Developing the backhaul exchange process between contractors in North Sweden

Michael Karlsson, Andrew Landström and Dag Fjeld*


Abstract. A number of studies have examined the potential to improve transport management decision-making via optimization models. One of the major bottlenecks for implementing suggested solutions in a decentralised system, however, is the lack of a standardised process which supports the operational exchange of backhauls between hauling contractors.

The first part of this study maps the hauling contractor sector structure in North Sweden and contractor attitudes to the business situation. The second part of this study maps current models for the backhaul exchange and presents a framework for supporting the exchange process.

The results show that typical coordination routines and truck types differ between independent and associated contractors. The interviewed haulers see a limited potential for increased backhauling in their areas. Three initial types of backhaul exchange agreements were found in the study. Based on these, a business process was prototyped with user groups.

Key words: hauling contractors, organisation, backhauls exchange, business process

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Background

The framework for roundwood hauling in a region is characterized by the patterns of wood flow from suppliers to customers. In Sweden, suppliers in the vicinity of a single hauling contractor can include the state forest, one or two large industrial forest companies and hundreds of non-industrial private forest owners. Since payment for transport services is most often based on the loaded transport distance, transport service providers (both hauling associations and independent contractors) minimize the unloaded transport distance through backhauling.

Wood supply in South Sweden is dominated by private forest owners and wood processing sites are located both on the coast and in the interior. This generates a relatively complex wood flow pattern for transport managers attempting to locate backhauls. Wood supply in North Sweden has a high proportion of wood from industrial forest companies moving to processing on the coast. While this appears to give a one-way flow of all assortments from the interior to the coast, a major transport channel connects many of the mills along the coast, enabling further exchange of assortments and mill specialisation. This creates a more easily overviewed wood flow pattern for locating backhauls. The small size of most hauling contractors’ home territories (area where they collect their loads), however, requires an exchange of loads or landings with other contractors in order to make a backhaul.
Models for improved transport planning

Wood suppliers and transport service providers in Sweden have been conservative in their implementation of optimisation solutions. One earlier wood flow optimisation model (Carlsson and Rönnqvist, 1998) has been developed in an application for locating and visualising potential backhaul flows (Forsberg et al., 2005). Other prototypes have been used on an experimental basis to estimate potential savings for better vehicle routing (Palmgren, 2001; Liden, 2006). Truck-PCs are now considered to be an integral component of transport management systems (Svanberg, 2000) and are being introduced in most transport organisations (Roscher et al., 2004).

Numerous wood flow studies have been done in North Sweden (e.g. Örtendahl, 2001; Bergdahl, 2002). Backhaul flows have also been examined in this region (e.g. Forsberg, 2003; Mellqvist, 2004). One study examines the implementation of an optimisation model to help transport associations and hauling contractors locate potential backhauls (Frisk, 2003; Eriksson & Rönnqvist, 2003). While many of these studies show potential costs savings for increased backhauling (often in the area of 2–5%) these potentials remain unrealized. Realising the remaining potential requires better coordination between hauling contractors along the coastline.

Perspectives on improving processes

A number of perspectives have been used when examining inter-organisational processes. Heinimann (2000) gives an overview of the potential advantages of business process re-engineering in forest operations and wood supply. Mattsson (1999, 2002) shows how to define and map processes both within and between organisations and shows 4 information exchange strategies to improve these. Hulten and Bolin (2002) examine controllability in truck transport systems from a system science perspective. They apply the NEVEM process chart (NEVEM, 1989) to model information flow and variety management. This approach goes as far as evaluating technological and organisational readiness for improvement efforts.

The business process and information exchange perspectives have been used in a number of studies of Swedish roundwood transport. Kastberg (2005) presents an overall map of transport administration processes. Ekstrand and Skutin (2004) present a map of transport management processes. Hedlinger et al. (2004) and Nilsson (2004) map and analyse these processes and propose a general information flow model for transport administration and management.

Goal

Backhauling is often based on landing exchange decisions made by the individual hauling contractor. This level of detail has not been emphasized in earlier studies. In this study we choose, therefore, the hauling contractor perspective and examine possibilities for better coordination of backhauling between these.

Two sub-goals are formulated:

1. To map hauling contractor organisations and contractor attitudes to further business development.
2. To map current models for exchanging backhauls between contractors and draft a prototype business process to make this exchange more efficient.

Methods

For several decades attitudes have been the dominating concept in explaining human decision behaviour. In this context, attitudes may be defined as a learned disposition
to respond in a consistently favourable or unfavourable manner with respect to a
given object (Fishbein & Ajzen, 1975). This definition emphasizes that attitudes are
learned. While a business process must be designed to improve efficiency, unless it
builds upon the sector experience and the way decisions are made in reality, it will
inevitably meet resistance in application.

Contractor organisations and attitudes to business development
The first study started with personal interviews with 5 independent contractors and 5
contractors who were members of hauling associations. This was to become familiar
with their views on the present organisation and potential business developments. From
these interviews a number of claims were chosen to be tested in a questionnaire. The
questionnaire was done by telephone with 10 independent contractors and 10 contrac-
tors who were members of transport associations. The questionnaire was anonymous
and contained open questions as well as a list of claims where the respondent was asked
to indicate on a scale of 1-5 if they disagreed (1) or agreed (5) with the claim.

Backhaul coordination and process prototyping
The second study also began with a round of open personal interviews. The interviews
were primarily aimed at understanding how backhauls are coordinated between
contractors, which decision-makers were involved in this, which information was
necessary to exchange and which changes are necessary for a more efficient exchange.
The interviews were done with 6 fleet managers and 6 contractors from contracting
associations.

Based on the interviews, the necessary steps in backhaul exchanges were formally
mapped and the business process drafted. The initial prototype was described as a list
of functions supporting the necessary steps at the fleet manager and contractor level.
These steps and functions were presented in a series of user groups was revised after
each meeting. In total 4 user groups meeting were done. Each user group contained
one contractor and one fleet manager from 4 different hauling associations. Each
association had between 10 and 30 trucks in operation. Two associations were from
the north coast and two were from the north interior.

Results

Contractor organisations and attitudes
The first study examines two groups: independent contractors contracting directly
to suppliers (IC) and associated contractors where the association bears contracting
responsibility (AC).

The dominating form for IC was one that relied only on his own transport capac-
ity, in some cases hiring a second contractor for shorter periods to cover a temporary
capacity deficit. In a few cases (3 of 15 ICs in this study), the primary contractor
contracted other sub-contractors for the whole contracting period, in addition to a
temporary sub-contractor for shorter periods.

The dominating form for AC was a member-owned association which contracts for
all its members. These distribute the work to their members and handle administration
and other issues such as certification. The association may have rights to distribute
trucks freely within their business area or some trucks may be “ear-marked” for
specific suppliers or supply areas. In a few cases (4 of 15 ACs in this study) a primary
hauler contracting other sub-contractors may be a member of an association only for
its administration/certification services.
Independent haulers had on average 7 trucks while associated haulers had 2. Independent haulers also transported a higher annual volume (317 000 m$^3$) than associated haulers (103 929 m$^3$) but roughly similar volumes per truck. The independent haulers typically had groups of trucks with a separate loader while associated haulers had self-loading trucks. Another important difference between the two groups was that while associated haulers delivered wood to 6–20 mills from 1 to 2 suppliers, independent haulers delivered wood to 5–12 mills, typically from 1 supplier.

Table 1. Key figures for independent (IC) and associated hauling contractors (AC).

<table>
<thead>
<tr>
<th></th>
<th>IC</th>
<th>AC</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. respondents</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Experience in sector (yrs)</td>
<td>35</td>
<td>27</td>
</tr>
<tr>
<td>Vehicles/contractor</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Respondents with group trucks/separate loader</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Respondents with removable self-loader</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Respondents with non-removable self-loader</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>M3/contractor/yr</td>
<td>317 333</td>
<td>103 929</td>
</tr>
<tr>
<td>M3/truck/yr</td>
<td>45 769</td>
<td>51 964</td>
</tr>
<tr>
<td>No. wood suppliers transported for</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>No. mills transported to</td>
<td>10</td>
<td>9</td>
</tr>
</tbody>
</table>

The business situation
A number of questions were related to the organisation and its business situation. All respondents agreed that large business areas require frequent redistribution of truck capacity. The independent haulers were, however, more in agreement that the organisation’s size often required extra capacity. Both groups, however, disagreed completely with the claim that wood flow patterns provided a good potential for backhauling.

Independent haulers were more inclined to agree with the claim that their organisational costs are reasonable than associated haulers. Independent haulers were also more inclined to agree with the claim that they are flexible than associated members. They were also more inclined to agree with the claim that they had a good working environment and that the future was promising for hauling contractors.

Table 2. Business environment and development attitudes for independent (IC) and associated hauling contractors (AC). Average respondent agreement with questionnaire claim (1=disagree, 5=agree).

<table>
<thead>
<tr>
<th>Claim</th>
<th>Response (1–5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large business areas require frequent redistribution of trucks</td>
<td>5</td>
</tr>
<tr>
<td>The organisation’s size often requires extra truck capacity</td>
<td>4</td>
</tr>
<tr>
<td>There is a good potential for backhauling</td>
<td>1</td>
</tr>
<tr>
<td>Our organisational costs are reasonable</td>
<td>5</td>
</tr>
<tr>
<td>The organisation is more flexible than earlier</td>
<td>5</td>
</tr>
<tr>
<td>We have a good work environment</td>
<td>5</td>
</tr>
<tr>
<td>The future is promising for roundwood trucking</td>
<td>4</td>
</tr>
<tr>
<td>IT solutions will be in all trucks in the future</td>
<td>5</td>
</tr>
<tr>
<td>Large business areas require navigation aids</td>
<td>4</td>
</tr>
</tbody>
</table>
All respondents agreed completely that IT solutions such as truck-PCs would be standard in the future. Both groups also agreed to the claim that large business areas require navigation aids.

**Coordination responsibilities**

Independent haulers had three ways of coordinating operations between trucks and in all cases these decisions were handled within the contractor’s own enterprise. For 7 of 15 respondents, these decisions were made in discussion with the operators. For 4 of 15 respondents, these decisions were made by the operator of the loader. For the other 4 of 15, coordination decisions were made by the contractor alone.

The associated haulers also had three ways of coordinating operations. 6 of 15 respondents had central coordination by either the supplier or the association manager. For 5 of 15, coordination was done within the contracting enterprise in discussion with its operators. For 4 of 15 the coordination was done by the contractor alone.

<table>
<thead>
<tr>
<th>Coordination decisions made by</th>
<th>IC</th>
<th>AC</th>
</tr>
</thead>
<tbody>
<tr>
<td>- supplier or association manager</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>- within contracting enterprise in discussion with operators</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>- within the enterprise, by the contractor alone</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>- within enterprise, by the loader operator</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

**Backhaul coordination and solution prototyping**

Given that self-loading trucks dominate in contractor associations, the study of backhaul coordination is focused on these organisations. Preliminary interviews with fleet managers and haulers were used to map the common ways of coordinating backhauls between associations. The study found 3 main types of agreements for coordination of backhauls.

**Contractor pair agreement** – The first and simplest is when two contractors who are already acquainted temporarily agree to exchange loads from two landings. No formal agreements for information exchange exist here.

**Multi-part agreement** – The same temporary agreements may exist between multiple contractors or associations. These agreements facilitate basic information exchange after specific enquiry.

**Partnership agreement** – Temporary agreements may be developed to a permanent partnership between two contracting associations. This agreement relies on regular meetings and integrated IT-solutions.

In most cases the contact is between the responsible fleet managers for each respective association and never between a manager in one association and a contractor of another association. Coordinating managers exchange information by telephone or preferably personal meeting.

All types require the following exchange of information: 1) knowledge of the possibility of an exchange (wood flow patterns, including the landing location and the destination of the different assortments), 2) exchange of extra knowledge such as number of trucks working, the road bearing capacity, prioritized assortments and finally 3) exchange of scaling orders for the respective landings allowing the actual delivery or roundwood by the exchanging haulers to the mill.

Interviews also examined the problems that an improved exchange process should
help solve. 7 of 12 respondents (4 managers, 3 contractors) considered that organisational territoriality was a major hinder to better coordination between organisations. 7 respondents (3 managers, 4 contractors) agreed that truck-PCs would improve the chance of exchanging backhauls. The main reasons given for this were simpler navigation, better control of the fleet and quicker information distribution and handling. 5 respondents (all contractors) said that they didn’t have enough overview over the wood flow or other contractors in other organisations to locate and suggest suitable backhauls. 3 respondents (managers) thought that there was already a transport overcapacity in the region. 3 respondents (2 managers, 1 contractor) consider different transport pricing agreements between suppliers to be a hinder to arranging backhauls. 2 respondents (both contractors) consider that poor support from fleet managers was a problem and 2 respondents (1 managers and 1 contractor) consider that poor support from suppliers was a problem.

Some specific comments around these areas are shown below.

“An IT system to help facilitate backhauls must be extremely easy to use. If it’s too difficult people will go back to the old system” (contractor).
“Experience show that cooperation is difficult between more than 2. With more than 2 friction and suspicion arises easily” (contractor).
“It feels better doing a backhaul for the same supplier” (contractor).
“If there was a FIND-function in a truck-PC where larger landings were in a database, it would be easier to search for backhauls” (contractor).
“Regardless of which routines lead to a backhaul, the two haulers have to make contact before it can be realized” (contractor).

Based on the interviews and comments we see that contractors need a better overview over which landings are available for exchanging backhauls and which contractors in other organisations have responsibility for these landings. The transport organisations which intend to exchange backhauls must have some established ground rules for how the work will be facilitated. These include:
- who is granted access to information on the respective organisations landings
- which prices and pricing systems are to be used
- if follow-up will be done in any other way than via SDC (Forestry Data Centre)
- key indicators used in the follow-up
- how uneven distribution of exchanges shall be regulated after follow-up

Prototyping a backhaul database

After the interviews were complete the initial prototyping of a business process and solution began. The solution in its simplest form is a database which satisfies the user demands. After the initial version, 4 user-meetings reviewed the various suggestions which led to a gradually clearer sequence of functions. The steps in the use of the database are shown below.

M1 Selection of landings – The manager selects the landings suitable for the database. Criteria can include: good geographical locations for backhauling, landings with high priority or large volumes.

M2 Data entry – each selected landing is entered in the database. Information includes: map coordinates, the volumes that are available after harvesting, the available volume per assortment at roadside according to SDC and destination per assortment. The contact information on the responsible contractor is also entered (contact info drawn from database). The scaling order is also entered so the responsible con-
tractor may read it and send this by e-mail/fax to exchanging partners. The manager also enters which associations/contractors who have access to this information.

C1 Log in and search – each contractor must personally log in and this gives access to the information allowed by the respective fleet manager. After this, searching may proceed. Search criteria may include destination, landing geographic location or a combination of the two.

C2 Choice of alternatives – the response to the search is presented on a map where the landings are marked. By clicking on landing the information from M2 is presented.

C3 Contact with respective contractor – Contact and discussion with the contractor responsible for the landing determines if the exchange is desirable and possible. Important factors include: current road bearing capacity, times when other trucks will be at the landing or if certain assortment must be transported first. If the exchange is not possible the searching hauler continues his search.

C4 Exchange of scaling order – When an exchange is agreed upon and booked, the scaling order is sent directly from the program to the exchanging hauler.

M3 Feedback – After the backhaul is accomplished according to the agreement and the wood is delivered and scaled for the respective truck number, feedback goes via SDC to the respective association and its manager.

M4 Follow-up – The exchanged and transported backhaul volumes are reviewed by the responsible manager and compared to the expected result of the agreement.

Discussion

Contractor organisations and attitudes
Both types of contractors claim that there is limited potential for backhauling in their areas. This is a typical claim in the north where much of the wood flow is one-way from the forests of the interior to the mills on the coast. This may be understandable in the case of the independent haulers who work primarily within their own groups (since one group and its loader normally empty one landing at a time). However, the negative attitude for the associated haulers may be more a reflection of a possible over-
capacity and the knowledge that increased backhauling may further reduce capacity requirements with consequences for fleet size and future number of operators.

Frisk (2003) recorded frequently cited hinders to increased backhauling. One common hinder was the limited communication and isolated decision making between geographically adjacent suppliers and transport organisations. Other commonly cited hinder was contact problems between contractors and that many haulers were frequently refused backhauls when they proposed them (in which case a lack of wood at the other hauler’s landing is the most common explanation). Mellqvist (2004) recorded the actual volume of backhauling in one area on the North coast. During stable periods of high transport volumes in February, the transport volumes in backhauls reported to SDC were up to 27%. During periods of low flow and low storage volumes the reported volume of backhauling fell to 2%. Mellqvist’s interviews over a broader area of the north coast showed an average proportion of backhauling (over the whole year) which varied from 5% in the interior to 32% along the coast. This is a logical trend given the wood flow patterns in the area.

Another hinder to backhauling noted by Frisk, which may be particularly relevant in marginal areas such as the interior, is the necessity to retain the self-loading crane on the truck. Almost all associated haulers in the study area had removable self-loaders. When working from the same landing these loaders may be removed after loading to allow an extra 2 t of roundwood (legal limit for total weight is 60 t). Arranging backhauls, however, requires the contractor to retain his own loader, reducing the paid transport volume. Earlier studies by Petersson (1999) show that truck transport costs are more sensitive to changes in vehicle weight (where a 10% reduction in vehicle weight yields a 4.1% reduction of transport costs) than the unloaded transport distance between landings (where a 10% reduction in unloaded distance yields a 2.4% reduction in transport costs). A year-round policy of maximising backhauling may, therefore, not always be profitable for the contractor. A case for case examination is therefore necessary to determine where the reduction of empty travel outweighs the extra weight of retaining the loader.

In any case, it is apparent that an improved process for communicating wood flows and backhaul potential is necessary. For independent contractors (working often with group trucks coordinated by the loader operator) this will require more coordination between suppliers. For associated contractors working for multiple suppliers, this will require more coordination in a network between associations and contractors.

The backhaul exchange process
The three models for backhaul exchange found in this study seem reasonable. Frisk (2003) notes that 75% of his respondents had contact with other associations or contractors from 1 to 3 times per week with the purpose of exchanging backhauls. Frisk’s respondents said that it was common to keep such contacts over a longer time. The development of these multiple contacts to a contractor pair agreement or multi-contractor agreement seems logical. The partnership model, however, requires such investments that it seems most relevant for associations.

Contractor attitudes to truck-PCs and mobile IT solutions seem to be improving. At the time of studies by Roscher et al. (2004) and Frisk (2003) hauler knowledge of IT or lack of willingness to invest in truck-PCs was seen as a potential hinder to implementation of new solutions in transport management. In the prototyping study, the selection of respondents was such only individuals already positive to IT solutions were chosen. The user demands to the backhaul database functions were therefore primarily related to the business processes or information flow of the system, and
not disturbed by negative attitudes to IT.

The backhaul database solution as represented in Figure 1 just clarifies the steps by which a backhaul is typically arranged between two established contacts with a pre-existing agreement. At the time the final version was presented, the user group participants characterized the system as mimicking the informal processes already in existence, but in a more efficient manner. A more complete version showing all sub-processes required (such as negotiation of common rules between partners and approval of new trucks for possible backhaul deliveries in the scaling registry at SDC) and their required sequence are found in Carlsson (2005).

Mattsson (2002, 2005) presents 4 information exchange strategies for improving efficiency in business processes. These 4 include simplification, automation, redesign and synchronization. In this case the analysis has lead to a simplified basic list of necessary functions. Prototyping with the 4 user groups has led to a slight redesign of these after which they are possible to automate in a database application. No synchronization issues have been handled in the study.

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