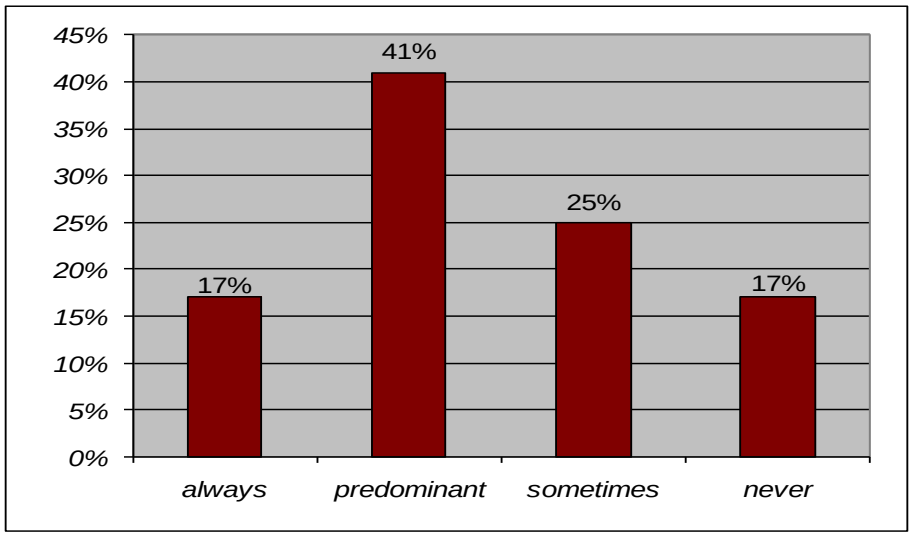

Figure 5 – time slots outbound

The findings indicate that 43% of inbound shipments is related to more or less fixed time slots, however, 57% are never or only sometimes related to fixed time slots. This leads to the assumption that there are possibilities to bundle part loads in a co-operative way. For outbound transport the situation is the other way round. To bundle 42% of outbound flows demonstrates a high potential.

Another obstacle for inter-company co-operation to optimize truck utilization would be high seasonal fluctuations in demand. It could be figured out that during an average working week 85% of the companies do not suffer high fluctuations in inbound and outbound good flows whereas over the year 58% suffer from monthly or seasonal fluctuation in inbound and 62% in outbound flows. Although these findings are a challenge, the fact that an average working week is not affected that strong by monthly fluctuations demonstrates that the effect on weekly transport organisation is not a main obstacle.

A further difficulty could be the specific requirements of the products transported. However, the main amounts of transported goods within inbound flows, i.e. 61%, have no specific requirements and can (theoretically) be combined with other products within a truck load. In outbound flows only 37% of the transported products have no special requirements. The predominant specifications are “bulky” or “voluminous”.

As we have seen, there is enough potential to improve truck utilization via inter-company bundling strategies. However, the willingness to co-operate is a prerequisite to realizing bundling measures and improving truck utility based on inter-company co-operations.

In the course of the questionnaire the firms were asked if they were interested in inter-company co-operations in transportation. In respect of inbound transports 71% of the interviewees could imagine such a co operation whereas in outbound transportation flows only 58% of the participating firms were interested.

The main reasons against it are (1) loss of flexibility (inbound 24%, outbound 28%), (2) time factors (inbound 18%, outbound 28%) as well as (3) complexity (inbound 18%, outbound 21%). Further factors against co-operation are costs and the special transportation requirements of the product.

As mentioned above, transport service providers play an important role within truck transportation in Upper Austria. Generally, there are over 13,400 hauliers and over 1,400 shipping agents in Austria which means that the market is very fragmented from “one- truck companies” to “big players” with over 500 trucks (WKO 2004). In order to realize more efficient road freight transportation a crucial point is the knowledge and experience of the transport service providers in rail, intermodal and multimodal transportation possibilities.

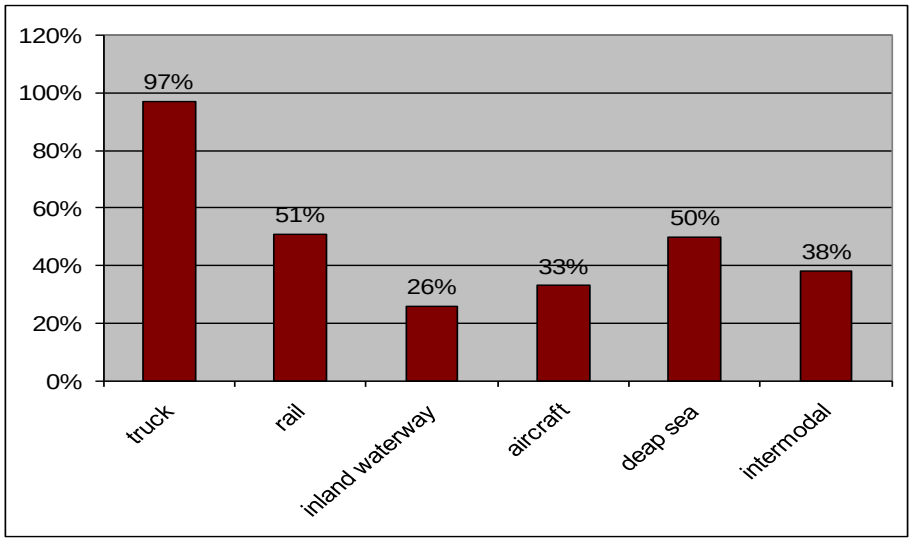

Figure 6 – Know How of transport service providers

Consequently, the firms were asked about the knowledge of their service providers in the different fields, unsurprisingly, 97% of them are considered to have knowledge in the field of road freight transportation. Within other transport modes or intermodal transportation, less than half of them have knowledge. Therefore, the general domination of road is not only a matter of cost advantages and higher flexibility etc. there is also a lack of knowledge about using other modes of transport and intermodal transportation.

To sum up, the results show, that inter-company co-operation is indeed an opportunity to increase truck utilization. Nevertheless there are still huge obstacles blocking its realization. One main factor is the lack of knowledge about the various modes of transportation as well as the “fear” of disclosing company secrets, competitive disadvantages, losing flexibility and increasing complexity.

Results for shifting to other modes

Modal shift from road to rail and inland waterway is a great occasion for the region of Upper Austria because of its tri-modal traffic infrastructure and connector of Western Europe and CEE countries. Metallurgical production and processing, plastics, chemicals, paper, wood construction as well as vehicles and automotive components are important transport intensive industrial sectors within Upper Austrian economy. In addition the high performance tri-modal terminals of the Danube ports Linz and Enns as well as the intermodal terminal of the Austrian Railways in Wels which has the highest turnover capacity in Austria in general guarantee the basic infrastructure required for intermodal transportation. These industry sectors still have a huge potential for shifts to rail and inland waterway as modal split was 79% to 21% compared for example between road and rail in 2005 (Herry, 2007). Although Upper Austrian economy is changing to a more service oriented as well as high tech research & development economy, high quality export oriented manufacturing processes within the mentioned industry sectors will grow and play an important role in future. This development will increase transportation volume and the need to shifts within modal split. As road infrastructure can not be extended to the prognosticated demand rail and inland waterway transportation must be stronger implemented in future transportation strategy and planning. Therefore the willingness to use rail and inland waterway transportation to a higher extent was surveyed. Over 53% of the interviewed firms currently use rail. The main results with respect to rail transportation are:

1. The share of rail transportation in companies with a high number of fixed time slots is not significantly lower than without fixed time slots.

2. Nearly 100% of the firms said that they or their transport service provider had know-how of truck transportation, whereas only 50% had know-how of rail transportation.

3. 25% of existing company-owned railway sidings is not in use.

4. Rail is generally used for shipment northbound to Hamburg and Rotterdam harbours. Southbound, eastbound and westbound destinations are significantly lower.

5. One quarter of the interviewed firms could imagine using rail transportation for short distances (transports under 150 km).

6. More than 50% are ready to use rail more often in the future if constraints are removed.

7. If truck transportation became more expensive than rail transport (assuming that rail prices are constant) e.g. through internalisation of external and source specific costs and higher road tolls, still only 34% would switch to rail. The main reasons are loss of flexibility, quality and complexity. The following figure gives an overview about the main constraints:

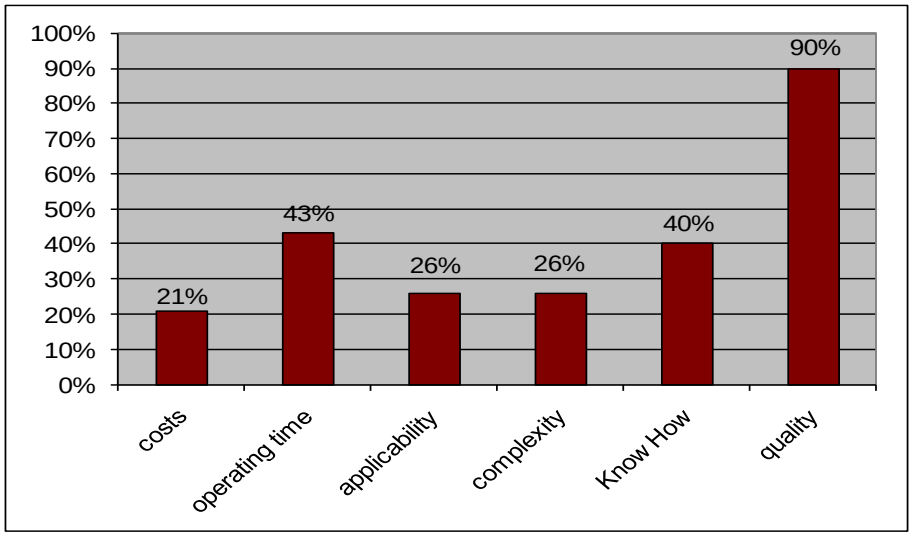

Figure 7 – constraints for rail transportation

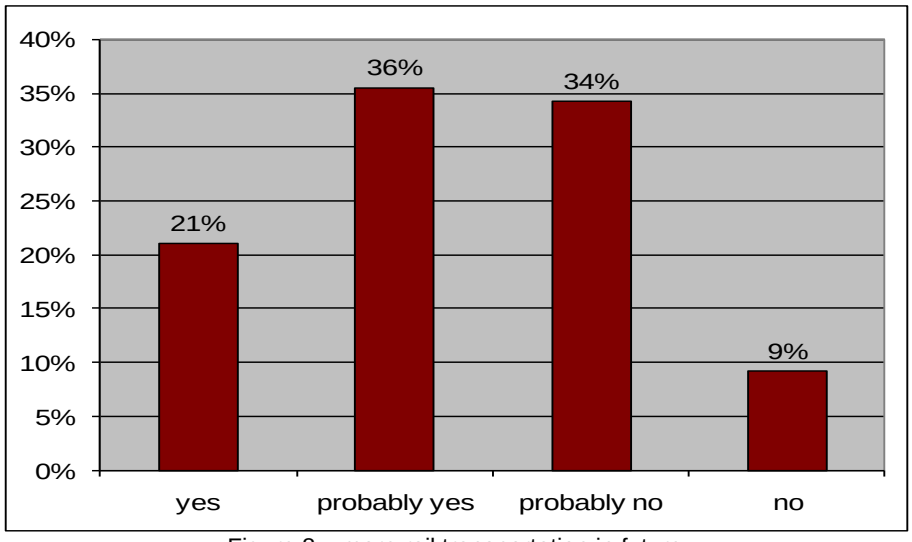

Figure 8 – more rail transportation in future

Considering the responses from the firms, transportation with inland waterway crafts will not play an important role in the transportation of finished and semi-finished goods in future. One of the greatest problems is the lack of know-how about this mode of transport and from an operative point of view operating time, applicability and complexity.

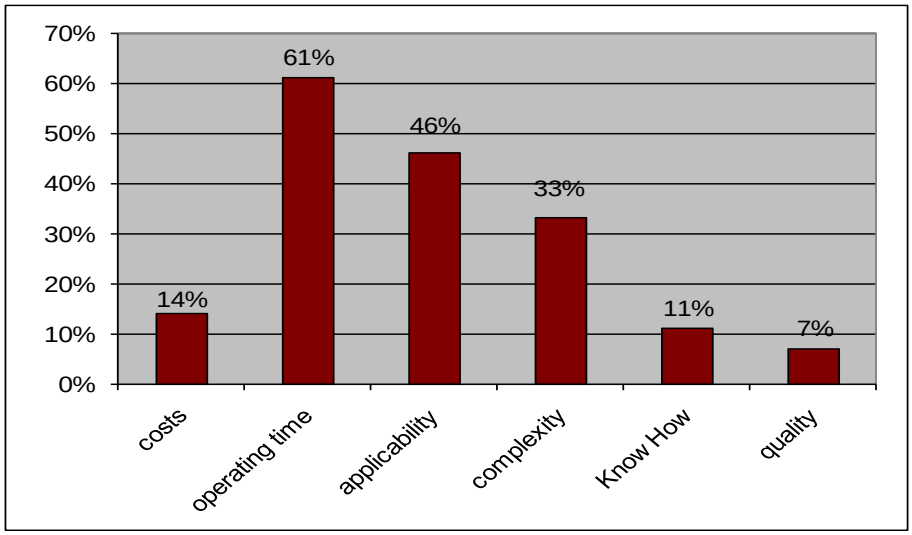

Figure 9 – constraints for inland waterway transportation

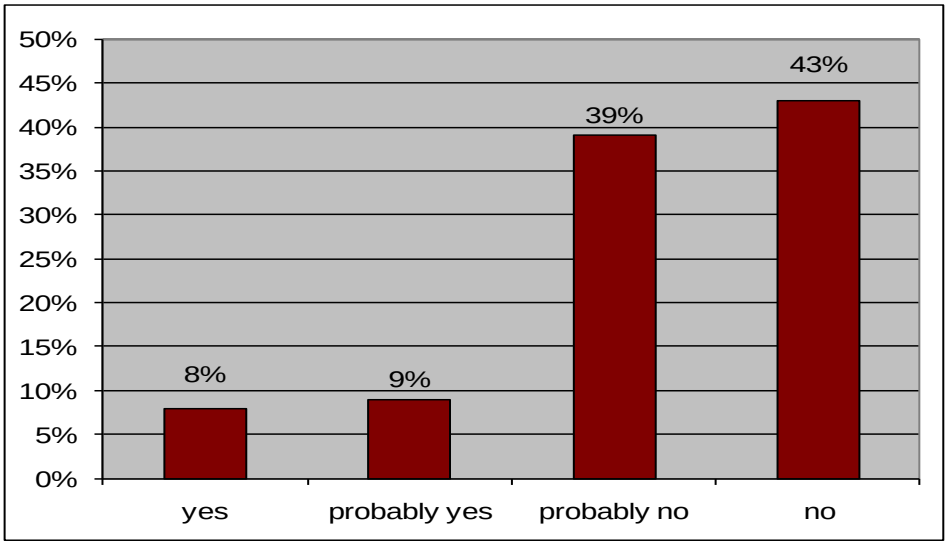

Figure 10 – more transportation on inland waterways in future

The findings show that there is still lack of information and constraints within the industry. Therefore an emphasis on the following general steps was especially developed for rail and inland waterway craft:

1. Stronger concentration on information for loaders and their logistics managers about possibilities within rail and inland waterway craft to change them into advantages for loaders, suppliers and customers.

2. Elimination of subjective prejudices about constraints considering these modes and dissemination of best practice examples.

3. Specific investigation into company-owned railway sidings and the reasons for not using them.

4. Concentration and emphasis on rail transportation to East and South Europe in co-operation with loaders and rail operators through bundling of transportation volume.

5. Concentration and emphasis on inland waterway transportation along the Danube corridor in co-operation with loaders, harbours and shipping operators through bundling of transportation volume.

6. Specific analysis of objective constraints amongst loaders and rail/IWW operators.

APPROACH

Theoretical saving potential through intercompany co-operation

For those companies interviewed face to face a transportation matrix was developed containing information about the most important suppliers and customers which are responsible for 70% of their transportation volume. Surveyed data: place of supplier/customer with postal code or town, modes in use, volume in tonnes, full truck load or less than full truck load and number of movements per year and month. Together with iNet-Logistics, a company which specialises in transportation planning technology, the potential of reduction of transportation kilometres through bundling was evaluated. As some companies had reservations due to security concerns, 13 useful matrices have been created but because of some constraints a number of assumptions had to be made:

1. The basis for the simulation was 240 working days, no transportation at weekends.

2. Average kilometre price for a truck with a capacity of 25,000 kg is 1 € (including road toll and costs for driver)

3. Monthly volume fluctuations are considered on the basis of the questionnaire.

4. Products transported by rail only are not considered because of full loads and a railway siding at the company.

5. Another step was the generation of geographic coordinates of all relevant addresses of companies, suppliers and customers.

For the simulation, the theoretical basis model was the Ant Colony Optimisation algorithm in particular used with the concept of the “travelling salesman – and vehicle routing problem”. Every delivery destination has to be visited as quickly as possible as well as delivered via the shortest route to minimise the number of kilometres travelled.

Assuming that currently every transport is planned on an individual basis, these transports were compared with the results of transports planned on an inter-company optimized transportation planning basis.

The "direct one-way run" on an individual basis costs 1 € per km whether it is a full load or less than a truck load. If firms can agree on inter-company co-operation they only pay for the transported volume and not the full truck. Also a stop fee was calculated because every stop generates extra costs. These calculations were done for inbound and outbound flows separately as well as combined together. Although this analysis is a small theoretical extract of reality, a high number of kilometres and therefore costs could be saved. Inter-company co-operation would enable that 35% in inbound transportation, over 93% in outbound transportation and inbound and outbound transportation combined 26% of driven kilometres could be saved. Transportation costs could be reduced by between 10% and 20%.

The quality of the input data has to be improved to be able to simulate the savings and to generate useful movement data more precisely. The used data is the core of the simulation described and it has to be remembered that this was only a first, small step to simulate the potential savings through inter-company co-operation within the regional freight transportation in Upper Austria. Nevertheless the results lead to the assumption that there is a high potential to reduce driven kilometres and costs which would benefit the economy and ecology of the region.

The Business Model

The main approach for optimizing truck utilization and shifting transportation volume from road to rail and inland waterways in regional freight traffic has to be co-operative bundling over the horizontal and vertical supply and delivery chains of the loaders. The high degree of fragmentation of the Austrian haulier sector as well as the SME (small and medium sized companies)-dominated industry structure in the region, are barriers to strong and successful co-operations. There are some forms of freight market models however, which all suffer from problems like competitive-thinking which avoids bundling and optimization amongst different firms, a lack of network connection between the loaders in a region, price discrimination, no involvement of rail or inland waterway shipping operators etc. Especially the lack of information exchange between loaders in different industries in a region about potential common delivery/supply destinations and the possibilities of bundling of transport volume implicate a potential for realizing full truck loads and shifts to other modes.

SME's do not have the market power and transportation volume to use rail or inland waterway transportation or do not even have enough volume to build full truck loads. Therefore a lot of transports are uncoordinated and sub-optimally planned. One approach is the development of a "co-operative loader transportation business model" which collects the transportation volume from SME's in a specific region and generates optimized transportation orders (full truck loads and optimized kilometers to drive) to reduce regional road freight transportation through bundling or, if volumes are sufficient, for rail and inland waterway transportation.

The process steps within the model are: the transportation needs of the industry are transferred electronically via an interface to the business model. The data transferred is volume, destination, time windows, special criteria and the possibility for rail or inland waterway shipment, etc. An algorithm (e.g. ant colony optimization, travel salesman problem etc.) generates optimized transport orders (emphasis on truck utilization, fewer kilometers, rail transportation, etc.) which are presented to registered hauliers who can submit offers for those orders.

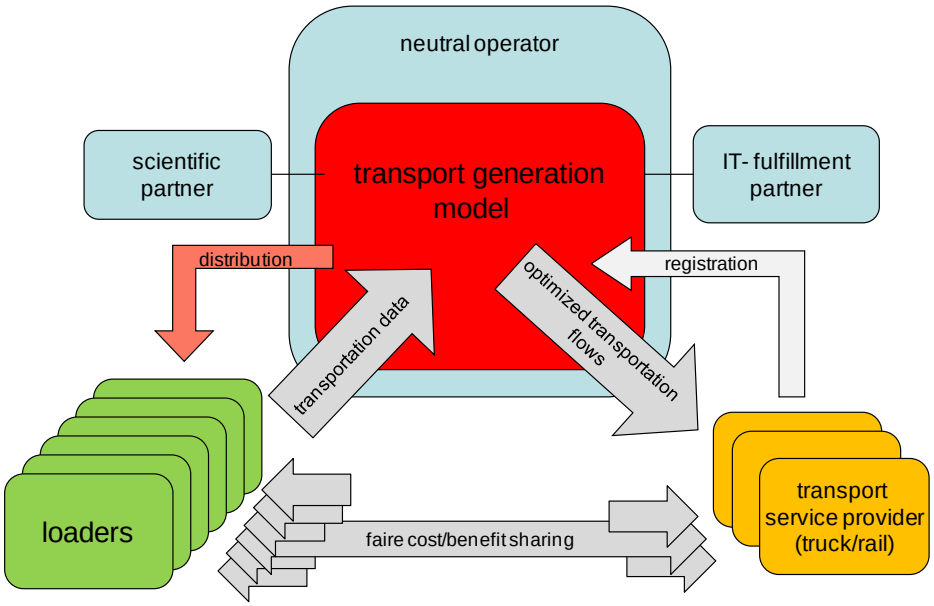

Figure 11 – general structure of business model

Challenges

Generally this approach can only be successful if the SME's are willing to participate. The difference to other (still existing) models is that the operator is a neutral and accepted authority within the industry. Participation is only allowed for loaders and not for transport service providers. The neutral authority bundles and administrates the transportation volume from the regional SME with the aim of reducing road freight traffic, better utilization of trucks and, if enough volume exists, a shift to rail or inland waterway transportation. This business model should not influence the market but bring transparency about transportation volume, bundling possibilities for more FTL and especially for rail.

The model should contribute to additional value for companies in the region, freight forwarders and the economic and ecologic region as a whole. Especially regional hauliers and industry can benefit from this model by reducing process costs. The main challenge is to make the cost reduction and benefits visible and share it fairly amongst the participants. Not only monetary savings should be visible but also reduction of emissions because of better utilized trucks etc. should be shown.

Further development research as well as administrative and legal work has to be done within this business model in future before starting a test run in a specific region.

CONCLUSION

To sum up, potentials within regional freight traffic transportation concerning reduction of trucks, increasing truck utilization and shifting transport volume from road to rail and inland waterways is very high in Upper Austria. Regional freight traffic is responsible for more than three quarters of freight traffic. The results from the survey show that there is a willingness to co-operate but prejudices have to be overcome through information and methodologies which ensure company confidentiality needs etc. The advantages and possibilities within rail and inland waterway transportation are also less fixed in the strategies and minds of loaders in general which mainly result in a lack of know - how. Therefore the emphasis on information and training is a prerequisite to overcome prejudices and increase the share of rail and inland waterway transportation within regional freight transportation in Upper Austria.

The results of a first theoretical simulation show the potential for a reduction of driven kilometers and costs. Consequently the development and realization of the business model approach described above is of high priority in the region. Without building transportation networks which bring together companies from different industries, the optimization within regional freight traffic transportation cannot be realized efficiently. Therefore the next step within this ongoing research work is the creation of a testing zone for the described business model in the region. This should be realized through the support of the federal state of Upper Austria and a project group covering and fulfilling the efforts for realization (especially the technical conversion). Additionally, important loaders and shippers have to be convinced for participating in a test period for one year. Afterwards an evaluation process is planned for valuation of pros and cons for further improvement.

The second step planned is the development and research on best practice examples for shifting truck transportation to rail and inland waterway transportation. Visitations of loaders and shippers as well as best practice events for interested logistics and transportation managers in Upper Austria are planned to increase the knowledge of possibilities in intermodal transportation opportunities. It is important to anchor intermodal transportation and its opportunities in future strategic transport strategies planned by industry as well as governmental institutions.

Nevertheless the discussion and research on regional freight transportation should not be limited to improving truck utilization and willingness of loaders to shift to rail and inland waterway transportation. However existing infrastructure and future investments, intermodal terminals, logistics strategies from the loaders as well as economic development and future export and import markets for Upper Austria have to be considered in this ongoing research process.

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