Tekes

Leverage from the EU 2007–2013

European Union
European Regional Development Fund

Wood supply chain optimization: Case studies of logging companies in Russia

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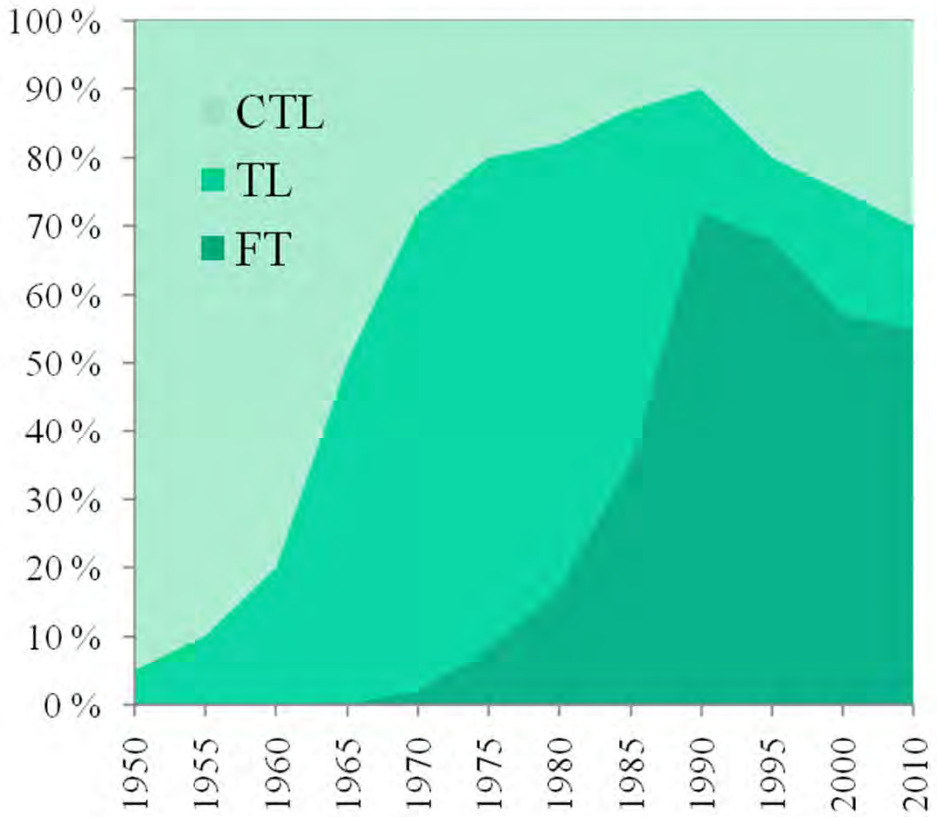
Outline

- The operational-tactical-strategic context of wood supply in Russia
- Short description of the integrated DSS for logistics planning
- 3 test cases within operational, tactical and strategic transport planning
- Outputs
- Conclusion

The operational context of wood supply in Russia



Region	CTL		
	Fully mechanized	Motor-manual	Total
Russia	18%	6%	24%
Karelia	75%	8%	93%

CTL machine	Import in 2008	Demand in 2015	Demand in 2020
Harvester	327	240-260	270-330
Forwarder	343	260-300	320-420

- Forest Development Project
- District Forestry Regulations
- Regional Forest Plan

Decision making levels in wood supply chains

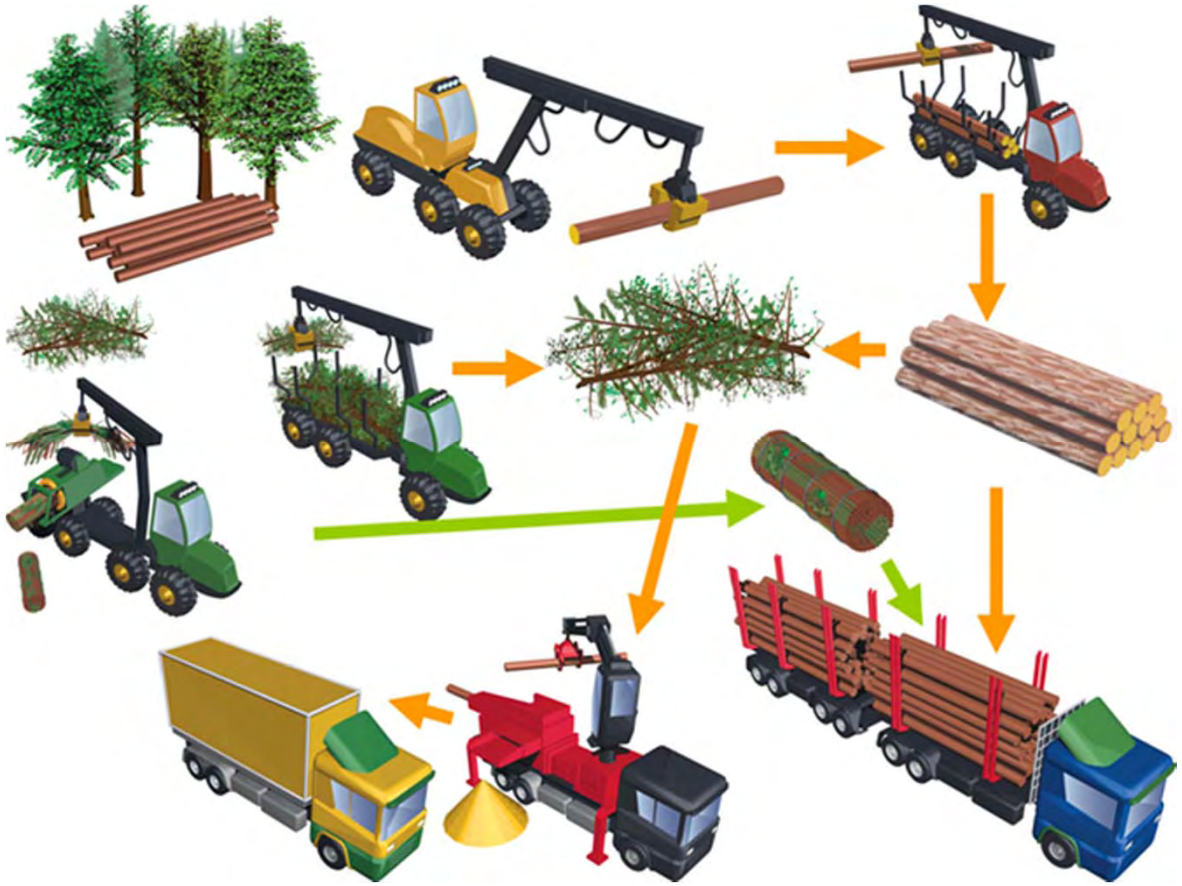
Planning level	Horizon	Harvesting decisions	Road decisions	Transport decisions
Strategic	1-10 yrs	Leasing area potentials Choice of harvesting method Equipment investments	Infrastructure investments Equipment investments	Choice of transport method Equipment investments
Tactical	3 months – 1 yrs	Annual harvesting volumes Harvest unit scheduling Equipment utilization Choice of equipment utilization level	Temporary truck access roads Upgrading and maintenance of permanent road	Transport delivery plan Choice of equipment utilization level
Operational	1 day – 3 months	Detailed harvesting plan		Truck routing

Specific restrictions for wood supply operations

The following business rules present specific restrictions for wood supply operations in Russia:

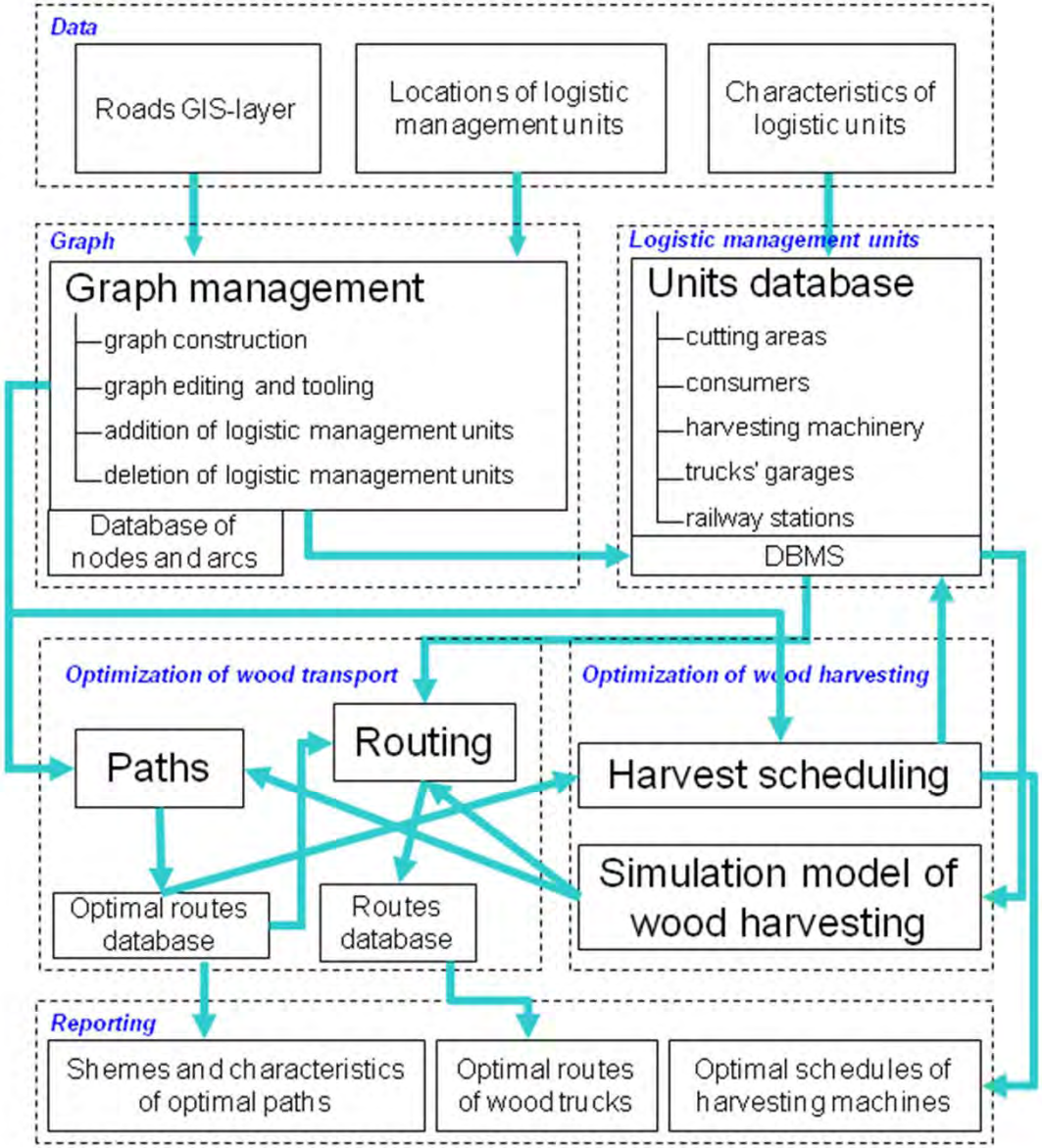
- A logging company owns equipment for wood harvesting and transport and manages forest operations itself; outsourcing and entrepreneurship is not common practice
- The annual delivery plan should be fulfilled according to the annual contract, however the monthly delivery plans are flexible depending on many reasons such as seasonal conditions, market situation, infrastructure etc.
- Seasonal intermediate storages in the forest or at the central processing yard are common practice
- Limitations for the maximal truck axle loads on public roads and bridges; use of heavy trucks are restricted in many places
- The condition of roads, bridges and even parts of the same road may vary between periods.

Supply chain



Develop a decision support tool to support a wide range of planning decisions at on the company level including truck routing, choice of equipment utilization level, choice of transport method and infrastructure investments.

Structure of the DSS



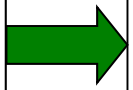
Tools for the system constructing

MapBasic

- Database management
- Interface

MapInfo

- Objective database
- Internal database management system
- Spatial functions



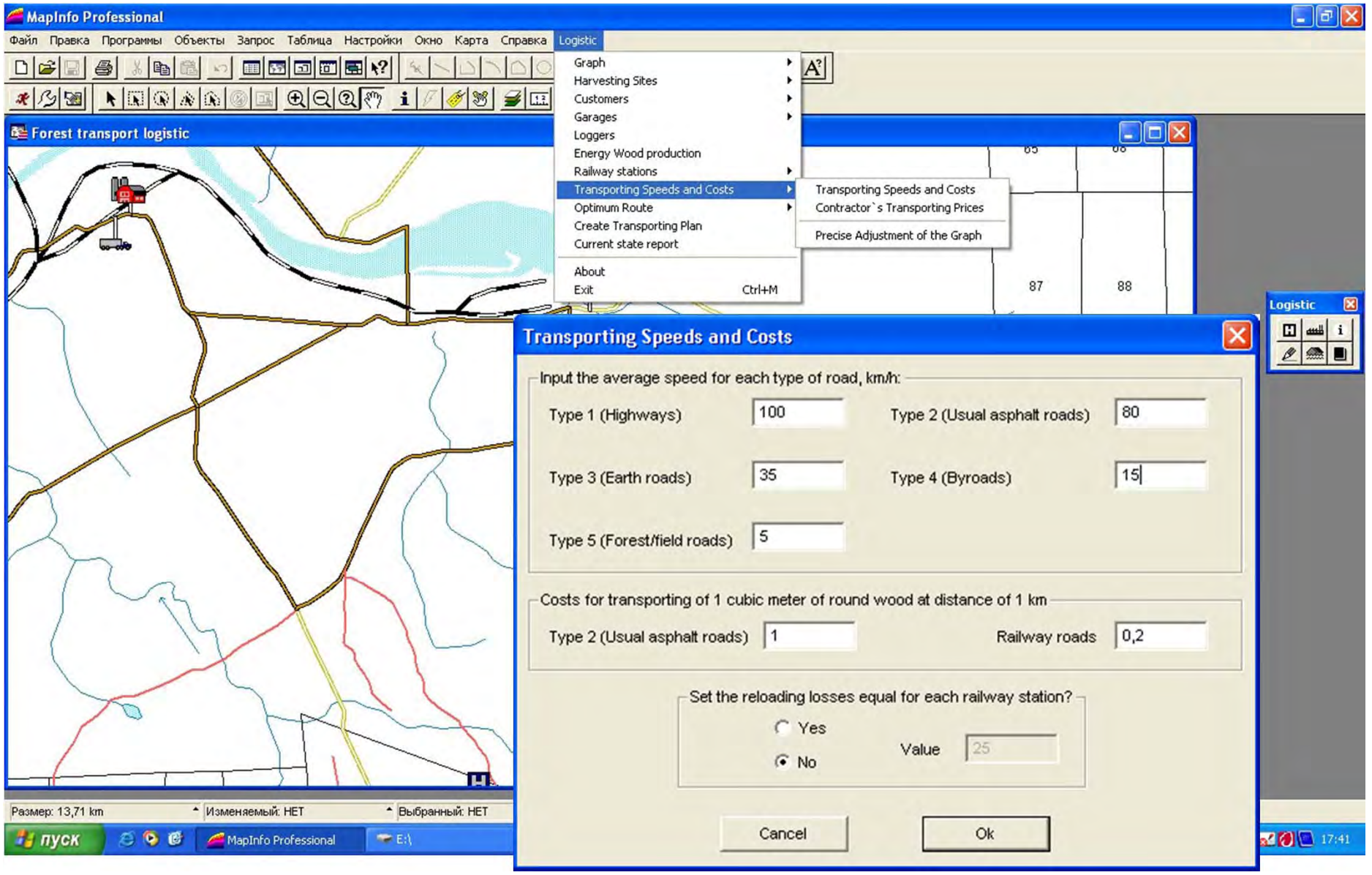
C++

- Simulation
- Search of optimal routes
- Search of optimal transtport plan
- Search of optimal harvesting schedules including energy wood
- Calculation of performance indexes

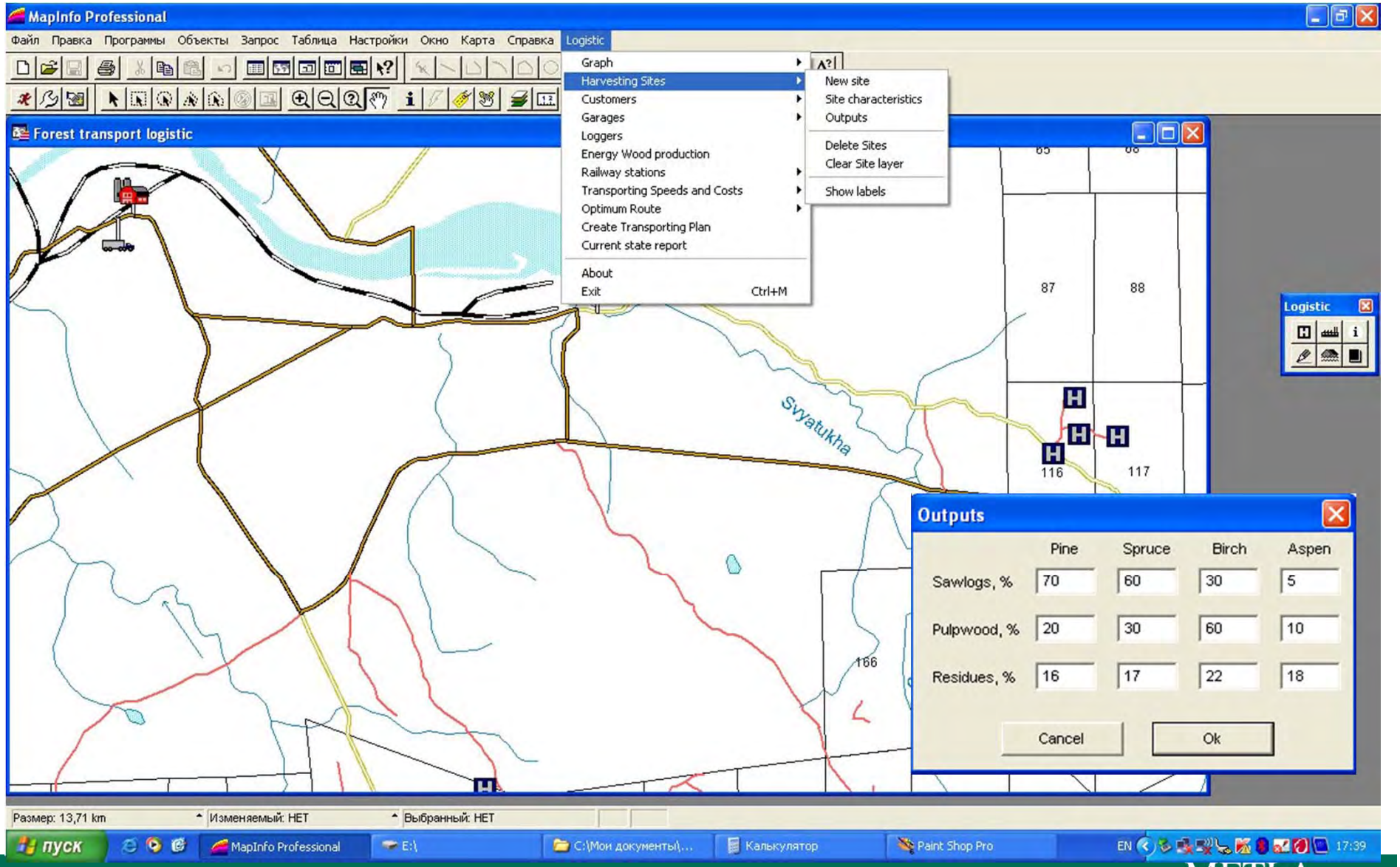
MS Excel

- Reporting

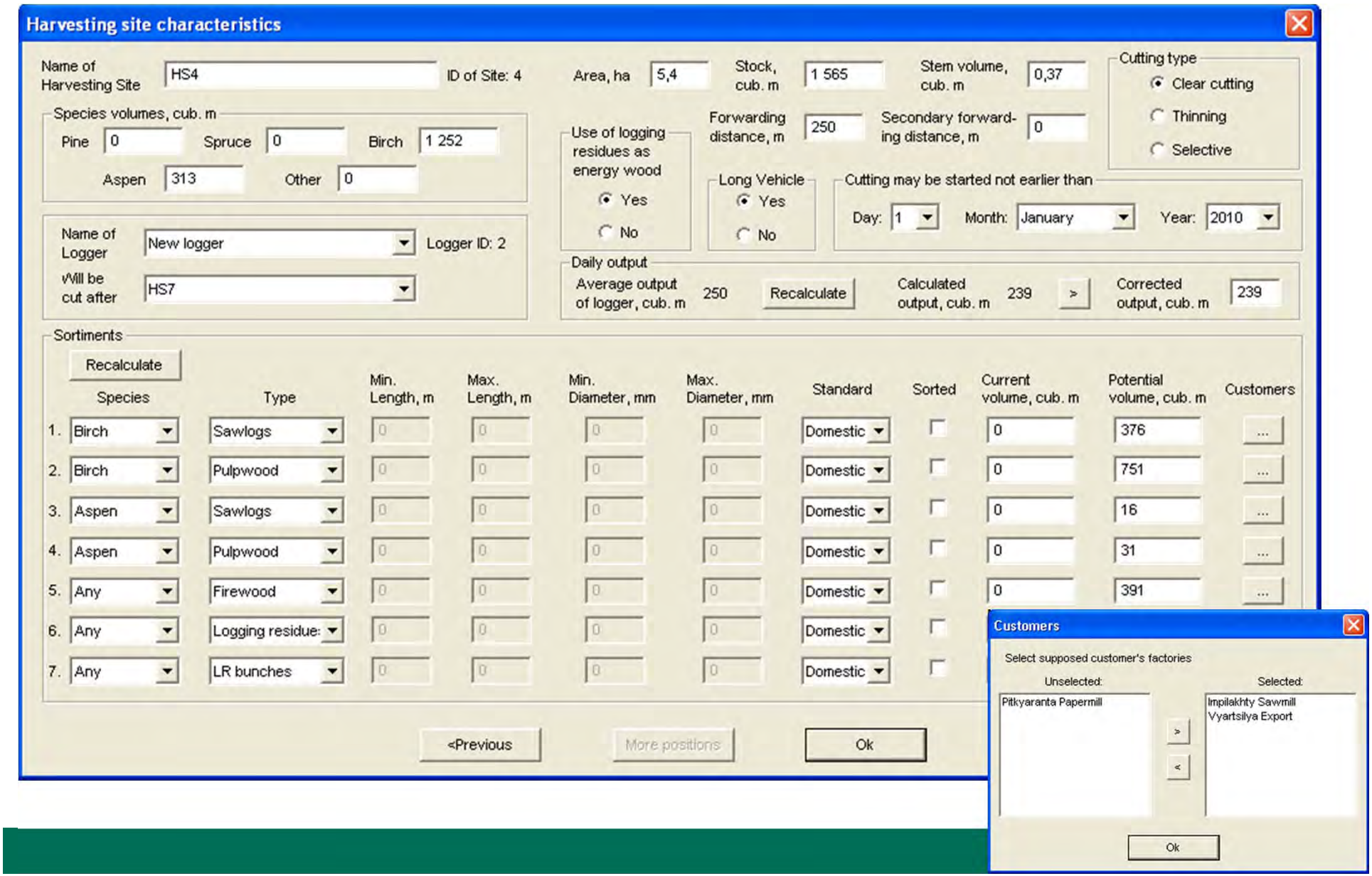
Interface - Road characteristics



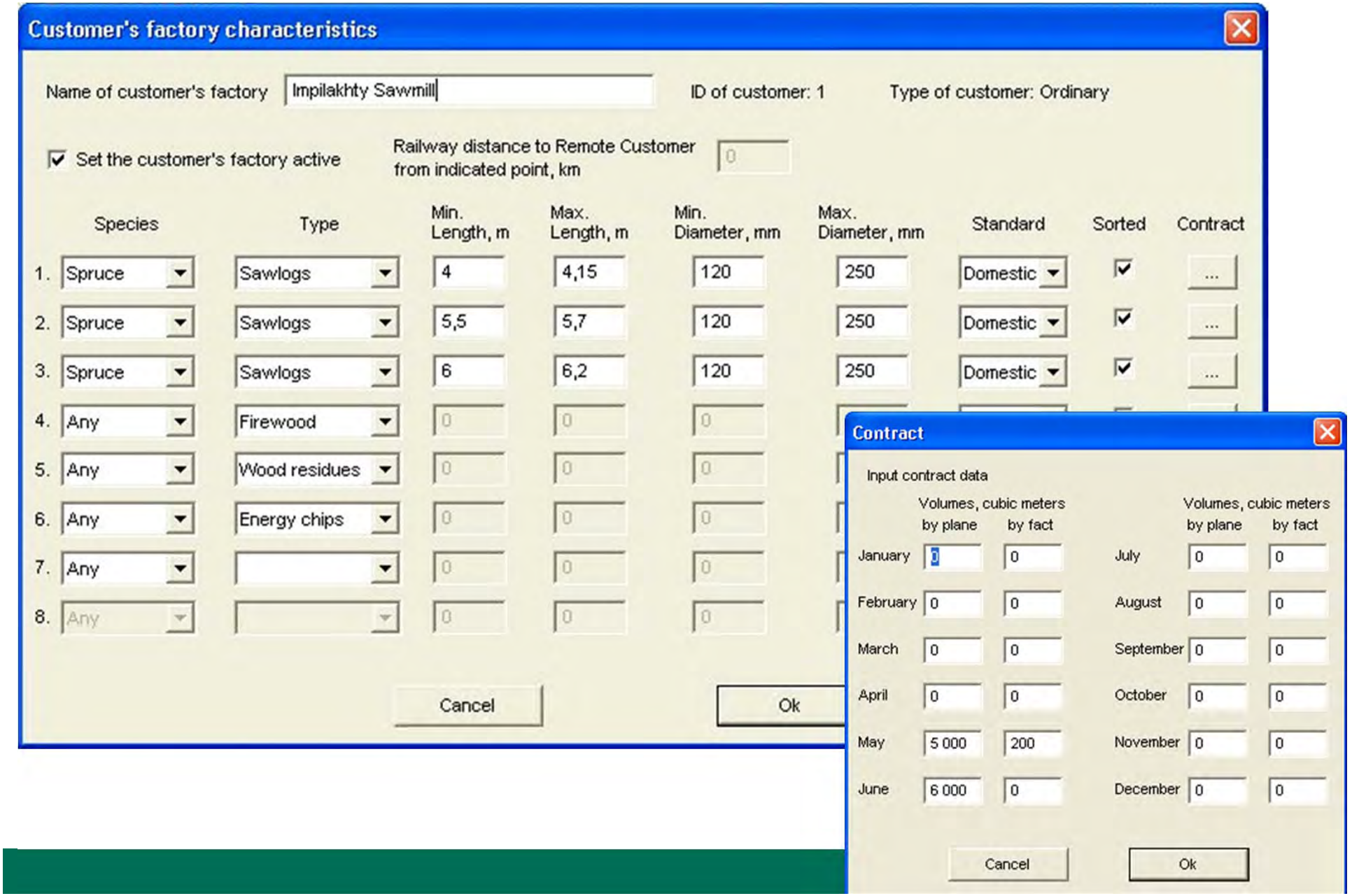
Interface - Harvesting site



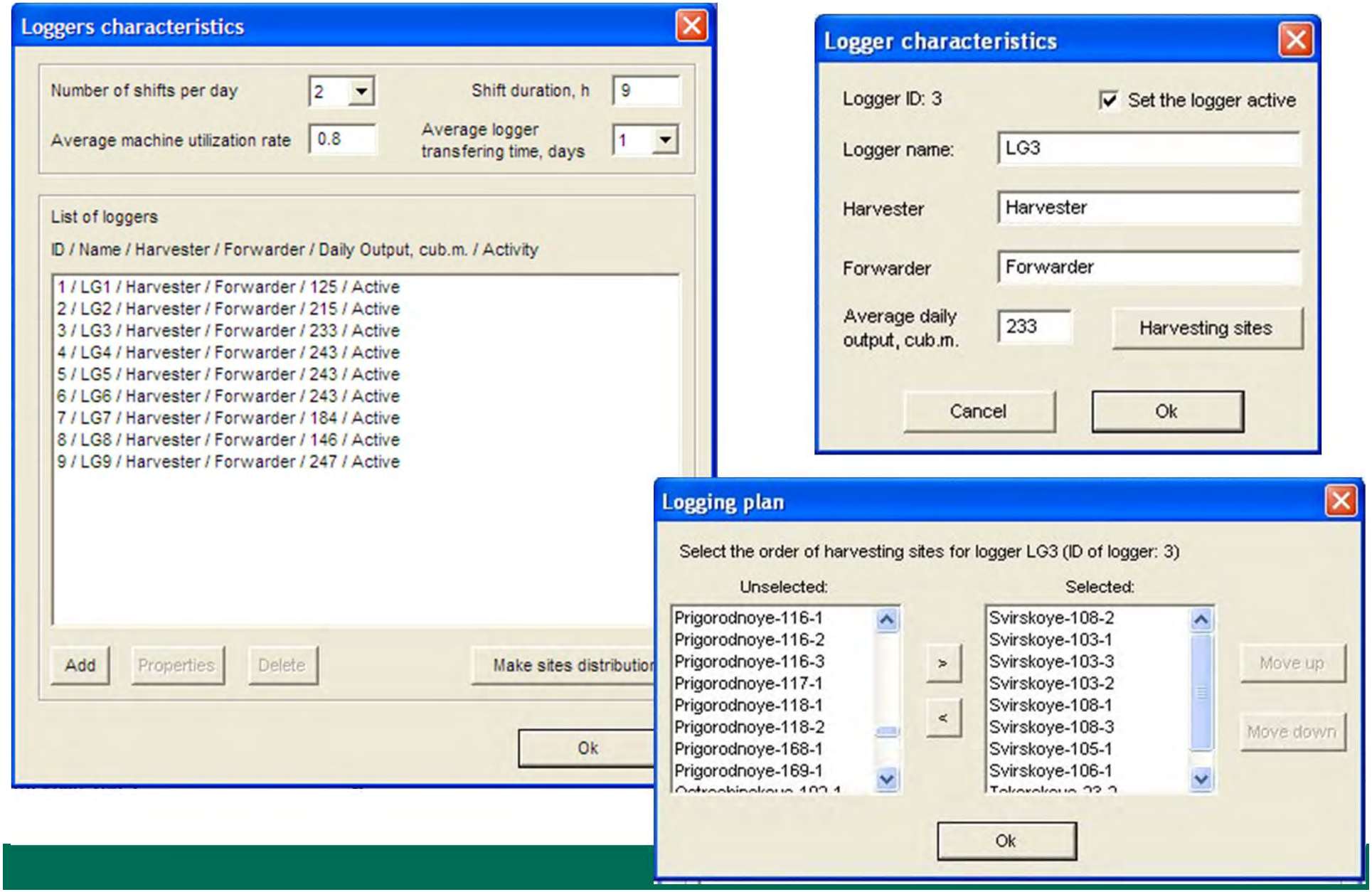
Interface - Harvest site characteristics



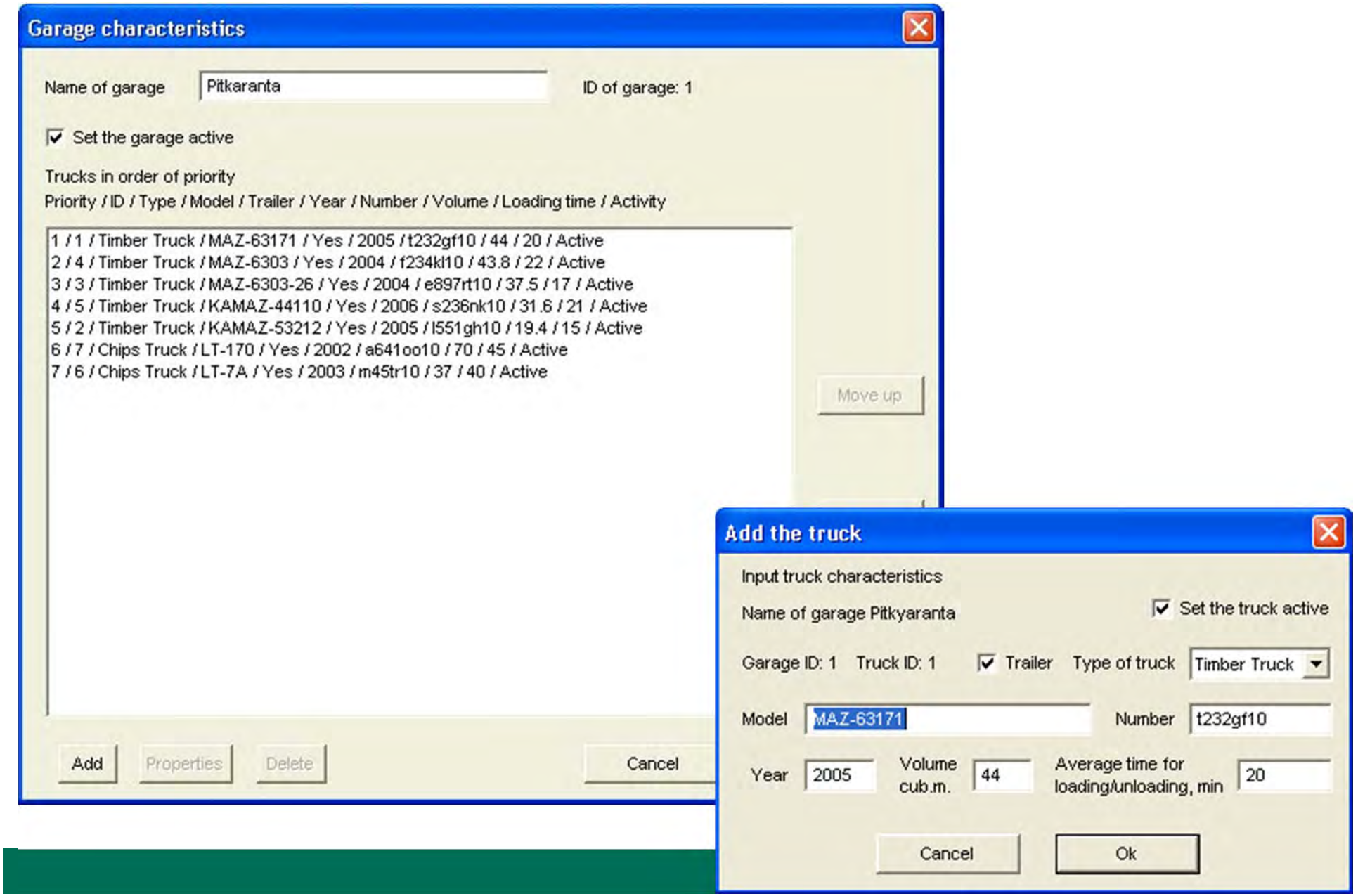
Interface - Input of customer's characteristics



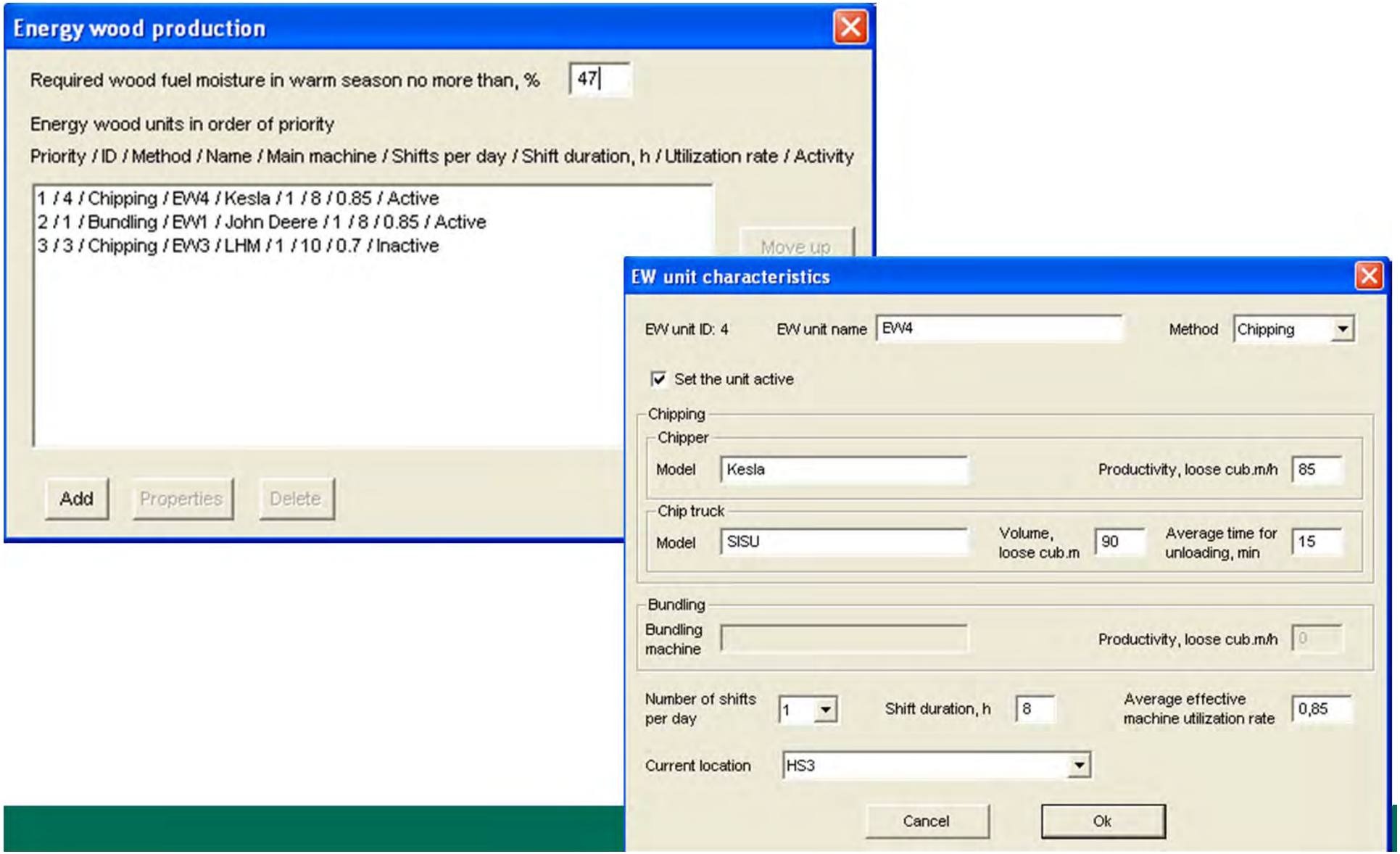
Interface - Input of logger's characteristics



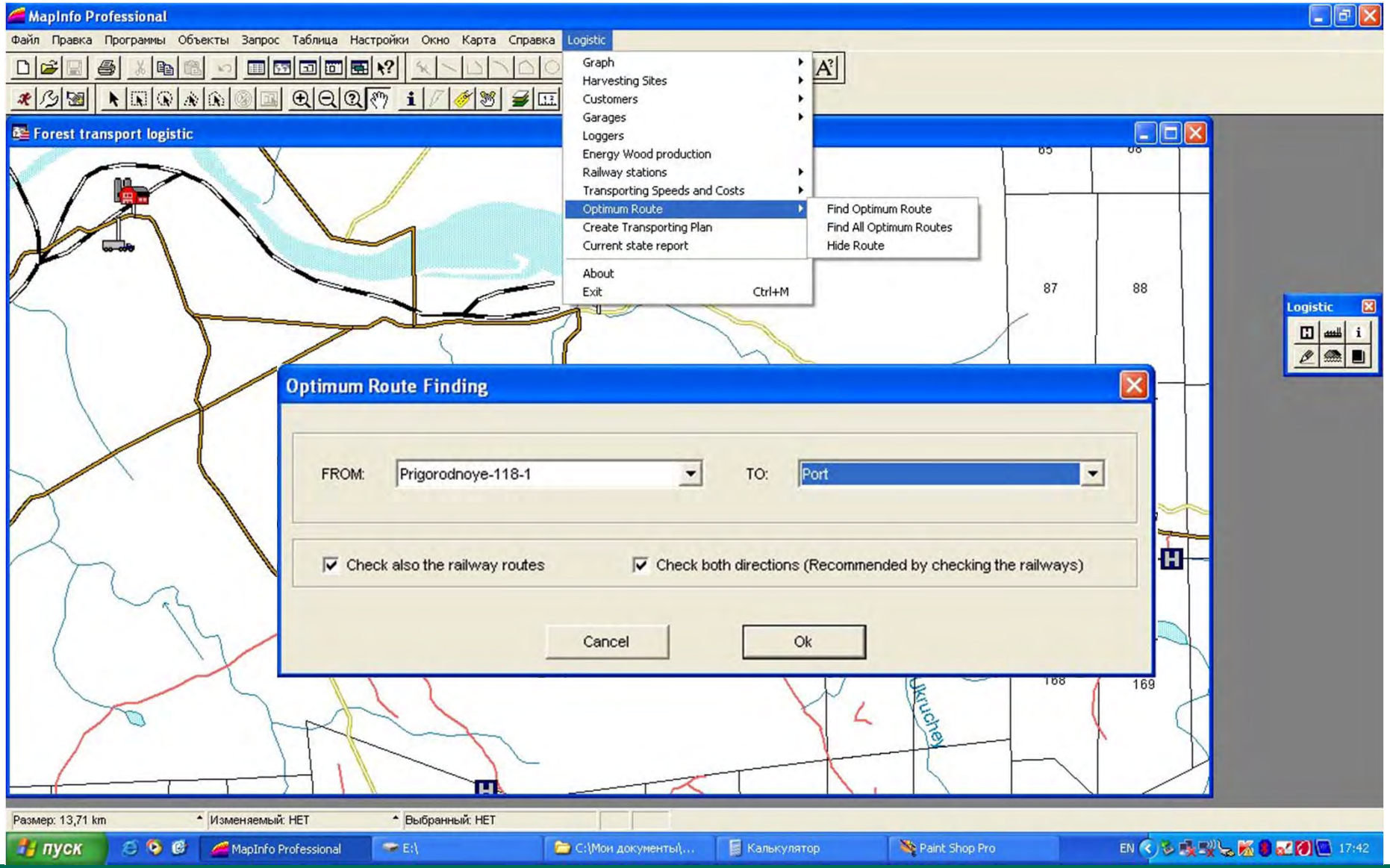
Interface - Input of truck's characteristics



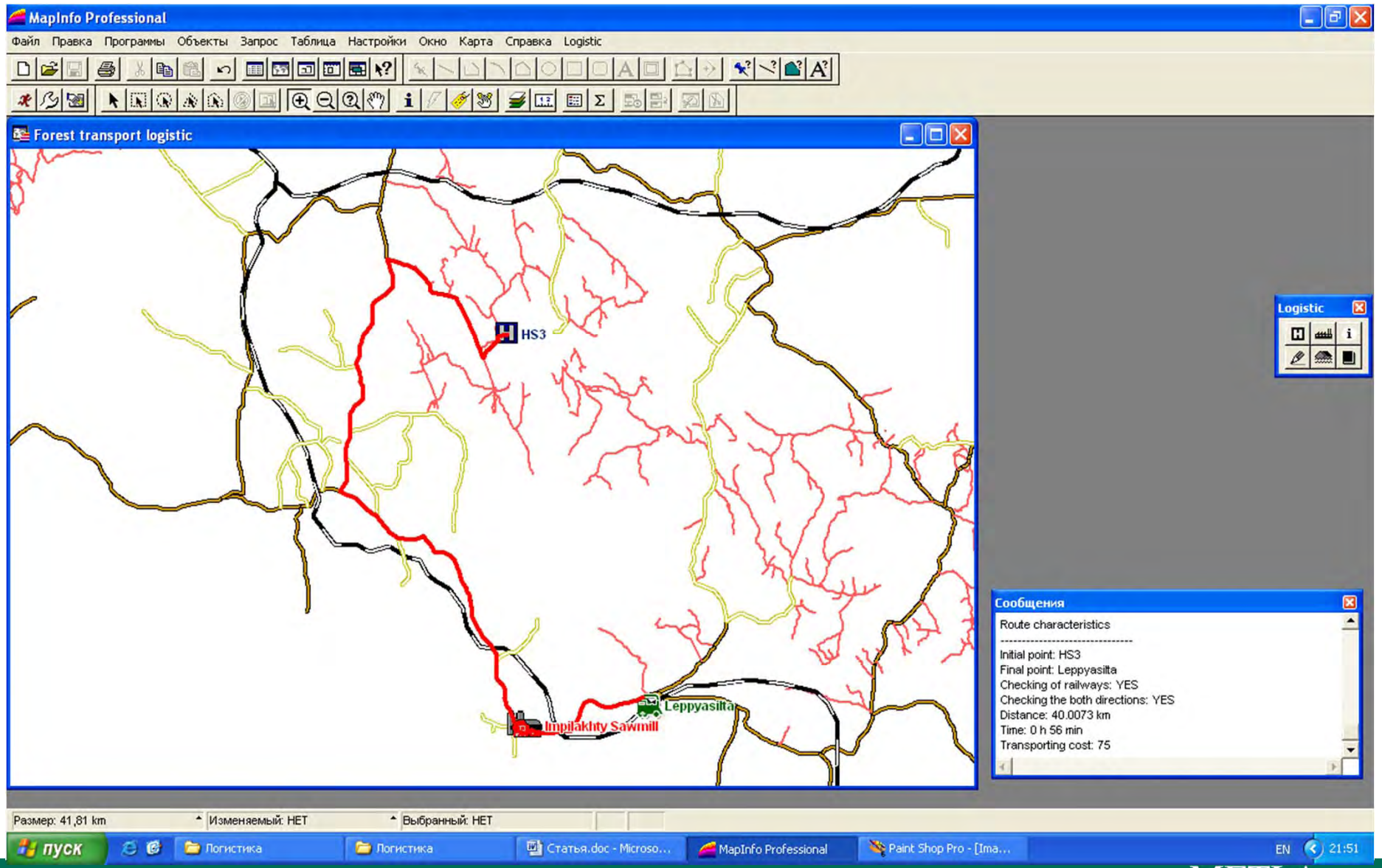
Interface - Energy wood machinery characteristics



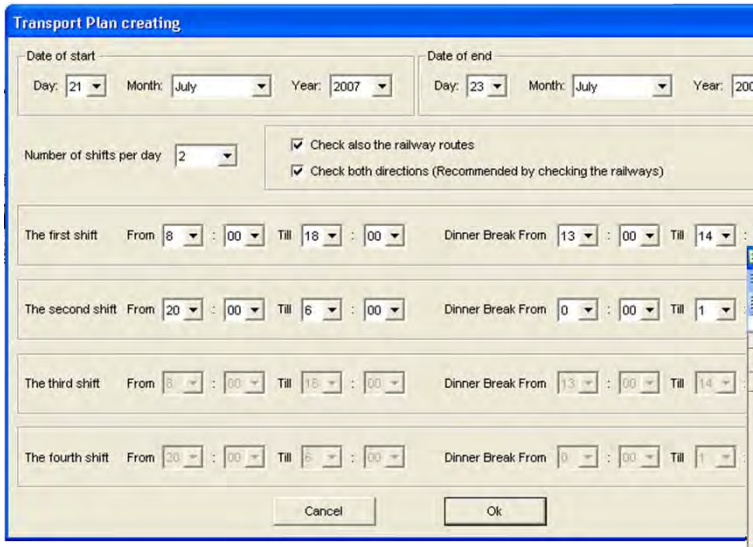
Interface - Search of optimal paths

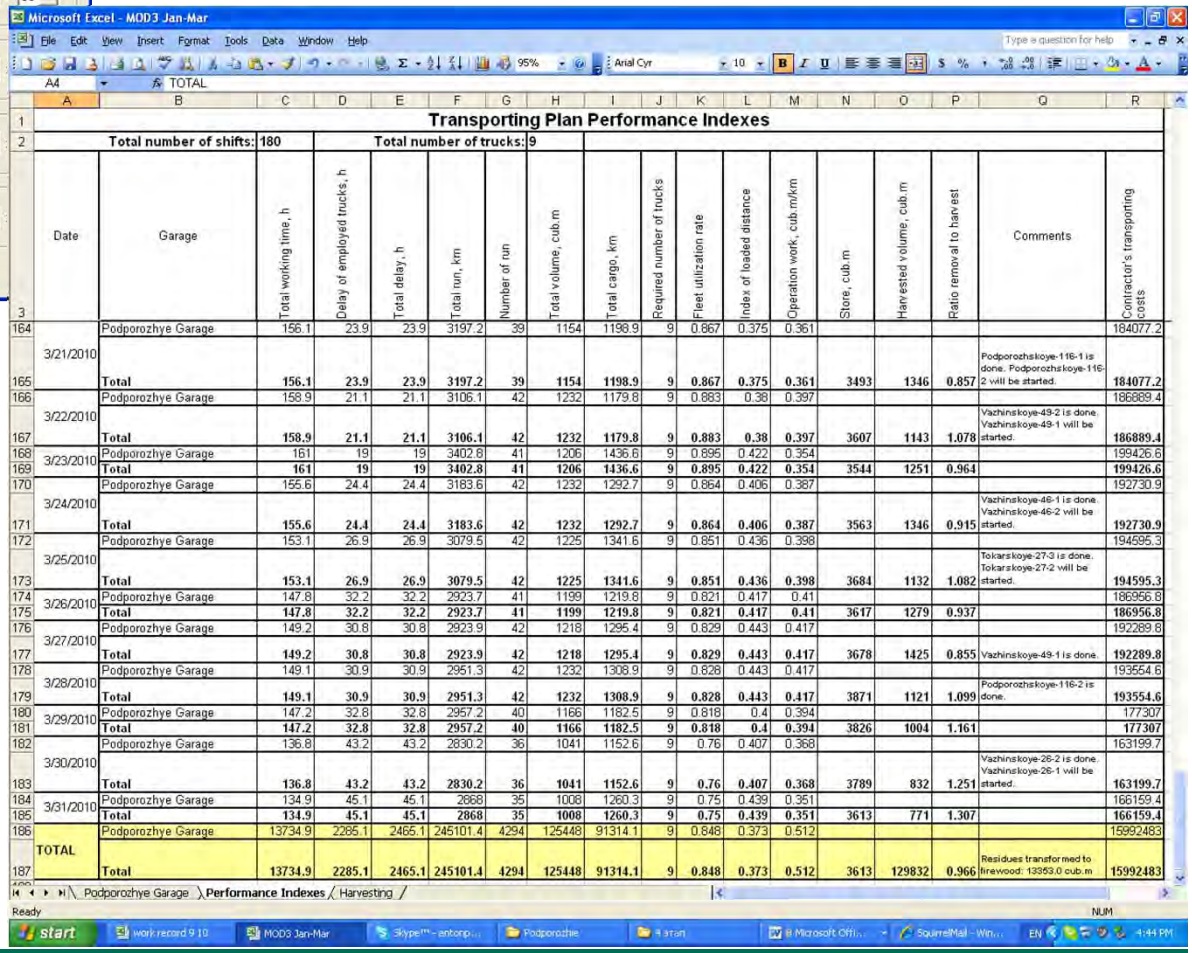


Interface - Search of optimal paths (results)



Search of the optimal routes and schedules





Microsoft Excel - MOD3 Jan-Mar

Transporting Plan Performance Indexes

Total number of shifts: 180 Total number of trucks: 9

Date	Garage	Total working time, h	Delay of employed trucks, h	Total delay, h	Total run, km	Number of run	Total volume, cub.m	Total cargo, km	Required number of trucks	Fleet utilization rate	Index of loaded distance	Operation work, cub.m/km	Store, cub.m	Harvested volume, cub.m	Ratio removal to harvest	Comments	Contractor's transporting costs
	Podporozhye Garage	156.1	23.9	23.9	3197.2	39	1154	1198.9	9	0.867	0.375	0.361					184077.2
3/21/2010																	
	Total	**156.1**	**23.9**	**23.9**	**3197.2**	**39**	**1154**	**1198.9**	**9**	**0.867**	**0.375**	**0.361**	**3493**	**1346**	**0.857**	Podporozhskoye-116-1 is done. Podporozhskoye-116-2 will be started.	**184077.2**
	Podporozhye Garage	158.9	21.1	21.1	3106.1	42	1232	1179.8	9	0.883	0.38	0.397					186889.4
3/22/2010																	
	Total	**158.9**	**21.1**	**21.1**	**3106.1**	**42**	**1232**	**1179.8**	**9**	**0.883**	**0.38**	**0.397**	**3607**	**1143**	**1.078**	Vazhinskoye-49-2 is done. Vazhinskoye-49-1 will be started.	**186889.4**
	Podporozhye Garage	161	19	19	3402.8	41	1206	1436.6	9	0.895	0.422	0.354					199426.6
3/23/2010	**Total**	**161**	**19**	**19**	**3402.8**	**41**	**1206**	**1436.6**	**9**	**0.895**	**0.422**	**0.354**	**3544**	**1251**	**0.964**		**199426.6**
	Podporozhye Garage	155.6	24.4	24.4	3183.6	42	1232	1292.7	9	0.864	0.406	0.387					192730.9
3/24/2010																	
	Total	**155.6**	**24.4**	**24.4**	**3183.6**	**42**	**1232**	**1292.7**	**9**	**0.864**	**0.406**	**0.387**	**3563**	**1346**	**0.915**	Vazhinskoye-46-1 is done. Vazhinskoye-46-2 will be started.	**192730.9**
	Podporozhye Garage	153.1	26.9	26.9	3079.5	42	1225	1341.6	9	0.851	0.436	0.398					194595.3
3/25/2010																	
	Total	**153.1**	**26.9**	**26.9**	**3079.5**	**42**	**1225**	**1341.6**	**9**	**0.851**	**0.436**	**0.398**	**3684**	**1132**	**1.082**	Tokarskoye-27-3 is done. Tokarskoye-27-2 will be started.	**194595.3**
	Podporozhye Garage	147.8	32.2	32.2	2923.7	41	1199	1219.8	9	0.821	0.417	0.41					186956.8
3/26/2010	**Total**	**147.8**	**32.2**	**32.2**	**2923.7**	**41**	**1199**	**1219.8**	**9**	**0.821**	**0.417**	**0.41**	**3617**	**1279**	**0.937**		**186956.8**
	Podporozhye Garage	149.2	30.8	30.8	2923.9	42	1218	1295.4	9	0.829	0.443	0.417					192289.8
3/27/2010																	
	Total	**149.2**	**30.8**	**30.8**	**2923.9**	**42**	**1218**	**1295.4**	**9**	**0.829**	**0.443**	**0.417**	**3678**	**1425**	**0.855**	Vazhinskoye-49-1 is done.	**192289.8**
	Podporozhye Garage	149.1	30.9	30.9	2951.3	42	1232	1308.9	9	0.828	0.443	0.417					193554.6
3/28/2010																	
	Total	**149.1**	**30.9**	**30.9**	**2951.3**	**42**	**1232**	**1308.9**	**9**	**0.828**	**0.443**	**0.417**	**3871**	**1121**	**1.099**	Podporozhskoye-116-2 is done.	**193554.6**
	Podporozhye Garage	147.2	32.8	32.8	2957.2	40	1166	1182.5	9	0.818	0.4	0.394					177307
3/29/2010	**Total**	**147.2**	**32.8**	**32.8**	**2957.2**	**40**	**1166**	**1182.5**	**9**	**0.818**	**0.4**	**0.394**	**3826**	**1004**	**1.161**		**177307**
	Podporozhye Garage	136.8	43.2	43.2	2830.2	36	1041	1152.6	9	0.76	0.407	0.368					163199.7
3/30/2010																	
	Total	**136.8**	**43.2**	**43.2**	**2830.2**	**36**	**1041**	**1152.6**	**9**	**0.76**	**0.407**	**0.368**	**3789**	**832**	**1.251**	Vazhinskoye-26-2 is done. Vazhinskoye-26-1 will be started.	**163199.7**
	Podporozhye Garage	134.9	45.1	45.1	2868	35	1008	1260.3	9	0.75	0.439	0.351					166159.4
3/31/2010	**Total**	**134.9**	**45.1**	**45.1**	**2868**	**35**	**1008**	**1260.3**	**9**	**0.75**	**0.439**	**0.351**	**3613**	**771**	**1.307**		**166159.4**
	Podporozhye Garage	13734.9	2285.1	2465.1	245101.4	4294	125448	91314.1	9	0.848	0.373	0.512					15992483
TOTAL																	
	Total	**13734.9**	**2285.1**	**2465.1**	**245101.4**	**4294**	**125448**	**91314.1**	**9**	**0.848**	**0.373**	**0.512**	**3613**	**129832**	**0.966**	Residues transformed to firewood: 13353.0 cub.m	**15992483**

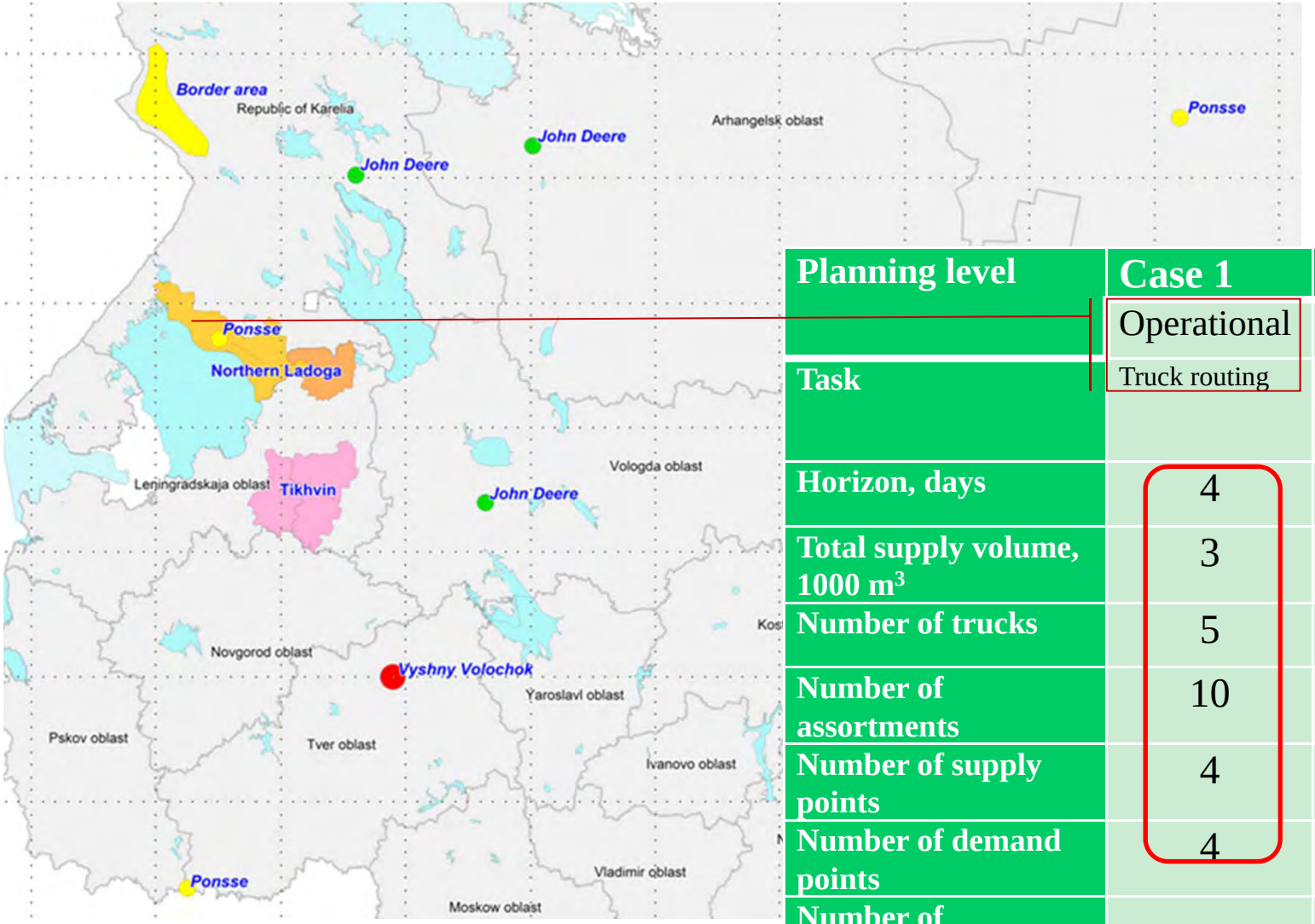
Podporozhye Garage | Performance Indexes | Harvesting

Ready

Performance indexes:

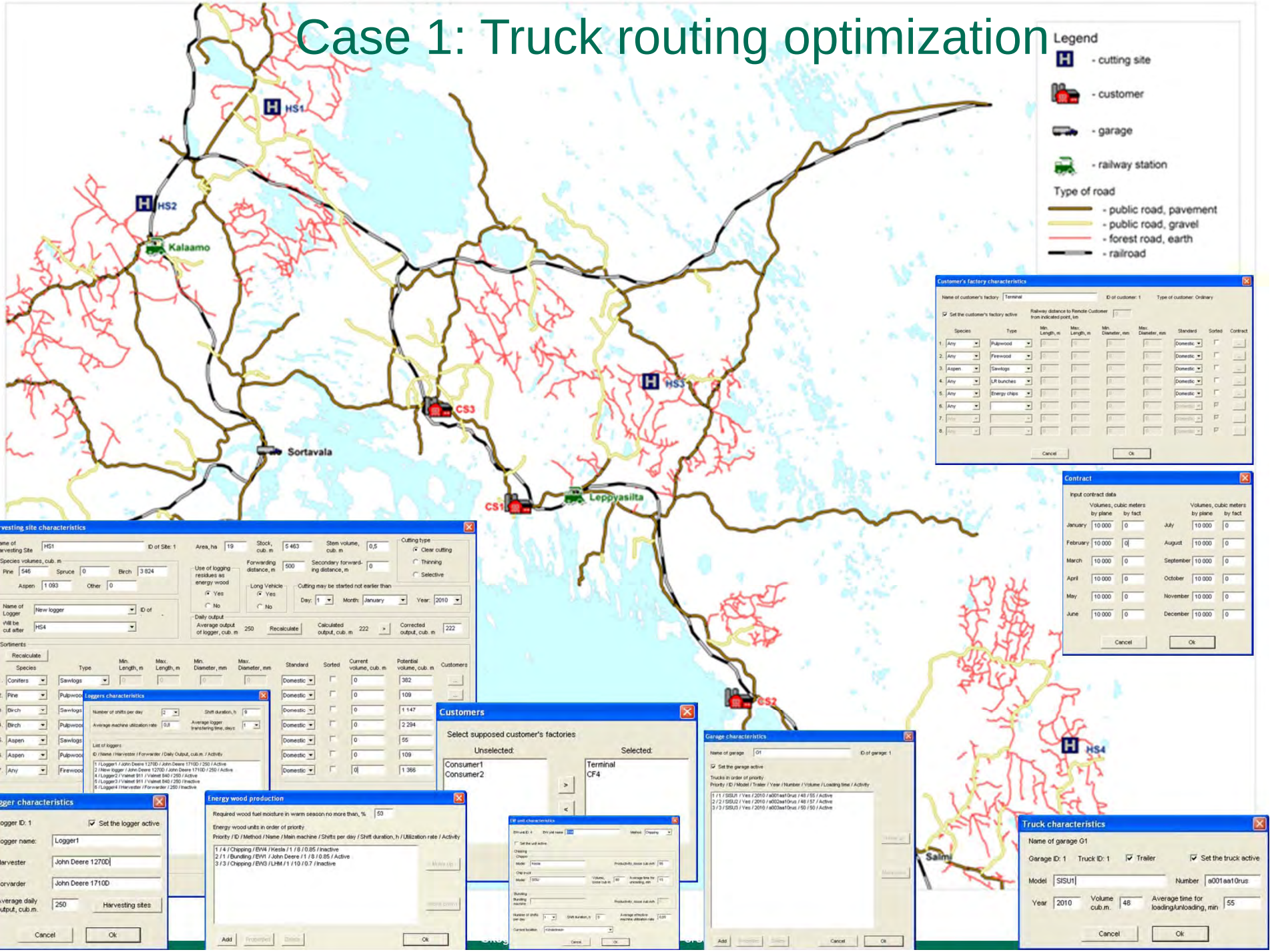
- Total working time and travel distance
- Total number of travels
- Total transported volume
- Total loaded distance
- Fleet utilization rate
- Index of loaded distance
- Transported volume per 1 km
- Transporting costs

DSS test cases



Planning level	Case 1	Case 2	Case 3
	Operational	Tactical	Strategic
Task	Truck routing	Choice of utilization level	Choice of transport; investments
Horizon, days	4	90	365
Total supply volume, 1000 m^3	3	80	272
Number of trucks	5	13	24
Number of assortments	10	9	8
Number of supply points	4	63	129
Number of demand points	4	5	5
Number of intermediate terminals	-	-	6

Case 1: Truck routing optimization

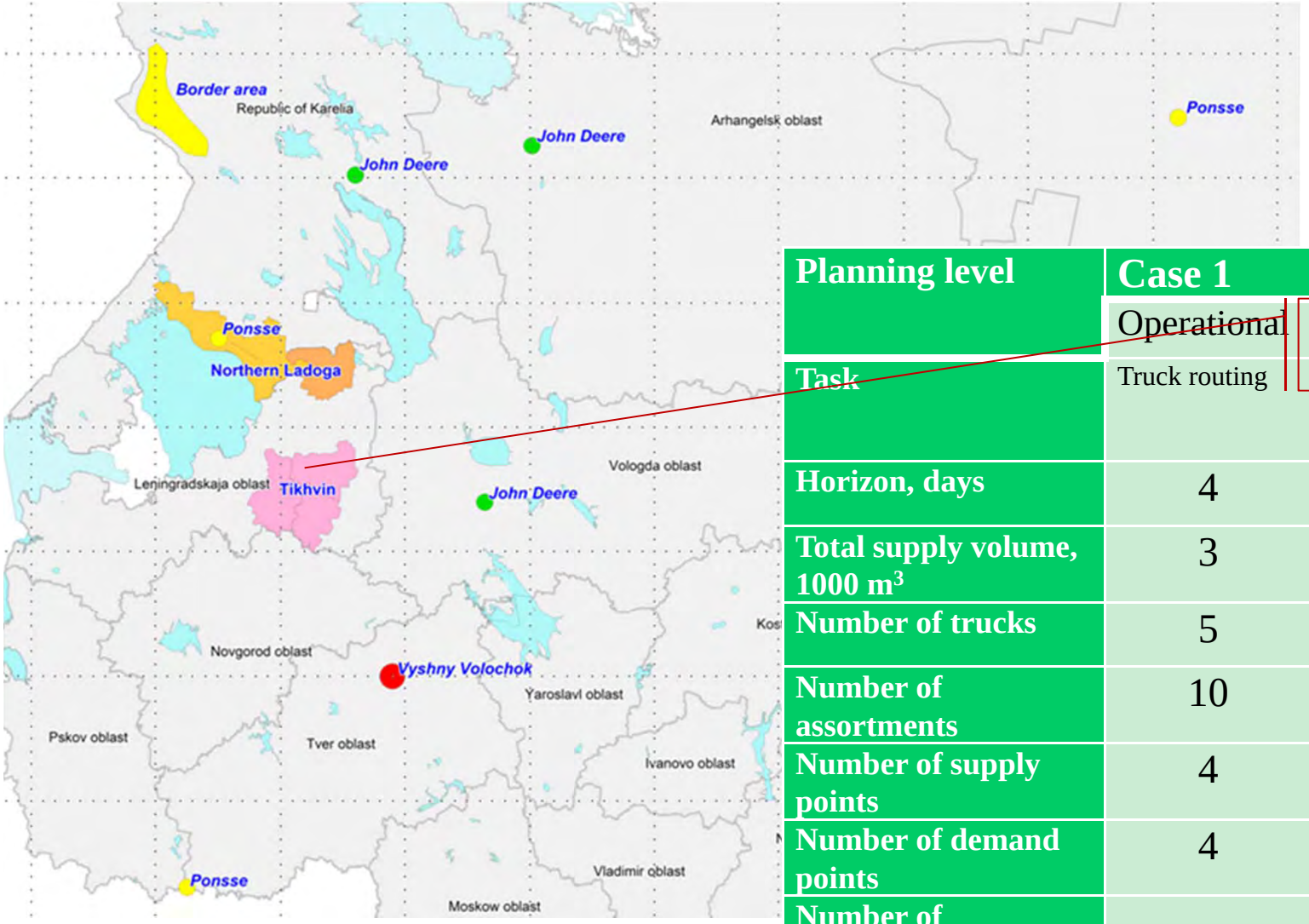


Case 1: Truck routing optimization (results)

Source: Gerasimov Y., Sokolov A., Karjalainen T. 2008. GIS-based decision-support program for planning and analyzing short-wood transport in Russia. Croatian Journal of Forest Engineering 29(2): 163-175

Scenario	Required number of trucks	Total working time *[h]*	Total distance *[km]*	Number of trips	Total volume *[m^3]*	Total loaded distance *[km]*	Fleet utilization rate	Index of loaded distance	Operation work *[m^3/km]*	Transpor-tation cost *[€/m^3]*
Basic	5	307	7382	53	2740	2,212	0.754	0.300	0.371	5.6
Optimal 1	5	255	7382	58	2996	2,697	0.728	0.365	0.406	5.1
Optimal 2	4 (-20%)	239 (–22%)	5743 (–22%)	58 (+9%)	3000 (+10%)	2,872 (+30%)	0.895 (+19%)	0.499 (+66%)	0.526 (+42%)	4.0 (-29%)

DSS test cases



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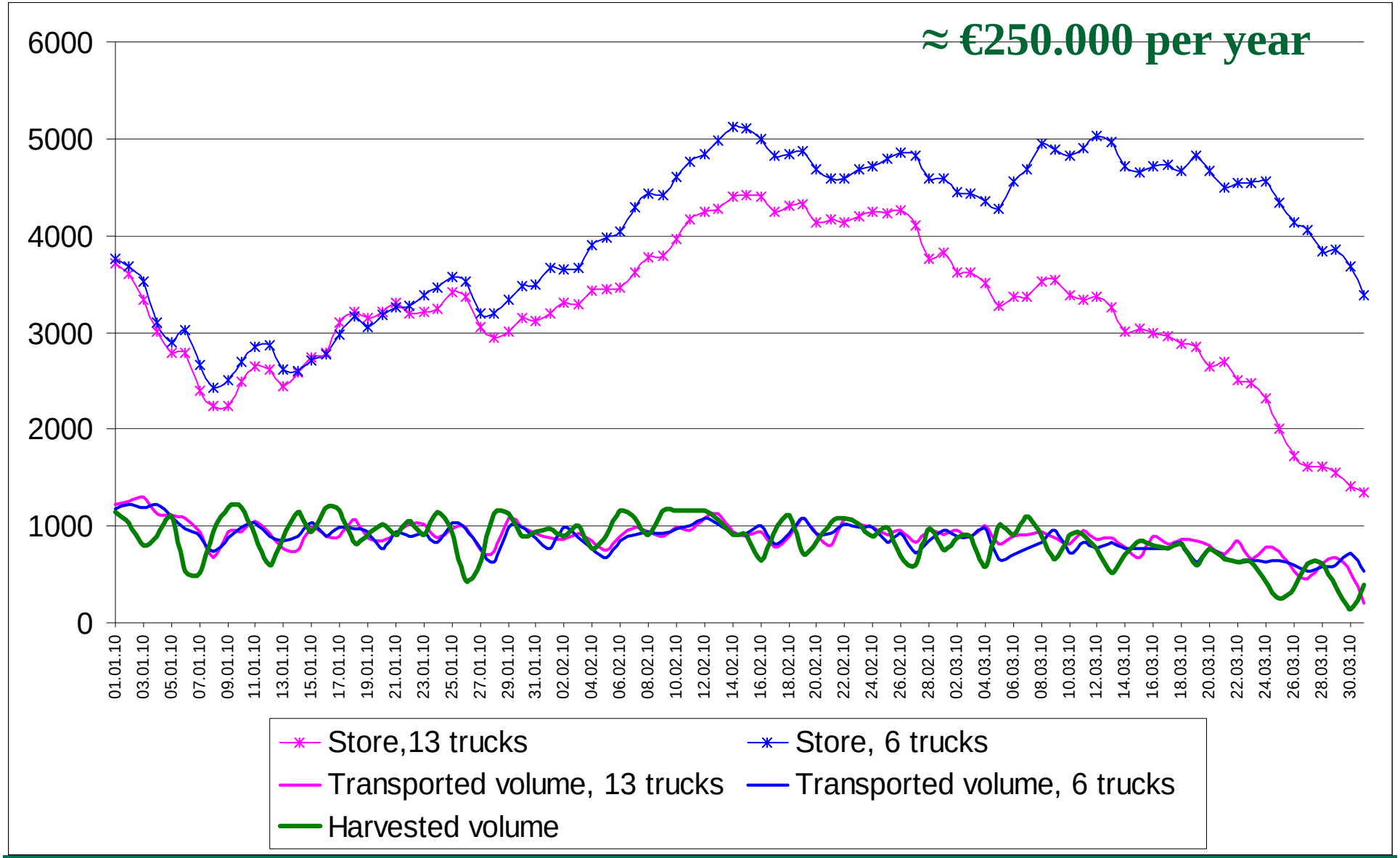
Number of intermediate terminals	-	-	6

Case 2: Choice of utilization level (results)

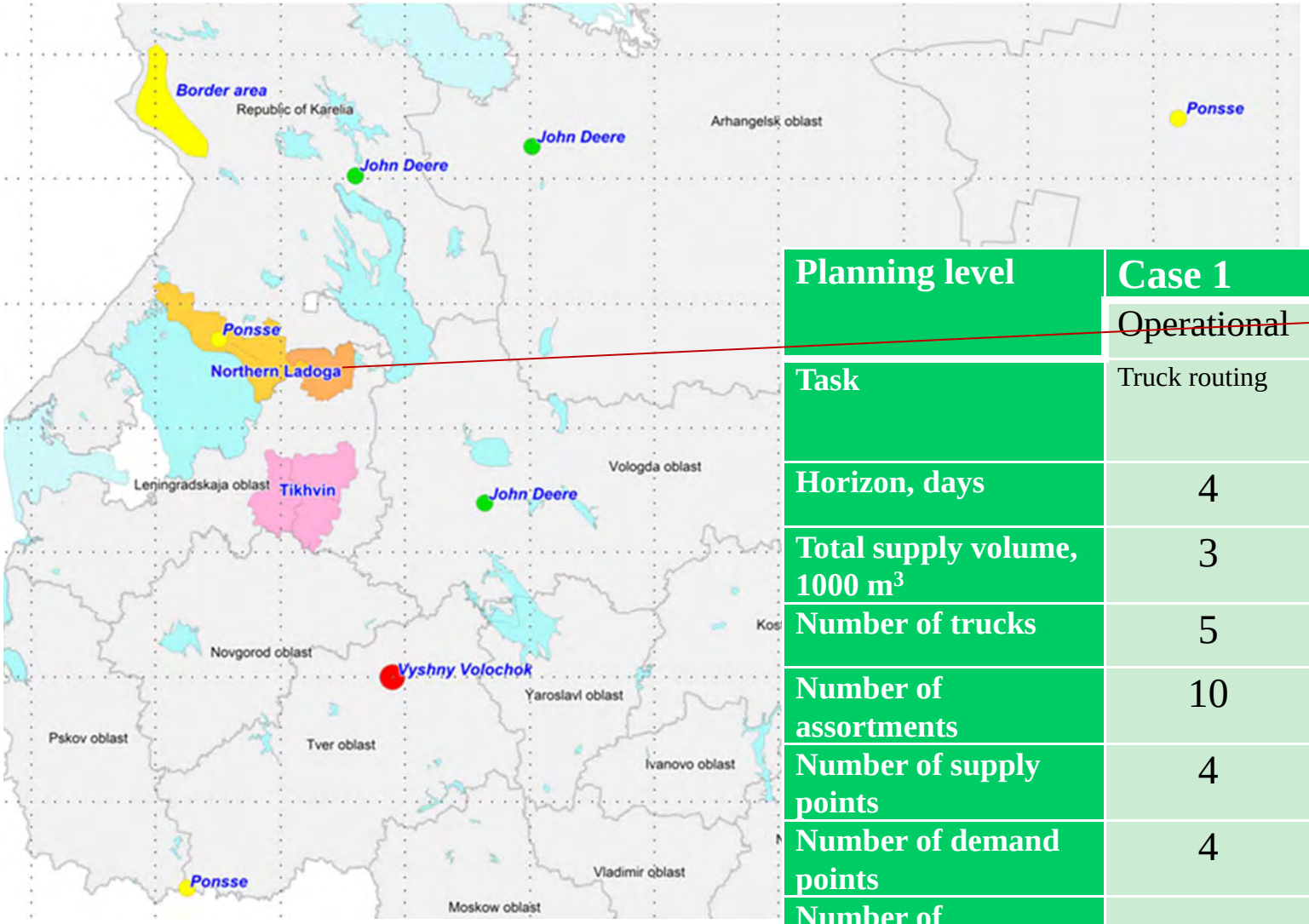
Source: Gerasimov Y., Sokolov A., Syunev V. 2011. Optimization of industrial and fuel wood supply chain associated with cut-to-length harvesting. *Systems. Methods. Technologies* 3(11): 118-124

Scenario	Required number of trucks	Total working time	Total distance	Total volume	Total loaded distance	Fleet utilization rate	Index of loaded distance	Operation work	Transportation cost
		h	*km*	*m³*	*km*			*m³/km*	*€/m³*
Basic	13	13474	622453	80025	308211	0.858	0.495	0.129	7.3
Optimal	6	10349	449648	80325	223389	0.864	0.497	0.179	6.3
%	–54%	–23%	–28%	+0.4%	–28%	+1.5%	+0.4%	+39%	-14%

Case 2: Choice of utilization level



The DSS test cases



Planning level	Case 1	Case 2	Case 3
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Horizon, days	4	90	365
Total supply volume, 1000 m^3	3	80	272
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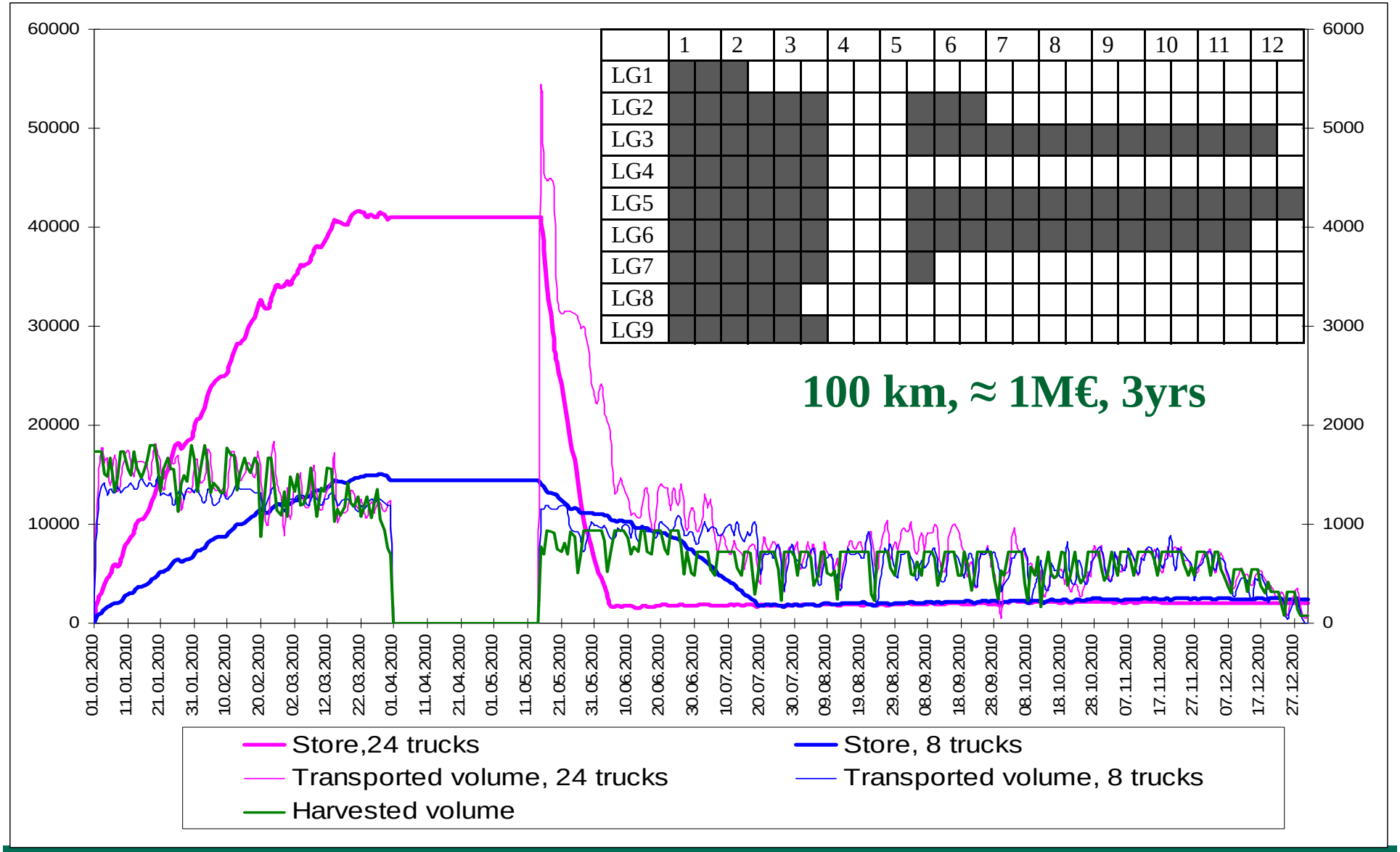
Number of intermediate terminals	-	-	6

Case 3: Transport method and road investments



Case study 3: Transport method and road investments

Scenario	Required number of trucks	Total working time	Total distance	Total volume	Total loaded distance	Fleet utilization rate	Index of loaded distance	Operation work	Transport-ing cost
		h	km	m^3	*km*			m^3/km	€/m^3
Basic	24	37231	709898	314031	296217	0.477	0.417	0.442	6.0
Optimal	8	30222	584310	270072	252143	0.636	0.432	0.462	4.5
%	-67%	-19%	-18%	-14%	-15%	+33%	+3%	+5%	-25%

Conclusion

The DSS can be used to support a wide range of planning decisions at on the company level including truck routing, choice of equipment utilization level, choice of transport method and infrastructure investments.

The potential cost savings calculated range from 14-29%.

Improvement of our knowledge on:

- Challenges CTL in Russia
- Current level of productivity/costs of CTL machines in local conditions

Know how about adaptation of FM CTL systems to specific conditions in Russia, in particular undeveloped infrastructure and service

Thank you very much for your attention!

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