



ECONOMIC ANALYSIS OF LONG-TERM OPERATION OF A HARVESTER LINE RUN BY A FOREST OWNER

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The forest enterprise, of which we are employees, manages 28,000 ha of forests.

The forests are situated in the Central Bohemian Region, Czech Republic, in altitudes ranging from 370 to 865 m above sea level.

All the managed terrains are suitable for the deployment of harvesters.

The ratio of harvester logging fluctuates around 66 % in the long term.

The principal species in the region is the Norway spruce.



- John Deere 770D harvester was purchased in October 2007 following a call for tender.
- This paper analyses the operating and economic results of this harvester and related technology in the period from November 2007 to December 2016 (110 months).

Vehicle	Make	Purchased	Purchase price	Sold	Selling price
		(month/year)	(CZK)	(month/year)	(CZK)
Harvester	John Deere 770	10/2007	7 088 179	X	X
Forwarder	Novotny LVS 5	3/2008	2 098 000	6/2016	400 802
Forwarder	Entracon EF60	5/2016	3 254 840	X	X
Technological vehicle	Nissan 2,5 TDI	11/2004	652 222	3/2015	65 222
Technological vehicle	Mitsubishi L200	3/2013	639 212	X	X
Service vehicle	Suzuki Jimny 1,3	12/2010	332 247	X	X
Total	X	X	11 314 478	X	X



HL work organization

- The HL is utilized purely for the purposes of the forest enterprise.
- The HL employs five members of staff.
- Harvester and forwarder operators work on shifts, they take turns after five calendar days, the duration of one shift being 11 hours.
- Both vehicles are in operation seven days a week.
- The HL provides forests districts with comprehensive services which include standing timber purchase, logging and forwarding of the timber, timber sale and post-harvesting treatment of the site.



Timber production costs at RS

- The purchase price of timber at RS in CZK/m³, which the HL pays to the given FD, is reduced to include timber production costs at RS.
- Factors determining production costs:
 - mean stem volume of harvested trees and
 - average forwarding distance.

Activity	Harvested stem volume (m ³)	Forwarding distance (m)				
		do 300	301 – 600	601 - 900	901 – 1 200	1 201+
Thinning	0,051-0,070	610	630	650	675	700
	0,071-0,090	510	530	550	580	610
	0,091-0,140	430	450	465	495	520
	0,141-0,190	380	410	430	450	475
	0,191-0,240	370	390	410	430	450
	0,241-0,290	350	360	370	400	430
	0,291-0,340	340	350	370	390	420
	0,341-0,390	330	340	360	380	410
	0,391-0,440	330	340	360	380	410
	0,441-0,490	315	320	340	360	490
	0,491+	285	295	305	310	320



Financial settlement between HL and FD

- The timber purchase price (timber price at RS – value of the work performed) is prepared for each workplace in the form of an overview table.

Stand	Species	Volume of timber harvested	Stem volume	Selling price	Production costs	Balance	To be invoiced	Forwarding distance	Quality
		(m ³)	(m ³)	(CZK/m ³)	(CZK/m ³)	(CZK/m ³)	(CZK)	(m)	
32 A 010	Spruce	11,40	0,096	913	-520	393	4 480	up to 300	B
	Larch	2,37	0,101	960	-520	440	1 043		B
	Broad. /soft	0,64	0,215	815	-350	465	298		
24 A 070	Spruce	3,76	0,096	954	-520	434	1 632	up to 300	A
	Larch	41,81	0,061	968	-520	448	18 731		A
106 B 020	Spruce	94,01	0,225	1 054	-390	664	62 423	up to 300	B
	Larch	6,44	0,259	1 040	-390	650	4 186		B
	Pine	3,00	0,347	967	-390	577	1 731		B
Total		163,4					94 524		



Analysis of HL performance

- A total of 154,600 m³ of timber were harvested,
- mean stem volume was 0.11 m³/harvested tree,
- the average forwarding distance was 389 m.

Forwarding distance	Volume of timber harvested		
	(m)	(m ³)	(%)
up to 300		64 363	41,6
301 - 600		62 904	40,8
601 - 900		21 861	14,1
901 - 1200		5 370	3,5
over 1201		70	0,0
Total		154 568	100,0

Species	Timber volume		Number of trees	
	(m ³)	(%)	(thousands)	(%)
Spruce	134 364	86,9	1 260	88,7
Pine	5 572	3,6	48	3,4
Larch	8 346	5,4	63	4,4
Broad/hard	3 372	2,2	22	1,5
Broad/soft	2 913	1,9	28	2,0
Total	154 568	100,0	1 421	100,0

Stem volume (m ³)	Timber volume		Number of trees	
	(m ³)	(%)	(pc)	(%)
-0,07	18 163	11,8	292 840	20,6
0,071-0,090	34 275	22,2	418 522	29,5
0,091-0,140	55 126	35,7	472 410	33,2
0,141-0,190	25 774	16,7	153 085	10,8
0,191-0,240	11 910	7,6	54 497	3,8
0,241+	9 320	6,0	29 638	2,1
Total	154 568	100,0	1 420 992	100,0



Analysis of HL activities

- HL costs and yields can be divided into two separate groups:
 - operational activities (timber production at RS) and
 - business activities (purchase and sale of timber).
- Operational activities encompasses all costs related to vehicle operation, preparation and cleaning of the workplace, technical support of production and relevant overheads. These costs are then compared with the actually invoiced amounts for these works.
- Business activities costs encompass timber purchase at RS, sales overheads and a relevant share of overheads. These costs are then compared with the actually achieved sales of timber.



Workplace adjustment costs

- Workplace adjustment costs encompass the following costs:
 - treatment of damaged trees and buttresses,
 - removal of drawn tracks,
 - other odd jobs related to making the stand accessible.



Harvester logging costs

- Throughout the monitored period all harvesting was done by a single vehicle.
- The total average timber harvesting costs were 229 CZK/m³.

Harvester John Deere 770	Costs			
	Total	Monthly	Annual	Share
	(CZK)			(%)
Tyres	261 012	2 373	28 474	0,7
Fuel	7 707 716	70 070	840 842	21,8
Repairs and operation	6 319 491	57 450	689 399	17,8
Depreciation	7 106 899	64 608	775 298	20,1
Staff	14 010 839	127 371	1 528 455	39,6
Total	35 405 957	321 872	3 862 468	100,0
Felling volume (m ³)	154 571	1 405	16 862	X
Operating time (h)	29 756	271	3 246	X
Downtime (h)	3 680	33	401	X
Vehicle utilization (%)	89	X	X	X
Average costs (CZK/m ³)	229	X	X	X
Average costs (CZK/h)	1 190	X	X	X
Average performance (m ³ /h)	5,2	X	X	X
Mean stem volume (m ³)	0,11	X	X	X



Timber forwarding costs

- Timber was forwarded by several forwarders.
- Most forwarding was done by Novotný LVS 5 forwarder - 74.3 %.
- The average costs were 147 CZK/m³.

Novotný LVS5 forwarder	Costs			
	Total	Monthly	Annual	Share
	(CZK)			(%)
Tyres	127 721	1 303	15 639	0,7
Fuel	2 438 849	24 886	298 635	14,5
Repairs and operation	1 204 306	12 289	147 466	7,2%
Depreciation	1 697 198	17 318	207 820	10,1
Staff	11 336 464	115 678	1 388 138	67,5
Total	16 804 538	171 475	2 057 699	100,0
Volume of timber forwarded (m³)	114 817	1 172	14 059	X
Operating time (h)	23 380	239	2 863	X
Downtime (h)	5 904	60	723	X
Vehicle utilization (%)	80	X	X	X
Average costs (CZK/m³)	146	X	X	X
Average costs (CZK/h)	719	X	X	X
Performance (m³/h)	4,9	X	X	X
Forwarding distance (m)	389	X	X	X





Technological vehicle

- It is an off-road vehicle with covered body on which is a tank for oil transport.
- The vehicle safeguards transport of diesel for both vehicles.
- The vehicle must be permanently present at the workplace for safety reasons.

Technological vehicle	Costs			
	Total	Monthly	Annual	Share
	(CZK)			(%)
Tyres	77 725	707	8 479	5,5%
Fuel	507 288	4 612	55 341	35,8%
Repairs and operation	403 709	3 670	44 041	28,5%
Depreciation	427 084	3 883	46 591	30,2%
Total	1 415 806	12 871	154 452	100,0%
Mileage	183 514	1 668	20 020	X
Average costs (CZK/km)	7,71	X	X	X
Fuel (CZK/km)	2,76	X	X	X



Technological production overheads

- Technological production overheads are costs which are directly related to the production process.

Technological overheads	Costs			
	Total	Monthly	Annually	Share
	(CZK)			(%)
Small assets	196 525	1 787	21 439	18,5
Working clothes	108 263	984	11 811	10,2
Cleaning of clothes	95 626	869	10 432	9,0
Medical services	27 189	247	2 966	2,6
Road tax	60 457	550	6 595	5,7
Workers' accident insurance	191 383	1 740	20 878	18,1
Contribution to pension scheme	380 800	3 462	41 542	35,9
Total	1 060 243	9 639	115 663	100,0



Joint production overheads

- Joint production overheads encompass overheads related to HL work organization.
- A major part (94.5 %) is associated with the HL manager (office, personnel costs, service car, uniform, liability insurance, etc.).
- Joint production overheads is divided into a part related to operation activities and a part related to business activities in a 1:2 ratio.

Joint production overheads	Costs			
	Total	Monthly	Annually	Share
	(CZK)			(%)
Office operation	880 000	8 000	96 000	8,9
Material and services	274 694	2 497	29 967	2,8
Telephones	50 381	458	5 496	0,5
Taxes and fees	7 163	65	781	0,1
Liability insurance	34 441	313	3 757	0,3
Training	192 415	1 749	20 991	1,9
Waste disposal	10 684	97	1 166	0,1
Work uniform	36 000	327	3 927	0,4
Employee	7 201 362	65 467	785 603	72,8
Service car	1 199 208	10 902	130 823	12,1
Total	9 886 348	89 876	1 078 511	100,0



Results of operational activities in thousands CZK

Activity	Year										
	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	Total
Workplace adjustments	183	201	226	40	62	131	96	139	307	0	1 386
Harvester	3 552	3 388	3 261	3 796	4 542	4 357	4 356	4 032	3 621	503	35 406
Forwarder contracted	143	314	256	68	253	267	831	1 108	780	122	4 142
Forwarder own	2 026	1 911	2 101	2 298	2 450	2 292	2 328	1 773	1 554	0	18 732
Tech. vehicle	197	170	87	99	142	111	118	140	269	83	1 416
Technological overheads	148	105	129	112	106	95	96	128	40	101	1 060
Joint production overheads	394	400	401	409	373	316	359	243	315	84	3 295
Total costs	6 643	6 489	6 460	6 822	7 929	7 570	8 184	7 561	6 886	893	65 437
RS production	7 498	8 379	8 870	8 141	8 819	8 420	9 693	8 605	8 314	282	77 021
Brushwood	10	26	44	26	0	7	0	0	0	0	113
Services	19	150	168	159	16	66	0	37	2	0	616
Total revenues	7 527	8 555	9 083	8 326	8 835	8 492	9 693	8 642	8 315	282	77 751
Operational result	884	2 067	2 622	1 504	906	922	1 509	1 081	1 429	-611	12 314
Volume of timber harvested (thous.m ³)	16 073	18 010	17 990	16 298	17 525	17 271	18 883	16 142	15 804	575	154 571
Profit (CZK/m³)	55	115	146	92	52	53	80	67	90	X	80



Results of business activities in thousands CZK

Business activity	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	Total
Timber purchase	14 366	20 208	19 530	15 708	16 592	18 548	16 564	11 583	12 431	539	146 068
Sales overheads	169	557	471	447	652	999	1 016	518	686	8	5 522
Joint overheads	788	800	802	819	746	633	718	486	630	169	6 592
Total costs	15 322	21 565	20 803	16 974	17 991	20 180	18 298	12 586	13 747	717	158 182
Timber revenues	16 539	23 782	22 139	19 384	20 025	20 964	20 191	13 147	12 860	554	169 587
Business result	1 220	2 217	1 336	2 411	2 034	785	1 894	560	-887	-156	11 415
Volume of timber harvested (m ³)	16 073	18 010	17 990	16 298	17 525	17 271	18 883	16 142	15 804	575	154 571
Profit (CZK/m³)	76	123	74	148	116	45	100	35	-56	X	74



Total costs in thousands CZK

Costs	Workplace adjustment	Harvester	Forwarder	Technol. vehicle	Technol. overheads	Joint operation overheads	Service car	Sales overheads	Total	Share
	(thousands CZK)									(%)
Tyres	0	261	157	78	0	0	50	0	546	0,70
Fuel	0	7 708	2 636	507	0	0	546	0	11 397	14,70
Repairs and operation	0	6 319	1 244	404	0	0	271	0	8 238	10,62
Miscellaneous	1 386	0	4 142	0	0	1 223	0	5 522	12 273	15,83
Depreciation	0	7 107	2 415	427	197	0	332	0	10 478	13,51
Staff	0	14 011	12 279	0	864	7 464	0	0	34 618	44,64
Total	1 386	35 406	22 873	1 416	1 060	8 687	1 199	5 522	77 549	100,00



The disadvantages of operating one's own HL:

- considerable initial investment of approx. CZK 10 mil to purchase the machinery; if an owner purchased the vehicles on credit, interest rates would need to be included in the calculation,
- increased costs incurred in the HL launch, operator training, financial losses suffered in the first months of operation,
- increased administrative burden on senior staff, setting of in-house purchase prices, in-house settlement of HL-related costs and revenues etc.



The advantages of operating one's own HL:

- HL operation can be subject to long-term planning and in the case of unexpected external events it can be used operatively to deal with pressing problems without the need for long negotiations with a third party,
- timber purchasing: employees of forest districts, who are themselves interested in achieving the best economic results, sell timber to HL, which means that the timber has a set value prior to harvesting itself,
- timber sale: HL employees are financially motivated to increase the value of purchased timber,
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Thank You For Attention!

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