

CUSTOMER-PERCEIVED VALUE IN FOREST HARVESTING OPERATIONS

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ABSTRACT

The measure of performance in forest harvesting is an essential prerequisite for planning and improving forest operations. Traditionally the focus has been towards machine-related performance measures such as production of wood per time unit. However, in today's increasingly complex wood supply networks, the demand of a more complex analysis of performance is on the rise. This study develops a method for evaluation of harvesting contractor performance and applies it in performance analysis of a large contractor dataset. The service management theory of customer-perceived value was used as a framework in a series of interviews with forest company officials in order to identify key indicators of performance that affect the harvesting service' value to the customer. Interview results reveal the complexity of harvesting operations and points out several important aspects of harvesting contractor performance. A questionnaire that measured the identified aspects was developed and used by five forest company production managers in their assessment of the perceived value of their employed contractors' services, which resulted in 74 assessed entrepreneurs in total. The questionnaire also measured how the production managers perceived the importance of each aspect. A main conclusion is that the largest potentials for improving the contractors' customer-perceived value is connected to timber and thinning quality, management, cooperation with forest company, productivity and machine utilisation. Such improvements, if realized on a broad scale, are likely to improve the function of the whole wood supply network.

Keywords: Customer-perceived value, harvesting, contractors, survey

INTRODUCTION

Many Swedish forest companies outsourced most of their harvesting operations to small contractors during the 1980's and early 1990's. These contractors were often recruited among the forest companies' own employed machine operators who were offered to buy their machines from the forest companies and continue as more or less independent contractors (Hultåker 2002, 2006). The outsourcing introduced a new interface in the wood supply system which put both forest companies and the usually recently started contracting businesses in totally new roles as customers and suppliers of harvesting services. This study will investigate

the nature of this relationship and try to quantify to what extent the contractors manage to create value for their customers using the theory of customer-perceived value (CPV).

Ravald & Grönroos (1996) define the customer-perceived value of a service as the customer's perceived benefits from the service in relation to the customer's perceived sacrifice needed in order to gain these benefits. Grönroos (1997) discussed this further in another article and developed the definition of CPV into a model well suited for analysis of the relations between harvesting contractors and forest companies. He argues that the CPV of a service can be regarded as a function of four main components; core solution, additional services, actual cost and relation costs (Equation 1).

$$[1] \quad \text{Customer Perceived Value} = \frac{\text{Core Solution} + \text{Additional Services}}{\text{Price} + \text{Relationship Costs}}$$

- *Core Solution* describes the physical outcome of a service in technical terms.
- *Additional Services* describes other immaterial values of a service that the customer benefits from such as delivery, claims handling, etc.
- *Price* describes the monetary cost of a service.
- *Relationship Costs* can be direct costs for maintaining the business relation, such as costs for administration or computer systems, but also includes indirect costs, caused by delivery problems for instance, and psychological costs, caused by the customer's fears that the service will not function as promised.

However, in order to analyse the customer-perceived value of harvesting contractors' services, the rather generic model needs to be put into a forest operations context and expanded into a concept of measurable aspects of perceived value. This study will use the generic CPV model as a conceptual framework and expand it with a set of forest harvesting specific subaspects. The goal is not to quantify CPV as such but rather to describe forest company officials' perceptions of the importance of various CPV subaspects and how well harvesting contractors perform in those. The described below will be used in studies in the future in order to gain a deeper understanding of CPV in a harvesting operations context.

METHODOLOGY

In this study we have focused on the Swedish forest company SCA as customer and a group of harvesting contractors employed by SCA as service providers. SCA's harvesting contractor relations are managed by a group of five production managers who acts like hubs in a large integrated network supplying SCA's own industries with timber and are responsible for contracting harvesting resources in their respective geographical areas. The 74 contractors included in the study were all employed on a long term basis by the production managers during the period 2007-2009. Most of the contractors had been working with SCA as the only customer of their services for several years.

Another group comprising a chief technical officer, a production manager who had acquired his office after the study period's end, an improvements manager and a production supervisor were formed in order to participate in the identification of CPV subaspects. The group of interviewees was selected because they had very good insights in SCA's contracting of

harvesting resources. The interviewees were first asked to reflect on Grönroos' (1997) four CPV aspects and elaborate on their meaning in the relation between forest company and harvesting contractors. Secondly a gross list of subaspects were compiled and sent back to the interviewees for comments and then reworked until all interviewees agreed on a common set of subaspects (Table 1).

The identified subaspects connected to the price aspect were all possible to measure accurately in SCA's production follow-up systems, whereas direct measurements for the other subaspects were lacking. This called for the development of a questionnaire designed to measure the production managers' perceptions of each contractors' services. The questionnaire (Table A1) comprised between one and three 10-graded Likert scale questions per CPV subaspect and was designed so that a high mark on any question would indicate a positive contribution to CPV. The 10-graded Likert scale format was chosen in order to encourage variation in the answers (DeVaus 2002). Subaspect scores is calculated from the questionnaire by taking the mean value of the questions associated with a certain subaspect. The finalised questionnaire was tested on two of the interviewees which revealed the need for some minor adjustments. The production managers were then asked to complete a questionnaire for each of their contractors. Additionally the production managers were asked to mark how important they found each subaspect to be on a 10-graded scale.

RESULTS

The interviewees of this study identified *Timber quality*, *Thinning quality* and *Environmental considerations* as the three most important aspects of the contractors' core solutions. Timber quality refers to how well the produced logs correspond to current bucking and sorting instructions and to what extent the contractors are causing unnecessary timber value losses due to log end checks, feeder roll slip, etc. Thinning quality is defined as the contractors' ability to meet demands on strip road width and spacing, thinning strength, residual stand damages etc. Since the harvesting contractors are responsible for taking appropriate Environmental considerations on their harvesting sites and thus for the operations' compliance with various environmental standards¹, it is of vital importance that they harvest according to all the demands stipulated in the certificate regulations.

In a complex supply network with minimised roundwood stock levels, *Flexibility* – the ability to respond to changes in the company's needs and to solve problems independently as they arise – and *Delivery performance* – the ability to deliver agreed volumes on time – are highly desirable contractor features for efficient operations. Long term contractor relations mean that it is imperative for the development of the supply network that the contractors take actions on their own to improve their effectiveness. The interviewees divided this ability to improve operations into two subcategories; *Management*, which is defined as the ability to constantly optimize and improve the contractors' own operations, and *Cooperation* focus, which is defined as the ability to initiate improvements and embrace suggestions on improvements of the company-contractor relationship.

The price of different contractors' harvesting services is difficult to compare since they are operating under different conditions. In order to assess the cost competitiveness of the

¹ SCA is certified according to FSC and ISO14001 standards.

contractors without comparing the actual prices, the interviewees suggested that two subaspects should be used for harvesters and forwarders; *Utilisation rate* and *Productivity* in relation to a productivity standard.

When asked to elaborate on relationship costs the interviewees pointed out efficient and accurate *Daily communication* and an easily maintained *Business relationship* as two desirable features of the company-contractor relationship. Table 1 gives a schematic overview of the identified subaspects and their relations to the main aspects of CPV.

Table 1: Descriptions of the identified subaspects of customer-perceived value.

Aspect	Subaspect	Description
Core solution	Timber quality	Bucking, sorting, timber damages, etc.
	Thinning quality	Damages to residual stand, strip road width and spacing, thinning strength, etc.
	Environmental considerations	Compliance with certification regulations, minimized soil damages etc.
Additional services	Flexibility	Geographically flexible, adapts production rate to the demand, solves problems independently, etc.
	Delivery performance Management	Delivers agreed volumes on time. Makes efforts to improve his own efficiency, develops the personnel, etc.
	Cooperation	Makes efforts to improve cooperation with the customer.
Relationship costs	Daily communication	Gives daily production reports in the stipulated manner, alerts the customer when encountering problems, has a keen ear to the customer's needs, etc.
	Business relationship	Smooth annual negotiations, easy to come to agreement with on piece rates, additional payments, etc.
Price	Harvester rate productivity	Harvester productivity in relation to a productivity norm.
	Forwarder rate productivity	Forwarder productivity in relation to a productivity norm.
	Harvester utilisation rate	Harvester productive machine time (PMH) over computer uptime
	Forwarder rate utilisation	Forwarder productive machine time (PMH) over computer uptime

Perceptions of contractor performance

Table 2 summarizes some descriptive statistics on how the contractors score on the various CPV subaspects. Contractors who exclusively worked in final fellings did not get marked on thinning quality and contractors who were ordered to produce at their maximum capacity at all times did not get marked on delivery performance. Notably, one of the production managers had ordered all contractors at his disposal to always produce as much as they could.

On average the production managers assessed the contractor's performance on the subaspects slightly above 7, with subaspects Management and Cooperation scoring slightly lower. The

largest standard deviations in scored subspects appeared in thinning quality, delivery performance and cooperation.

The contractors in the study produced on average 4 % more wood than was predicted by the productivity standard, but the differences between individual contractors were very large. The most productive contractor exceeded the standard by more than 40 % while the least productive contractor only reached about 73 % of the production predicted by the standard, with a standard deviation of 14 % for all contractors. Average machine utilisation rate was about 83 % with a standard deviation of 6 %. As with the productivity rate, there were large differences in machine utilisation among the contractors. In fact the least utilised forwarder only forwarded 55 % of the time the machine was available and the machine computer turned on, while the most utilised harvester reached a very impressive utilisation rate of 97 %.

Table 2: Subspects of customer perceived value scored or measured for 74 contractors during the period 2007-2009.

Aspect	Subspects	n	Mean	StDev	Min	Max
Core Solution	Timber quality	74	7.2	1.4	4.0	10.0
	Thinning quality	44 ^a	7.1	2.1	1.0	10.0
	Environmental considerations	74	7.4	1.2	5.0	10.0
Additional Services	Flexibility	74	7.0	1.3	3.0	9.3
	Delivery performance	44 ^b	7.0	2.0	2.0	10.0
	Management	74	6.5	1.6	2.3	9.0
	Cooperation	74	6.1	1.9	1.0	9.7
Relationship Costs	Daily communication	74	7.7	1.4	3.0	10.0
	Business relationship	74	7.2	1.4	2.0	10.0
Price	Harvester productivity rate ^c	74	1.05	0.14	0.73	1.44
	Forwarder productivity rate ^c	74	1.03	0.14	0.72	1.43
	Harvester utilisation rate ^d	74	0.82	0.06	0.66	0.97
	Forwarder utilisation rate ^d	74	0.84	0.06	0.55	0.96

^a 30 contractors with large machines were only involved in final felling operations.

^b 30 contractors were ordered to always produce as much timber as they could manage which makes an assessment of their delivery performance irrelevant.

^c Actual productivity during the period divided by expected productivity according to a productivity standard.

^d Productive machine time (PMH) during the period divided by machine computer uptime.

Perceived importance of CPV subspects

The production managers graded subspects connected to the Core solution on average around 9 on the 10-graded importance scale while the other subspects were graded around 8. The exception from this was Delivery performance which got the lowest average mark of 5 (Figure 1). Delivery performance also contains the largest differences in perceived importance; the five production managers marked it, respectively, 9,7,6,2 and 1, which

indicate that there are two quite opposite opinions within the group. Perceptions of Management and Cooperation importance also cover fairly large ranges.

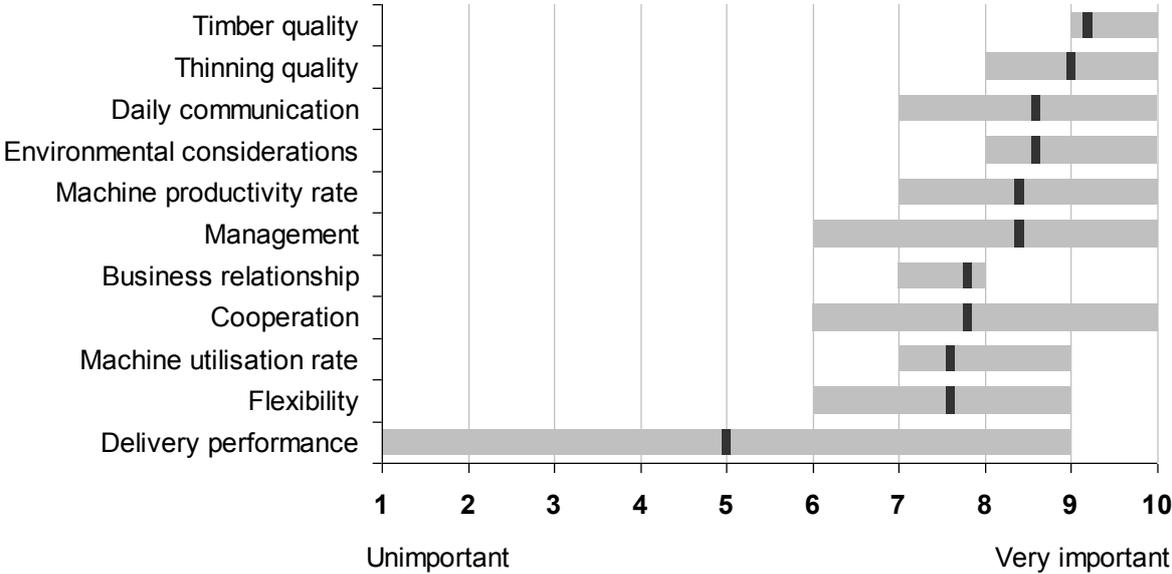


Figure 1: Subaspect importance according to the five production managers (black bars indicate the mean value, whereas grey bars are the minimum-maximum range).

A low price of the harvesting service will always be of interest for the customer, but which other aspects or subsaspects of CPV that is most important to improve is more difficult to determine. In Figure 2 the importance assessed by the production managers for each non-price related subaspect is compared to the contractors’ average score. Large discrepancies between perceived importance and average scores given to contractors were observed for subsaspects Timber and Thinning quality, Management, Cooperation and Delivery performance.

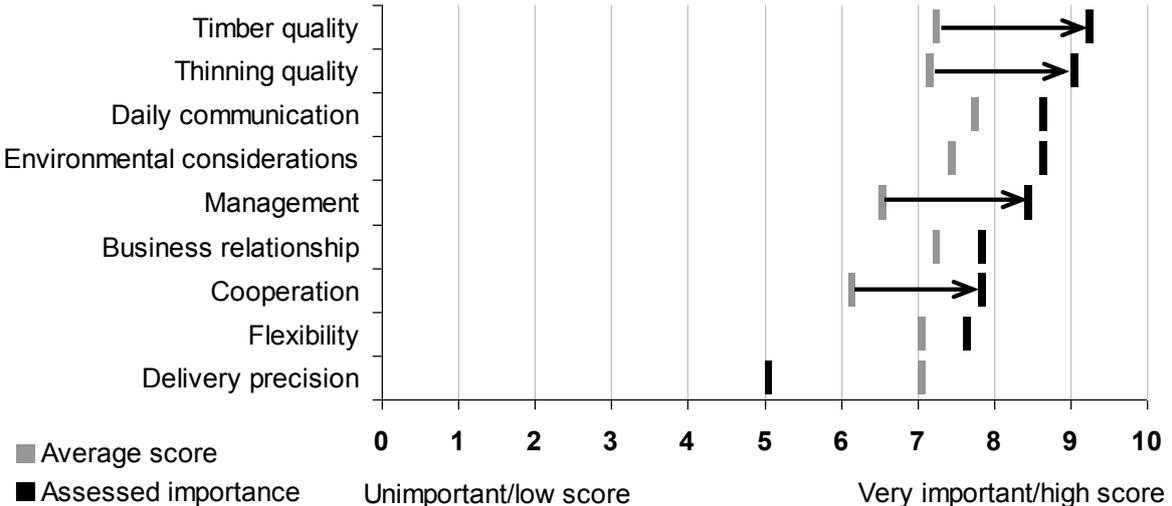


Figure 2: Assessed subaspect importance and average contractor scores. Arrows represents large possible improvements.

CONCLUSIONS

Contracting forest harvesting services might seem like a fairly simple business at first glance, but this study has revealed that it can be described as a multi-faceted operation that requires high performance in a number of fields in order to keep the customer happy. The contractors in this study managed fairly well in this and on average scored quite high even though the variation in some of the identified subaspects was large.

Most production managers considered all subaspects to be fairly important which indicates that, overall, the study was successful in the subaspect identification process and that the suggested model should be well suited for further analyses of CPV in harvesting operations. A notable exception was two managers who graded Delivery performance as unimportant. This could indicate that these two are managing their contractors in a way that lessens the need for controlling deliveries from individual contractors. The same thing is implied by the fact that 30 of the 74 contractors worked under the order to constantly deliver as much timber as they could manage while the deliveries from the other 44 contractors were more or less closely monitored and managed by the production managers. The possibility that harvesting resources likely are managed in different ways by the production manager's call for further research and analysis. If the requirements on Delivery performance could be lifted for a larger proportion of the contractors through more efficient management they probably could put more focus on improving their performance in other fields, such as for instance Timber quality or Productivity.

Large discrepancies between perceived importance and average scores were observed for five subaspects, but since the perceived importance of Delivery performance covers such a large range it is inadvisable to draw any conclusions from that discrepancy. However, the remaining four subaspects with large discrepancies indicate possible improvements of CPV which should be prioritized by both contractors and forest company in order to improve their business relationship. The large variation in Productivity and Utilisation rate indicate possible improvements in those aspects as well and call for further research in order to investigate the underlying causes of variation and identify possible actions to improve the contractors' performance.

This study was conducted within a single forest industry company which makes it advisable to use some caution before making generalizations of the results. However, the number of contractors included in the study was quite large and the five production managers were facing different supply situations in their respective geographical areas which ensure that considerable variation is included in the studied material. This makes it safe to assume that patterns like the ones outlined in this paper exist in similar relationships between other harvesting contractors and wood procurement organizations as well.

The theory of customer-perceived value offers an attractive conceptual framework for the analysis of customer-supplier relationships. Possible further studies of CPV in a harvesting services context could include, for instance, analysis of correlations between various CPV aspects and contractor profitability.

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APPENDIX

Table A1: The questionnaire used for assessing the production managers' perceptions of the identified subaspects of customer-perceived value (translated from Swedish).

Aspect	Subaspect	Question ^a
Core solution	Timber quality	product quality?
	Thinning quality	thinning quality?
	Environmental considerations	environmental considerations?
Additional services	Flexibility	<i>How much do you agree to the following statements;</i> The contractor adapts his production rate to the company's needs.
		The contractor is geographically flexible if needed by the company.
		The contractor solves problems in a suitably independent manner.
	Delivery performance	The contractor delivers agreed volumes on time.
		The contractor train and develop his personnel.
	Management	The contractor uses equipment well suited for the task at hand. The contractor is constantly trying to improve his business.
Relation costs	Cooperation	The contractor gives suggestions on possible improvements of the cooperation with the company. The contractor carries through suggestions on improvements from the company officials. The contractor's commitment helps the company to improve its operations.
		Daily communication
	Business relationship	

^a Respondents were asked to give their answers on a 10-graded scale where 1 equalled very unhappy or strongly disagree and 10 equalled very happy or strongly agree. The questionnaire was constructed with the intention that high marks always should be a positive indication for customer-perceived value.