The cost effect of forest machine relocations on logging costs in Finland

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Abstract. In Finland, 70 to 80% of all logging contractors have their own truck fleet for relocation of their forest machines. Some of the smaller contractors – usually having less than 3 machines – are relying on outsourcing for machine relocation. Even though the cost of machine relocation carried out by machine relocation service companies can often be cheaper than the use of contractors’ own relocation trucks, contractors prefer to have their own trucks. The explanation for that is that contractors need to carry out the machine relocation at specific times with minimum machine delays.

A cost calculator for forest machine relocations was formulated and the most relevant issues related to forest machine relocation in Finland are presented in the paper. On average, the relocation cost of forest machines was about 6 to 10% of the total logging (cutting and forwarding) costs. In the case of a logging contractor with one low-bed truck and one harvester-forwarder system, the machine relocation cost was 0.80 €/m³ (Based on 35 000 m³ of annual harvesting). Whereas, in the case of a contractor with one truck and two harvester-forwarder systems the cost of machine relocation was 0.52 €/m³ (Based on 70 000 m³ of annual harvesting).

The study found that the annual use of logging contractors’ machine relocation trucks is relatively low. The low annual use of truck results in a higher share of the capital costs, and thus, results in high relocation costs. In the future, bigger contractors with larger harvesting amounts and control over several forest machines will improve the cost-competitiveness of machine relocations.

Key words: forest machine relocation, relocation cost, low-bed truck, logging contractor

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Introduction

The annual logging removal of industrial roundwood is around 55 million m³ in Finland (Mustonen, 2005). There are about 800 trucks specially for relocating forestry machines (Asikainen, 2004; Jaakkola, 2006), which means 68 750 m³ cuttings per annum for each forest machine relocation truck, on average. The number of forest machine relocation trucks will increase in Finland mainly because of the increased harvesting of energywood from forests (Asikainen et al., 2005).

According to Jaakkola (2004) and Lehtmäki (2006) approximately 70–80% of forest machine contractors in Finland have their own trucks for machine relocation. Some of the smaller logging contractors, owning one or two machines, rely on outsourcing for machine relocation. Occasionally, bigger logging contractors use the service of machine relocation companies especially when own relocation fleet is overloaded. In
Finland there are several dozen machine relocation companies. Most of them also have other related business activity, such as logging or earth moving, only a minority of them are offering only machine relocation activities (Contractor interviews, 2006).

Considering the cost effective use of machine relocation trucks, logging contractors' own annual use of trucks is surprisingly low, on average. The results of a survey showed that annual use of machine relocation trucks varied from 15 000 km to 50 000 km (Contractor interviews, 2005). For small logging contractors – such as contractors with one harvester-forwarder system – the annual use of machine relocation trucks is around 20 000 km, or less. In these situations the share of capital, insurance and transportation license costs per operating hour or driving kilometer is relatively high. In Finland nearly 90% of all logging contractors own three forest machines or less (Puunkorjuualan yrittäjä..., 2005).

Even though, using machine relocation service companies can often be cheaper than the use of contractors’ own machine relocation trucks, the contractors prefer to have own trucks. Why? The main explanation is that contractors need to carry out the machine relocation at specific times with minimum machine delays. Sophisticated logging machines are too expensive to leave inactive for a long period of time. In order to use the services of the machine relocation company it often requires booking well in advance, which is often impractical. It is not easy to predict when the logging activities in certain sites will end and whether or not the truck fleet of the machine relocation service company would be available at that time. In addition to this, there can be also unpredictable need for sudden machine relocations such as relocation of broken machines from the logging site to a garage for repair. Thus, own truck gives more flexibility for contractor in logging operations.

The main focus of this paper is to show the significance of the cost of forest machine relocations from the total logging costs in Finland. Additionally, some base factors influencing the relocation cost calculations are presented. An interest was also to present the effect of the annual use of relocation trucks on the costs of machine relocations. The results of machine relocation costs are presented with a few cost calculation examples.

Material and methods

Noticeable factors in cost calculation

Most trucks used in forest machine relocations are low-bed trucks with 3 or 4 axels. Above the chassis of the truck there is a purpose built platform (low-bed) for the use of machine transport. Nearly all forest machine relocation trucks’ exceed the maximum allowed weights and heights of trucks for traffic use (Setälä, 2003). Therefore machine relocations by trucks belong to licensed special transportation. In addition, after mounting the transport platform to the truck’s chassis, the truck has to be inspected as it is being used for a new purpose (Setälä, 2003).

The whole investment cost of a low-bed truck consists of the price of the truck chassis and the platform, including mounting. The purchase price of a truck is between 90 000–110 000 € (VAT 0%), where the definite price level is dependent on the standard of equipment and the number of axels (Contractor interviews, 2005). The price of the transportation platform ranges from 16 000–21 000 € (VAT 0%) including installation costs (Toivonen, 2005).

The main influencing factors determining the life time of truck are the annual use of truck, its ageing and general condition. According to interviews the life time of low-bed trucks range between 10 and 15 years. The percentage of the decrease in value
in cost calculations of the most common truck types is around 20 to 30% depending on several factors such as the manufacturer and type of the truck, market situation of second hand trucks, purpose of use and the truck’s general condition (Oksanen, 2003). Because of the low annual use of low-bed trucks the decrease in value can sometimes be less than 20% per annum.

Most often the relocation trucks are driven by the owner or the operator of the forest machine. The bigger logging contractors with close to a dozen or more forest machines can have also drivers employed solely to drive the low-bed trucks. If machine relocations are carried out by forest machine operators, their wages have already been taken into account for the operating costs of forest machines.

In addition to basic machine relocation between logging sites, relocation to mechanics for repairs or servicing and back to forest are estimated to be around 5 to 10% from all driven kilometres (Contractor interviews, 2005). Only 5%, or less, of harvester and forwarder relocations are accomplished during the same job cycle, when the harvester and the forwarder have to be relocated to a new logging site. Relocation of the harvester could be carried out even a couple of days earlier than the forwarder relocation from the same finished site to a new one.

Cost calculation case and its cost values
Formulating the cost calculator for a machine relocation truck leads to the use of a common cost calculation method of transportation vehicles. A cost calculation sheet, in EXCEL spreadsheet format, was received from SKAL – Finnish Transport and Logistics Association. The cost level of the used cost factor values is from 2005. Cost values for calculation were obtained from SKAL and some logging companies and transport platform manufacturers.

The structure of relocation costs is based on the contractor with a harvester-forwarder system. For the system the annual cutting was set at 35 000 m³ and average cutting site was set at 300 m³. This means 117 cutting sites per annum. In addition, 70% of all logging machine relocations are done by low-bed trucks (Kuitto et al., 1994) and 10% of all machine relocations are relocations to mechanics for repairs or servicing and back to site. According to Kuitto et al. (1994) the total driving kilometers per relocation cycle of one machine was 96 km in Finland. Thus, the total driving kilometers of a low-bed truck in this case will be 17 297 km per annum. All base information needed for the cost calculation of machine relocations with the low-bed truck is presented in Table 1.

The formulas for straight line depreciation, interest cost and salvage value are presented below:

\[ D = \frac{(P - S)}{n} \]
\[ I = \frac{p}{100} \times \frac{((n + 1)P + (n - 1)S)}{(2 \times n)} \]
\[ S = P \times \left(1 - \frac{D_p}{100}\right)^n \]

Where,
- \( D \) = annual depreciation (straight line method), €
- \( I \) = annual interest cost, €
- \( S \) = salvage value, €
- \( P \) = purchase price, €
- \( n \) = life time, year
- \( p \) = interest rate, %
- \( D_p \) = decrease in value, %
Results

The cost structure for the machine relocations calculated for a logging contractor with one harvester-forwarder system is presented in Table 2. In this case it is assumed that the forest machine operator drives the low-bed truck and so there is no wages’ cost included to Table 2 cost calculation.

The three most expensive cost factors were depreciation (24.7%), fuel (20.8%) and insurance (10.7%). The share of fixed costs was relatively high (63.9%) due to the low annual use of the machine relocation truck. For the annual cuttings of 35 000 m³ machine relocation costs per m³ was 0.80 €.

If the use of a low-bed truck could be increased, the cost per kilometre will be drastically reduced at the beginning, but will get smoother after 20 000 kilometres (Figure 1). The additional effect of the low-bed truck driver’s wages on total relocation cost is illustrated with the dash line. The wages’ cost of the low-bed truck driver was defined as 10.5 €/operating hour plus indirect wages’ cost (+63%). The addition of the wages’ cost for relocation costs per kilometre was 0.41 €/km.

With the use of one low-bed truck the relocation cost of logging machines is 0.52 €/m³ when harvesting 70 000 m³ per annum (Figure 2). In the calculation, the average removal from the logging site and driving kilometres of low-bed truck per site was estimated to be 300 m³ and 96 km, respectively. The cost effect for logging costs when using own truck for machine relocations will be extremely high in small annual cuttings (cuttings less than 35 000 m³).

In the following case the logging contractor with four harvester-forwarder systems has two optional machine relocation methods to choose from. The annual harvesting amount for a logging contractor is 140 000 m³ (4 two machine systems × 35 000 m³). In the first option the contractor has two low-bed trucks and operators of logging machines are driving the trucks. In the other option the contractor has one low-bed
Table 2. The cost calculation structure of machine relocations in a case of a logging contractor with a harvester-forwarder system. Driver’s wages are not included.

<table>
<thead>
<tr>
<th></th>
<th>Cost per annum, €</th>
<th>Share of cost, %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel</td>
<td>5 838</td>
<td>20.8</td>
</tr>
<tr>
<td>Lubricants</td>
<td>600</td>
<td>2.1</td>
</tr>
<tr>
<td>Repair and service</td>
<td>1 730</td>
<td>6.2</td>
</tr>
<tr>
<td>Tyres</td>
<td>554</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8 721</td>
<td>31.1</td>
</tr>
<tr>
<td><strong>Fixed costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>6 934</td>
<td>24.7</td>
</tr>
<tr>
<td>Interest cost (rate:4%)</td>
<td>2 442</td>
<td>8.7</td>
</tr>
<tr>
<td>Insurance costs</td>
<td>3 000</td>
<td>10.7</td>
</tr>
<tr>
<td>Transportation costs</td>
<td>2 573</td>
<td>9.2</td>
</tr>
<tr>
<td>Administration</td>
<td>1 500</td>
<td>5.3</td>
</tr>
<tr>
<td>Maintenance</td>
<td>1 500</td>
<td>5.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>17 950</td>
<td>63.9</td>
</tr>
<tr>
<td><strong>Cost per annum</strong></td>
<td>26 671</td>
<td>95</td>
</tr>
<tr>
<td>Entrepreneurship risk (5%)</td>
<td>1 404</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>28 070</td>
<td>100</td>
</tr>
<tr>
<td><strong>Cost per operating hour:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relocation costs:</td>
<td></td>
<td>69.2 €/h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.62 €/km</td>
</tr>
<tr>
<td></td>
<td></td>
<td>171 €/relocation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.80 €/m³</td>
</tr>
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<td>(annual cuttings: 35 000 m³)</td>
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</tbody>
</table>

Figure 1. The effect of the annual driving of low-bed truck on the relocation costs per kilometre. Cost curve with the dash line shows the relocation cost with driver’s wages’ cost.

Figure 2. The effect of contractor’s annual logging removal on the relocation costs per logged cubic metre of wood. Cost curve with the dash line shows the relocation cost with driver’s wages’ cost.
truck and a separate driver for the truck. The wages’ cost of the low-bed truck driver was 10.5 €/operating hour plus indirect wages’ cost (+63%). Which option is most cost effective for the contractor, if the average machine relocation cycle is assumed to be 96 km/machine in both options?

In the first option the relocation cost for both low-bed trucks is 0.52 €/m³ and annual relocation cost is 73 240 €. In the other option the relocation cost is 0.59 €/m³ and 82 339 € respectively. Wages’ cost per annum was 27 384 € (option 2) and total driving time was 1600 hours.

Even though the first option of relocations resulted in cheaper cost than the option with separate driver of the truck, there are other factors to be considered. The work shift time of the forest machine operators could be used more for pure logging operations in the latter option and therefore it would decrease logging costs. On the other hand, in high logging seasons the use of one low-bed truck might cause idle time easier for logging machines.

Conclusions

In 2005, the average logging costs of logging machine contractors (cutting and forwarding) in Finland was 8.53 €/m³ (Kariniemi, 2006). Therefore, the relocation cost of forest machines can be calculated to be about 6 to 10% of the logging costs. Relocation costs for small logging contractors having their own low-bed truck can be relatively high. The low percentage of machine utilisation of the truck causes a high share of the fixed costs, and results in high relocation costs. Therefore, finding alternative options to carry out machine relocations could significantly reduce logging costs of small contractors.

One option could be the co-ownership of machine relocation truck, where two to four small contractors co-own a low-bed truck. Nevertheless, a contractor, who offers machine relocation services, needs to get a special road transportation license and a training course for this. Furthermore, if the owner wishes to transport the machinery of other logging contractors, additional transportation insurance is required. (Sivonen, 2006).

A change towards a real or total logging contracting could give some benefits and synergy on machine relocations as a whole (Ala-Fossi et al., 2004). Bigger logging contractors with a large coverage area can coordinate and offer machine relocation services for their smaller sub contractors. Loggings itself is mainly conducted in winter and therefore the use of the relocation fleet in the remainder of the year is limited. Finding the alternative forestry works for logging machines - like planting, site preparation, clearing of saplings and bio-energy harvesting – will improve also the cost efficiency of relocation trucks outside of winter.

The outsourcing of relocation maybe a cheaper option than the contractor using his own relocation truck. According to a small survey of five relocation service companies in Finland, the relocation costs varied from 1.0 € to 1.25 € per driven kilometre (VAT 0%) (Contractor interviews, 2006). The main factor explaining this relatively low cost was, on average, due to the higher annual usage of the machine relocation trucks compared to logging contractors. The average use of trucks per annum for relocation service companies was 69 000 km with a range of 30 000 to 140 000 km (Contractor interviews, 2006).

In the future, the focus in the field of machine relocations has to be on the economy and also on the functionality of the machine relocations as a whole. There are number of limitations in using special transportation in the smaller road networks in Finland.
especially the load bearing capacities of roads and bridges and clearance under bridges and power lines (Setälä, 2003).

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