Gentle Logging System Evaluation

(PARTICIPANTS' QUESTIONNAIRE REPORT)

November 26, 2001

Raymond O. Miller
William E. Cook

Published by
Michigan State University
Upper Peninsula Tree Improvement Center
Escanaba, Michigan

The title of this project is Improving Environmental Quality by Identifying, Demonstrating, and Evaluating Hardwood Harvesting Systems on Sensitive Soils. It was funded in part by the United States Forest Service Wood Education Resource Center and by cooperating organizations that include: Michigan State University, USDA Forest Service Hiawatha National Forest, USDA Forest Service Southern Research Station, Michigan Department of Natural Resources, USDA Natural Resources Conservation Service, and the Michigan Association of Timbermen.

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Raymond O. Miller and William E. Cook[1]

Abstract

Five, new, cut-to-length harvesting systems were demonstrated to a group of several hundred loggers, foresters, and other interested individuals in a northern hardwood stand in Upper Michigan. The site was typical of many in the region where productive hardwood stands grow on soils that are wet and vulnerable to damage much of the year. We asked the participants to evaluate the harvesting systems as they carried out a thinning in our test stand. Participants shared their impressions of system operability, productivity, and ability to minimize damage to the site.

Some expressed the concern that these new harvesting systems were too big for this type of thinning but most felt that size was not a problem. Logging company owners and equipment operators tended to feel that they could do an equally good job with equipment they already owned, but foresters and resource specialists tended to think that these newer systems would do less damage to the site than traditional systems. Most agreed that, although this equipment would be best suited to large, conifer, clearcuts, it was versatile enough to be effectively used in thinning jobs like this. Owners and operators indicated that this equipment would be slightly more difficult to operate than existing equipment but felt that it would have average productivity and better than average reliability. In general, most participants were favorably impressed with the performance of these new systems, although loggers were apparently not as convinced of a need to change as were foresters and resource professionals.

Introduction

A significant portion of the northern hardwood forest in Upper Michigan grows on productive sites where seasonally moist soils are subject to damage from mechanized harvesting equipment. Management of these sites is severely limited without a viable harvesting option. Recent advances in harvesting equipment designs have produced machines that may be able to operate on these sites without causing as much damage as traditional systems. This project was designed to evaluate several types of newer harvesting systems on a typical, sensitive site in Upper Michigan.

A forest in north-central Alger County near Munising, Michigan was chosen for the evaluation. The land is managed by Shelter Bay Forests and supports a productive hardwood forest on seasonally moist soils. It was also easily accessible for both equipment and visitors.

The soils on the site are of loamy glacial till origin and are deep and moderately well drained. Typically, these soils have a firm, dense fragipan layer about two feet below the surface that restricts vertical water movement and creates a perched water table in the early spring. Areas near the bottom of slopes and in depressions can stay excessively wet well into the growing season. We chose to conduct our evaluation in early spring, shortly after snowmelt, to ensure that the water table would be high.

The fragipan and perched water table in sites like this forces trees to develop shallow root systems. This leaves the trees vulnerable to windthrow. As a result, this site was strewn with abundant windthrow mounds. These mounds produce drier microsites on their tops while the adjacent depressions form wetter microsites. Forwarders that pitch around while moving over mounds often cause injuries high on standing trees where their bunk stakes scrape the bark. This microrelief challenged equipment operators to both avoid disturbing the wetter depressions and avoid injuring residual trees in the stand.

The study forest is dominated by second growth, pole-sized sugar and red maple with black cherry, American beech, and yellow birch associates. There are conifers (eastern hemlock, balsam fir, and white spruce) scattered sparsely throughout the stand. A preliminary inventory showed that: the average basal area was 135 sq. ft., there were an average of 325 trees per acre with an average diameter of 10" DBH, and the average volume was 37 cords per acre.

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[1] The authors are respectively: Research Forester and Forestry Extension Specialist at Michigan State University's Upper Peninsula Tree Improvement Center.

The first day of this two-day demonstration exhibited the harvesting systems to a broad audience of professionals. On the second day we evaluated the systems in some detail. Three separate reports provide the basis for evaluating the harvest systems:

- A diverse group of observers was selected to watch the systems and interact with the manufacturers and operators during both days of harvesting. A summary of their impressions and conclusions is presented in the ***Observer Report***.
- Forest scientists made a series of measurements in the areas harvested during the second day's operation. Summaries of these data were made to describe the stand before and after harvesting as well as to assess the harvesting equipment itself. Those summaries are presented in the ***Quantitative Measurements Report***.
- Loggers, foresters, landowners, resource specialists, and others who attended the first day's operations were given a questionnaire and asked to share their impressions. More than 200 of these questionnaires were summarized and discussed in this report, the ***Participant's Questionnaire Report***.

The study forest was divided into ten harvesting areas of roughly equal size – about 2.5 acres each. Five of these areas were used on the first day (May 9, 2001) for visitors to observe the harvesting systems in operation and to allow the operators to become familiar with stand conditions. The remaining areas were harvested on the second day (May 10, 2001). Quantitative measurements were made in the plots harvested on the second day.

Trees to be cut were marked by a crew from the Michigan Department of Natural Resources several weeks prior to harvesting. Trees were painted so that the marks were visible from all sides. An attempt was made to leave a uniformly stocked stand (a basal area of about 80 sq. ft. per acre), but allowances were made for the natural variability throughout the site.

Five harvesting systems were chosen to represent a range of equipment types. A summary of this equipment appears in Table 1. Two systems employed large, tracked, skid-steer harvesters, two employed rubber-tired, articulated harvesters, and one employed a small, tracked, skid-steer harvester. All harvesting was "cut-to-length" but with a variety of booms and harvesting heads. All forwarding was done with either six-tired or eight-tired articulated machinery. All rubber-tired machines were equipped with steel Olofsfors Eco-Tracks over their tandem tires. No forwarding was done in the area harvested by the small "Harvest Systems" machine because the unit scheduled for that area was withdrawn at the last minute. Harvesting systems were randomly assigned to five, 2 ½-acre evaluation areas for the first day's demonstration. All but the smallest system completed the thinning of their area within that time.

The site was fairly dry for the first day's harvesting and so the people who attended that day did not see the site in its most sensitive condition. The answers to our questionnaire were all based on what participants saw on this dry day. Responses may have been much different on another day or at another site. This limitation should be remembered throughout the following discussion.

The Questions

Everyone who visited the site during the first day's demonstration was given a short, multiple-choice questionnaire. Questions were arranged into several categories to help gather information about; what type of person was responding, how this site compared to other areas where participants work, and what their reactions were to the equipment being demonstrated.

We tried to understand what type of person was answering the questions by asking:

- **Who are you?** (a logging company owner (hereafter referred to as "Owners"), an equipment operator, a forester, a resource specialist, or a landowner).
- **What types of landowners do you work with?** (industrial, small private, or public).

Table 1. Harvesting system components used for Gentle Logging System Evaluation.			
System Description	**Manufacturer**	**Harvester**	**Forwarder***
Tracked harvester and 6-wheeled forwarder	Timberjack	608s, 25' articulated boom	1010, 6-wheeled
Tracked harvester and 6-wheeled forwarder	Fabtek	FT133, 21' articulated boom	FT346B, 6-wheeled
6-wheeled harvester and 8-wheeled forwarder	Ponsse	Ergo, 33' telescopic	Caribou, 8-wheeled
	Valmet	911.1, 32' telescopic boom	840, 8-wheeled
Small, tracked harvester with no forwarding	"Harvest Systems"	Link-Belt LS1600, 21' articulated boom	NONE
* - all forwarders were equipped with Olofsfors Eco-tracks			

- **What kind of equipment could you (or would you) put on this site today?** (chainsaws, wheeled forwarders, wheeled processors, tracked forwarders, tracked processors, or cable skidders).

We asked them to compared this stand to similar ones in which they work:

- **How do the number of trees per acre in this stand compare to similar sites you work on?** (above average, average, or below average).
- **How does the volume of this stand compare to similar sites on which you work?** (above average, average, or below average).

And finally we asked about their reaction to the equipment they saw operating:

- **How does this equipment fit this job?** (too small, just right, large, too big).
- **Do you think this equipment will do less damage than the equipment you have now?** (yes or no).
- **On what types of jobs or sites would you use this equipment?** (a range of job sizes, species types, types of cutting, soil moisture, and topography were offered as choices).
- **How difficult to operate does this equipment appear to be?** (easy, average, or difficult).
- **How do you judge the reliability of this equipment?** (low, average, high).
- **How do you judge the productivity of this equipment?** (below average, average, or above average).
- **What is your overall impression of the system?** (definite interest, favorably impressed, not suited to my operation, not suitable for the Upper Peninsula).

The Responses

Who are you?

We estimated that approximately 350 people attended the demonstration. Of these, 206 responded to our questions. About ⅔ of the respondents were logging company owners ("Owners") and equipment operators ("Operators"). About ¼ were foresters or resource specialists (soil scientists, hydrologists, forest finance specialists, forest health specialists, etc.), and the rest were either large industrial or small private landowners. A summary appears in Table 2. Responses from each participant group were separated during the analysis to observe differences of opinion among them.

Table 2. Distribution of respondents attending the Gentle Logging System Evaluation by Participant Groups.		
Participant Group	Number responding	Percent of all respondents
Owners	95	46%
Operators	41	20%
Foresters	45	22%
Specialists	10	5%
Landowners	15	7%

What types of landowners do you work with?
A summary of the type of landowners with whom participants work is presented in Table 3. Many respondents worked with more than one type of landowner, so the percentages within each participant group do not sum to 100%.

Foresters reported working more-or-less equally with all types of landowners. Specialists seem to spend most of their time working with public agencies. Loggers work about twice as much with small private landowners as with public or industrial landowners which suggests that perhaps; (a) industrial and public managers are more selective about who operates on their land, (b) many loggers choose not to work on public and industrial land, or (c) twice as much timber comes from private land so more loggers are required there. About 35% of Michigan's forestland is held by private, non-industrial owners and represents about 46% of the total standing volume of the state according to the last forest inventory. These figures are slightly lower in the Upper Peninsula.

Table 3. Distribution of service to landowners by each Participant Group.

Participant Group	#	Percent of each Participant Group serving these landowners:		
		Industrial	Small Private	Public
Owners	95	45%	84%	54%
Operators	41	41%	78%	66%
Foresters	45	56%	73%	58%
Specialists	10	30%	50%	90%
Landowners	15	33%	73%	27%

What kind of equipment could you put on this site today?
We expected only Owners to respond since they are the only group that actually owns equipment. Since other groups responded, we assume that they interpreted the question to be asking what type of equipment they would <u>like to see used</u> on these sites. A summary of responses is presented in Table 4.

Owners and operators indicated that: (1) chainsaws, wheeled forwarders, and tracked processors are fairly common, (2) that wheeled processors and cable skidders are less common, and (3) that tracked forwarders are essentially unknown. Foresters, Specialists, and Landowners expected to see traditional chainsaw systems used but indicated a stronger preference for larger mechanized systems than did the loggers. Foresters and loggers expressed a slight preference for tracked rather than wheeled processors.

The preference that foresters and specialists expressed for "Tracked Forwarders" is interesting. Such equipment is rare and so those who made this selection may have been referring to the wheeled forwarders with Olofsfors Ecotracks that operated at the evaluation. If that were the case, then perhaps foresters and specialists were expressing a preference for the three-axle or four-axle forwarders demonstrated here as opposed to traditional two-axle forwarders.

Table 4. Equipment preference or availability from each Participant Group.

Participant Group	#	Percent of each Participant Group that favored each type of equipment:					
		Chainsaw	Wheeled Forwarder	Wheeled Processor	Tracked Forwarder	Tracked Processor	Cable Skidder
Owners	95	56%	68%	32%	5%	41%	24%
Operators	41	41%	78%	29%	5%	51%	12%
Foresters	45	42%	53%	31%	24%	56%	29%
Specialists	10	40%	60%	40%	30%	40%	10%
Landowners	15	47%	40%	20%	13%	33%	13%

How do the number of trees and volume of this stand compare to similar sites on which you work?
The majority of respondents agreed that this stand was typical of others in the region, in terms of density and volume (Table 5). This implies that operating conditions here were normal. Processors faced typical maneuvering challenges and handled typical-sized trees. The wood that forwarders gathered and hauled was normally distributed throughout the stand and did not present any unusual forwarding challenges.

Table 5. How does this stand to compare to others in which you work?							
Participant Group	#	Number of Trees			Standing Volume		
		Above Average	Average	Below Average	Above Average	Average	Below Average
Owners	95	14%	74%	12%	13%	76%	11%
Operators	41	8%	82%	10%	10%	71%	19%
Foresters	45	12%	73%	15%	18%	61%	21%
Specialists	10	25%	75%	0	20%	40%	40%
Landowners	15	22%	64%	14%	9%	73%	18%

How does this equipment fit this job?
A majority of owners, operators, and landowners felt that the equipment in the full-size harvesting systems was about the right size for this type of hardwood thinning. Foresters and specialists were not so sure. About 60% of their responses indicated that the equipment may be too large. A few respondents indicated that the full-size systems used here were too small for this job. This is hard to believe and may in fact be a mistake. Perhaps the answers were marked incorrectly or the question was misunderstood. A summary of participant responses about the full-size systems is represented in Figure 1. This figure is a bubble chart. The size of each bubble represents the proportion of each participant group that made that choice.

There was unanimity among various participant groups about the smaller, Harvest Systems processor. 83% of all respondents felt that it was too small for this operation. Only 14% thought it was adequately sized for this thinning.

Do you think this equipment will do less damage than the equipment you have now?
Answers to this question (as summarized in Table 6) were mixed. Owners and operators tended to feel that the equipment they already had would do an acceptable job on this site. Other participant groups thought that many of these newer systems did have the potential to do less site damage than conventional equipment.

Two thirds of the owners and operators were not convinced that any of these systems would do a better job than the equipment they were currently using. The soil was fairly dry on the day when this group observed the operation and so the site appeared to be less sensitive than it really was. The reaction of the owners and operators might have been different had they seen the systems operating under different ground moisture conditions (as existed on the following day at this site). They may have genuinely felt that their equipment was equal to the systems being demonstrated, but they may also have been defending their existing investment in machinery.

Specialists were not as impressed by the larger systems as they were by the small, “Harvest Systems” machine. Foresters were less impressed by the smaller machine and evenly split over the superiority of the larger systems. A majority of landowners thought that all the systems were an improvement over traditional equipment.

Although not shown in Table 6, systems with tracked harvesters received poor reactions from all participant groups but foresters and landowners were generally impressed by systems with wheeled processors.

Table 6. Will these harvesting systems do less damage than existing systems?				
Participant Group	Big Systems		Small System	
	Yes	No	Yes	No
Owners	46%	54%	58%	42%
Operators	21%	79%	35%	65%
Foresters	49%	51%	32%	68%
Specialists	39%	61%	75%	25%
Landowners	59%	41%	63%	38%

On what types of jobs or sites would you use this equipment?
Respondents often did not provide complete responses to this question and about half chose not to answer at all. As a result, interpretation of these responses is difficult and often ambiguous. Responses were tallied across participant

groups and equipment classes to arrive at the summary presented in Table 7. The numbers reported in the table represent the proportion of all the participants who selected a particular job or site where this equipment would be useful. The fact that the balance of the respondents did NOT choose that job or site could mean that they thought the systems would not be useful under those conditions or it could mean that they merely skipped the question. Consequently, we cannot draw conclusions about the absolute preferences being expressed here but must look for general trends among the positive responses instead.

Many felt that the larger systems would be best used on large, conifer clearcuts. That combination of features in a timber sale will lead to the highest productivity for the operator and therefore maximize profits. It is no surprise then that participants would prefer to place expensive machines in conditions like that. Participants felt that the larger systems would perform equally well across various ground moisture and topographic conditions. In general, everyone seemed to feel that this equipment was fairly versatile.

There was less enthusiasm expressed (fewer responses) for the small Harvest Systems machine than for the larger systems. Participants felt that this machine would be poorly suited to large jobs, hilly ground, and deep snow conditions. Otherwise, the responses indicate that this machine would be versatile across the range of remaining conditions.

Table 7. Type of job or site on which these systems might be used.

Characteristic of job or site	Proportion of 206 respondents selecting this equipment for use on:					
	Large Systems			Small System		
Job Size	Big (37%)	Small (21%)		Small (30%)	Big (13%)	
Species	Conifers (40%)	Hardwoods (34%)		Conifers (24%)	Hardwoods (21%)	
Type of Cut	Clearcuts (42%)	Thinnings (28%)		Thinnings (26%)	Clearcuts (19%)	
Soil Moisture	Dry (32%)	Snow (29%)	Wet (27%)	Dry (20%)	Wet (15%)	Snow (9%)
Topography	Flat (32%)	Hilly (24%)		Flat (21%)	Hilly (9%)	

How difficult to operate does this equipment appear to be?
How do you judge the reliability of this equipment?
How do you judge the productivity of this equipment?
The answers to these questions given by owners and operators was examined in detail because it was felt that they would be in the best position to judge. Answers from other participants will not be discussed except to note that they did not differ markedly from those given by the owners and operators.

Owners and operators felt that the Fabtek system would be of average difficulty to operate (Figure 2). They felt that the Harvest Systems machine would be slightly easier than average to operate and the other systems would be slightly more difficult. On average, this group felt that the Ponsse system would be the most difficult to operate. It is not clear if this means that they felt the difficulty lay in (a) maneuvering the equipment through the stand, (b) handling trees of the size in this stand, or (c) learning to operate the machines productively.

Owners and operators were generally impressed with the reliability of all the equipment demonstrated. All systems were ranked at or above average. Differences among ratings for each system were minor (Figure 3).

Productivity ratings are summarized in (Figure 4). Owners and operators rated the Harvest Systems machine as below average in productivity. It was much smaller and slower than the other systems but it was also much less expensive (Table 1). Productivity ratings of the larger systems were more nearly average. Systems with wheeled processors were seen as slightly more productive than those with tracked processors.

Actual system productivity was calculated and is reported in the "Quantitative Measurements Report" of this project. These calculations show that the more costly Timberjack, Valmet, and Ponsse systems were less productive (about $14.79 per green ton produced) than the Fabtek system (about $11.78 per green ton produced) under these conditions. The questionnaire respondents arrived at a different conclusion. It is possible that respondents expected certain systems to provide better product utilization and based their productivity assessment on total value produced rather than total weight produced (as was done in the above mentioned report). It is also possible that the questionnaire respondents simply misjudged productivity.

What is your overall impression of the systems?
Most participants were generally impressed with the overall performance of the large harvesting systems being evaluated here. They were less sure that the small system would be widely useful. Foresters and specialists were more anxious to see these systems adopted than owners and operators, although even these latter groups were significantly impressed (Figure 5). Some owners (about 30%) were impressed but not enough to abandon their existing systems based on what they saw. If foresters and specialists want this equipment to be more widely used (as their responses indicate), then they have some convincing to do among the logging community.

Figure 1.

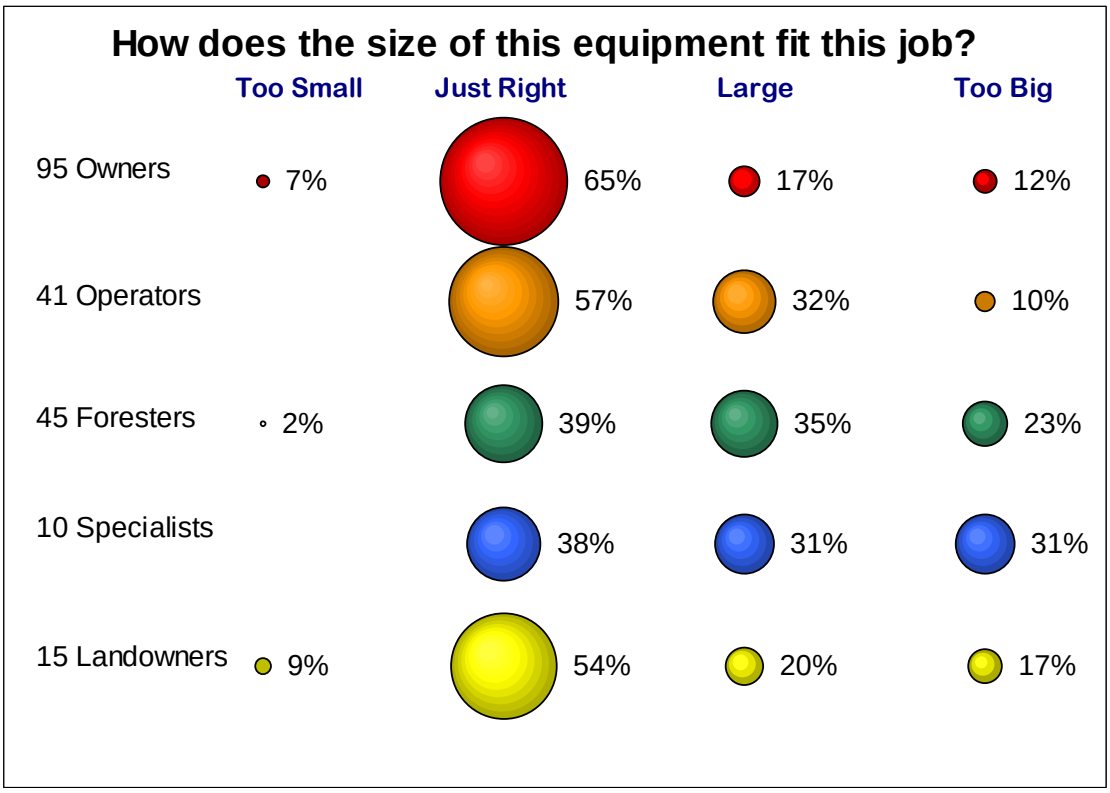


Figure 2.

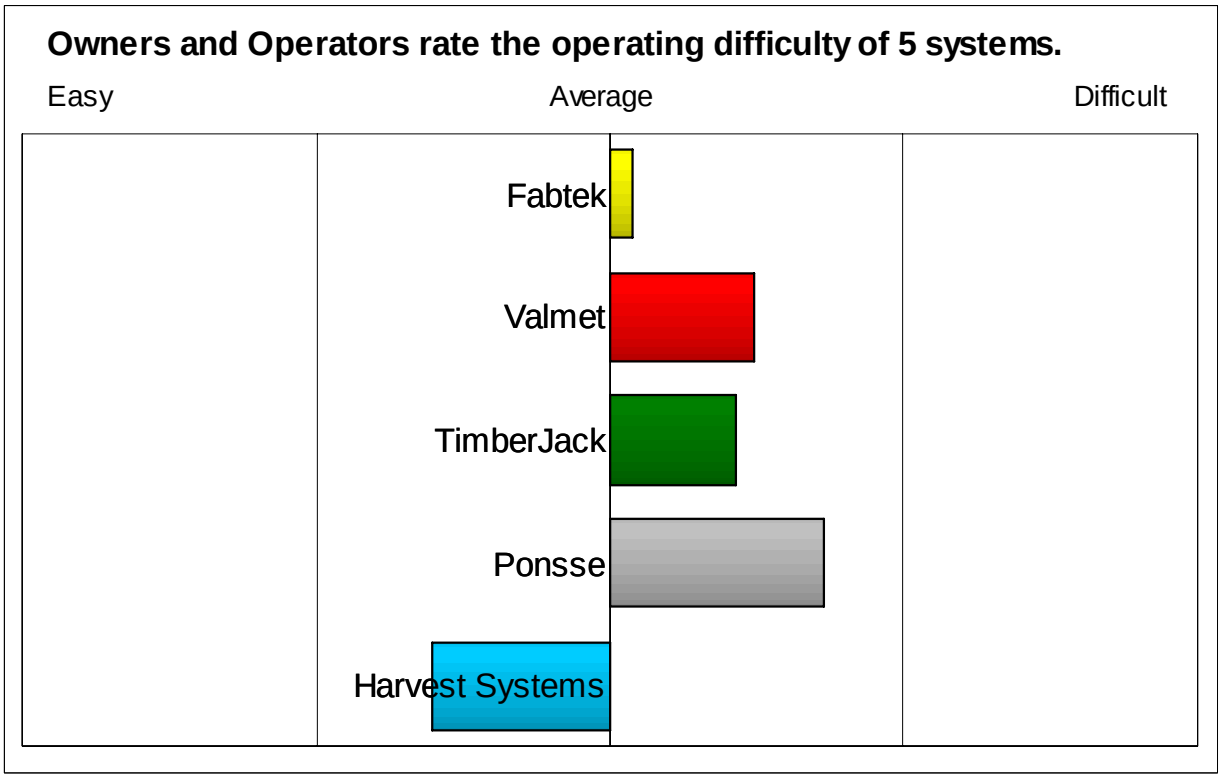


Figure 3.

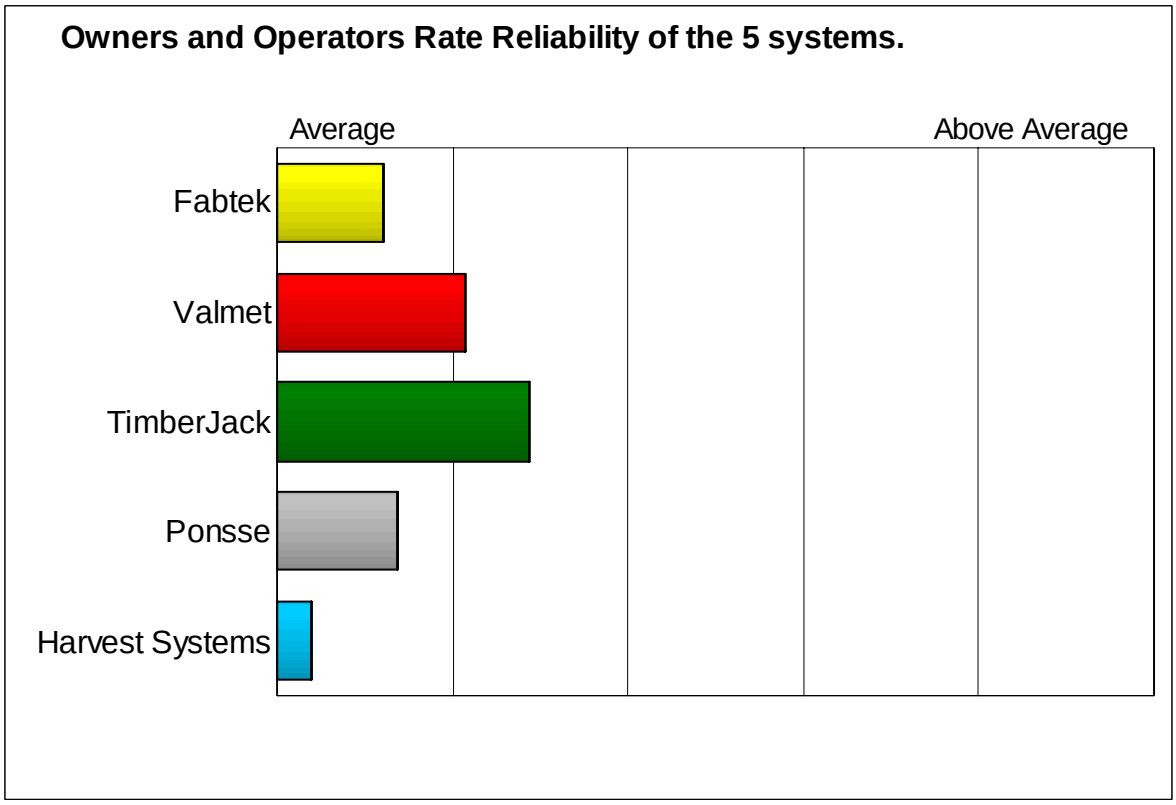


Figure 4.

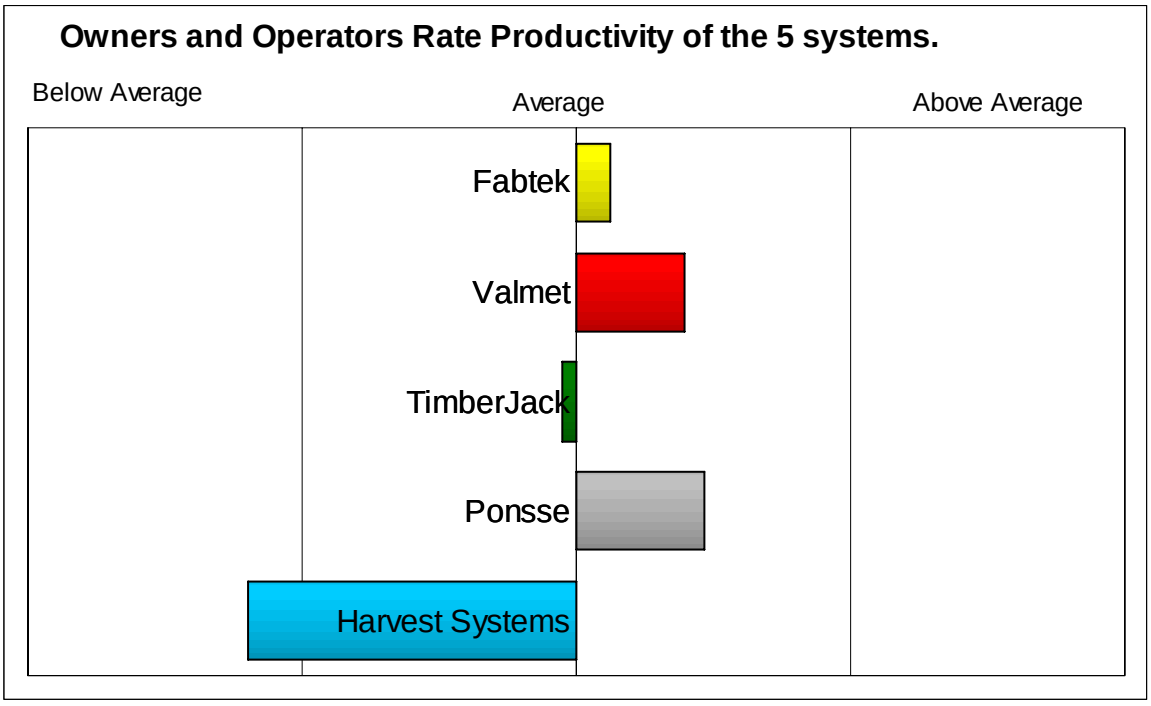
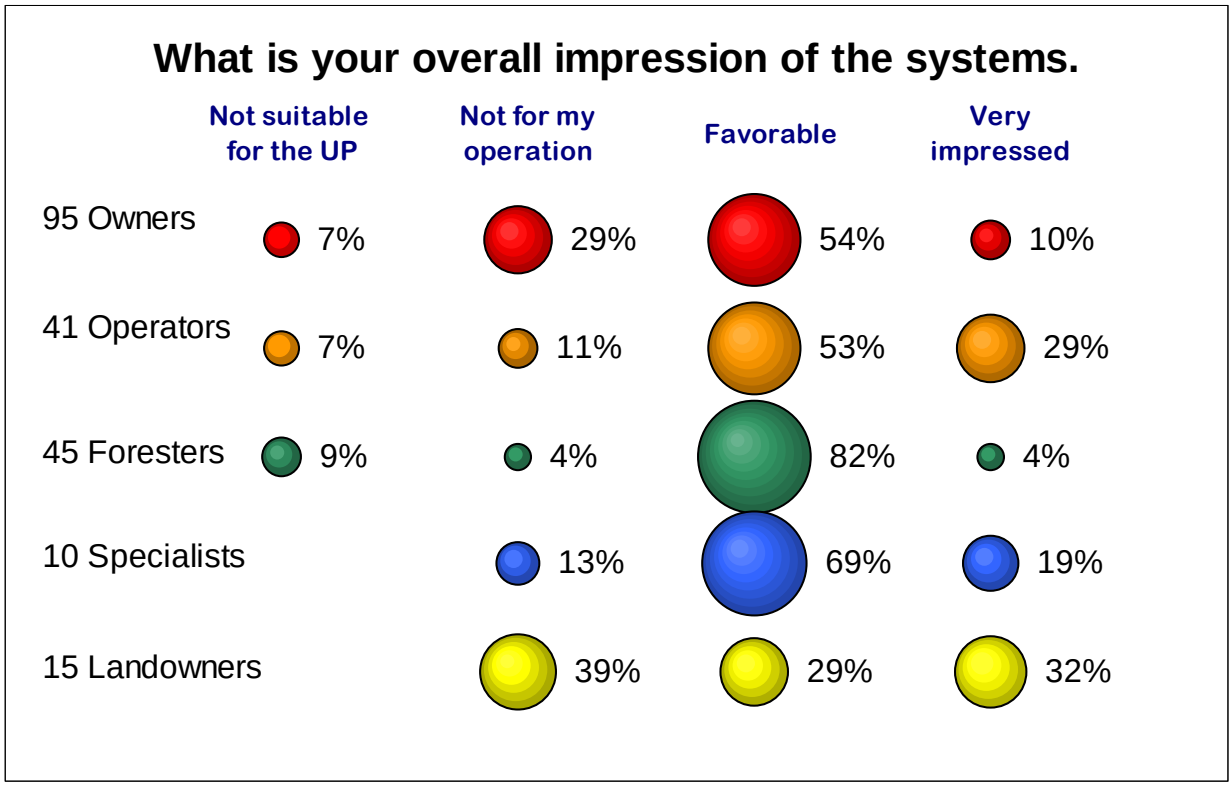


Figure 5.


What is your overall impression of the systems.
Not suitable for the UP
Not for my operation
Favorable
Very impressed
95 Owners
7%
29%
54%
10%
41 Operators
7%
11%
53%
29%
45 Foresters
9%
4%
82%
4%
10 Specialists
13%
69%
19%
15 Landowners
39%
29%
32%