NOTES AND COMMENTS

THE RATIONAL DIVISION OF FREIGHT TRAFFIC BETWEEN ROAD AND RAIL

By Breda Zelenko*

This note summarises a study of the rational allocation of freight traffic between modes in the Socialist Republic of Slovenia, Yugoslavia. Estimated door-to-door transport costs were compared for road, rail and combined transport. For combined transport, the comparisons included containerised transport as well as conventional modes.

The analysis was on the basis of economic costs. Thus, it was necessary to extract taxes and transfer costs from the individual elements of financial costs in the study. Overall, the economic costs of transport services were 78 per cent of financial costs. The elements of cost included direct transport costs (for example, the costs of labour, materials and maintenance) and depreciation of mobile facilities used, an allocation of costs for fixed traffic facilities, as well as other costs and losses caused directly in a definite transport process.

For the purpose of the study the transport process was divided into individual transport operations: vehicle movement, terminal operations, shunting, reloading, and operations at container terminals. In addition to the costs of individual transport operations, the infrastructure costs per tonne-kilometre were calculated, taking into account the average utilisation of the railway (46 per cent) and road capacities (60 per cent). The analysis was based on 1981 data, but all calculations were at 1983 prices.

For rail and road transport the costs cover one trunk haul and two terminal operations, and for rail also the necessary number of shunting operations (conditioned by the length of the transport route). Where road delivery or collection was involved, either at one end or at both of a rail trunk haul we added the costs of one or two reloading operations and one or two local road hauls of an average length of 6 kilometres. These cases are referred to as "semi-combined" and "combined" transport, respectively.

The running costs of railway vehicles were computed by the German method ZUKO; those of road vehicles were determined according to the *Guidelines* elaborated by Dorsch Consult and Louis Berger (1974). Both methodologies

* ZG–Prometni Institut, Ljubljana, Yugoslavia. The full results of this research are available in Zelenko (1984), which is available from the author. She is grateful to Milorad Duricic from the Traffic Institute of Sarajevo for assistance with the methodology.

were adapted for the purposes of this study to the transport situation in Slovenia. The costs of running railway vehicles included interest charges; but in the costs of road transport the overhead and insurance costs and the costs of traffic licence and registration for trucks were excluded. Fuel costs were adapted by the subtraction of contributions for roads and taxes, which are not paid in the case of railways. Labour costs were computed in the same way for roads and railways.

The calculations are based on averages for the entire road and railway network of Slovenia. For rail the costs of run are given for an average train weight of 1060 tons, calculated separately for electric and diesel traction, and also for single and double track lines, on an average haul sector length of 86 km for diesel traction and of 113 km for electric traction.[1] Locomotive types are those most commonly found on the network of the Railway Transport Enterprise Ljubljana (diesel locomotive 661 and electric locomotive 336), and wagons are open ones (gondolas). The cost calculations of terminal and technical operations are based on the averages for the network of ZG Ljubljana.[2] Data for the costs of reloading operations were obtained from Railway Traffic Data Center Ljubljana–Moste; account was taken of the structure of individual commodity groups transported in Slovenia and of the types of mechanisation used in reloading. The calculation of container transport costs is based on rates of utilisation in the container terminal Ljubljana–Moste, which is one of the best equipped and most efficient terminals in Yugoslavia.

The results of these cost calculations of individual transport phases are set out in Table 1 and Figures 1 and 2.

The results show that where private sidings are available at both ends of the haul the most rational mode is direct railway transport irrespective of the type of traction. Road transport can be competitive only if one or both ends are without sidings.

Semi-combined transport, where there is an industrial track at one end of the route only, was found to be less economic than road transport by 30-ton trucks for hauls less than 127 km (assuming electric rail traction).

Reducing truck-carrying capacity increases transport costs per unit, so that road goods transport by 20-ton trucks is more rational than rail transport on a route distance not exceeding 188 km, or with 9-ton trucks on a route of up to 52 km. Diesel traction increases the costs of railway transport.

Where there are no industrial sidings at either end of the rail haul the costs of transport are substantially increased. Over a distance of up to 248 km, road goods transport by 30-ton trucks is more rational than the combination road–rail–road, even if the railway uses electric traction. The rationality limits of road transport are reduced with lower truck-carrying capacity; for example, road

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[1] These are the average sector lengths on which a locomotive hauls a set of wagons before being replaced by another locomotive. The data are obtained from the calculation of the turnround time of locomotives running on the network of ZG Ljubljana.

[2] Detailed data on run costs for particular sections and various train weights are computer-processed and are available for the whole railway network in the Prometni Institut, Ljubljana. Data on roads in the same form are available in the *Republiska skupnost za ceste.*

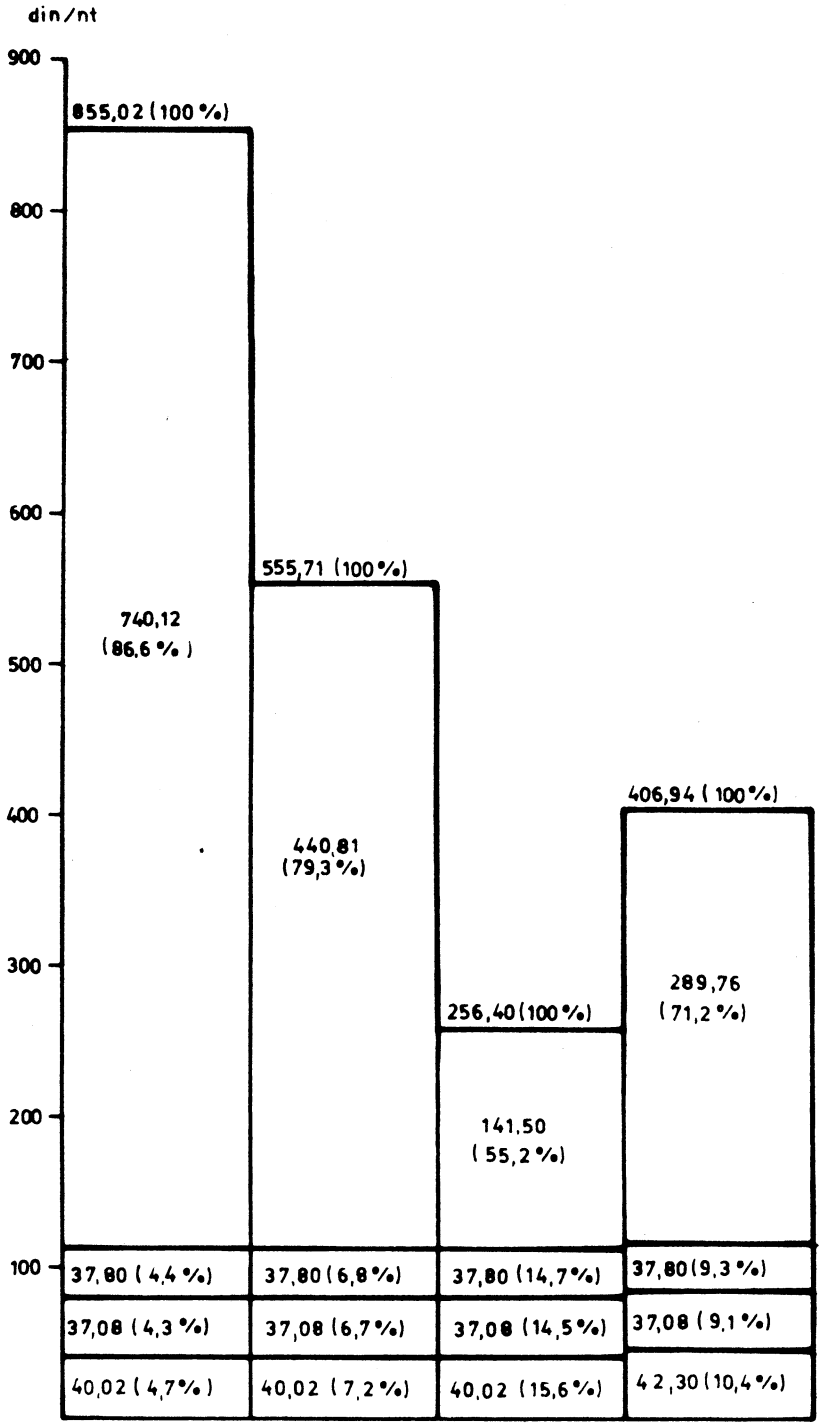

FIGURE 1

Cost Comparison of railway, semi-combined and combined freight transport on a distance of 100 km; electric traction; train weight: 1060 tons.

TABLE 1

Socio-economic Cost Comparison of Railway, Semi-combined,[a] Combined,[b] Combined-container and Road Goods Transport

	Freight transport costs on route distances (Din/ton at 1983 prices[c])									
Transport modes	*50km*	*100km*	*150km*	*200km*	*250km*	*300km*	*350km*	*400km*	*450km*	*500km*
Railway										
D–Diesel	218.29	314.87	409.65	425.24	601.03	715.61	792.40	906.98	983.77	1,098.35
E_1 (single track)	185.03	266.35	309.88	391.20	434.73	516.05	559.58	640.90	684.43	765.75
E_2 (double track)	180.05	256.40	294.95	371.30	409.85	486.20	524.75	601.10	639.65	716.00
Semi-combined										
D–Diesel	517.60	632.18	708.61	823.55	901.87	1,014.92	1,091.71	1,206.29	1,283.08	1,397.66
E_1 (single track)	484.35	565.66	609.18	690.51	734.04	815.36	858.89	940.21	983.74	1,065.06
E_2 (double track)	479.36	555.71	594.26	670.61	709.16	785.51	824.06	900.41	338.96	1,015.31
Combined										
D–Diesel	816.91	931.49	1,008.27	1,122.86	1,199.65	1,314.23	1,391.02	1,505.60	1,582.39	1,696.97
E_1 (single track)	783.66	864.97	908.49	989.82	1,033.35	1,114.67	1,158.20	1,239.52	1,283.05	1,364.37
E_2 (double track)	778.67	855.02	893.57	969.92	1,008.47	1,084.82	1,123.37	1,199.72	1,238.27	1,314.62
Combined-container										
D–Diesel	369.87	487.77	567.88	685.78	765.89	883.79	963.90	1,081.80	1,161.91	1,279.81
E_1 (single track)	334.71	417.46	462.41	545.16	590.11	672.86	717.81	800.56	845.51	928.26
E_2 (double track)	329.45	406.94	446.63	524.12	563.81	641.30	680.99	758.48	798.17	875.66
Road										
5-ton trucks	635.19	1,055.00	1,474.81	1,894.62	2,314.43	2,734.24	3,154.05	3,573.86	3,993.67	4,413.48
9-ton trucks	447.42	712.61	977.81	1,243.00	1,508.20	1,773.39	2,038.59	2,303.78	2,568.98	2,834.17
20-ton trucks	304.95	486.66	668.37	850.08	1,031.79	1,213.50	1,395.21	1,576.92	1,758.63	1,940.34
30-ton trucks	295.57	468.28	640.99	813.70	986.41	1,159.13	1,331.83	1,504.54	1,677.25	1,849.96

[a] Transport route terminates with an industrial siding at one end and with road transport at the other.
[b] Transport route terminates with road transport at both ends.
[c] Rate of exchange on 30 June 1983: 1 US $ = 89.2081 din.
D = Diesel
E = Electric

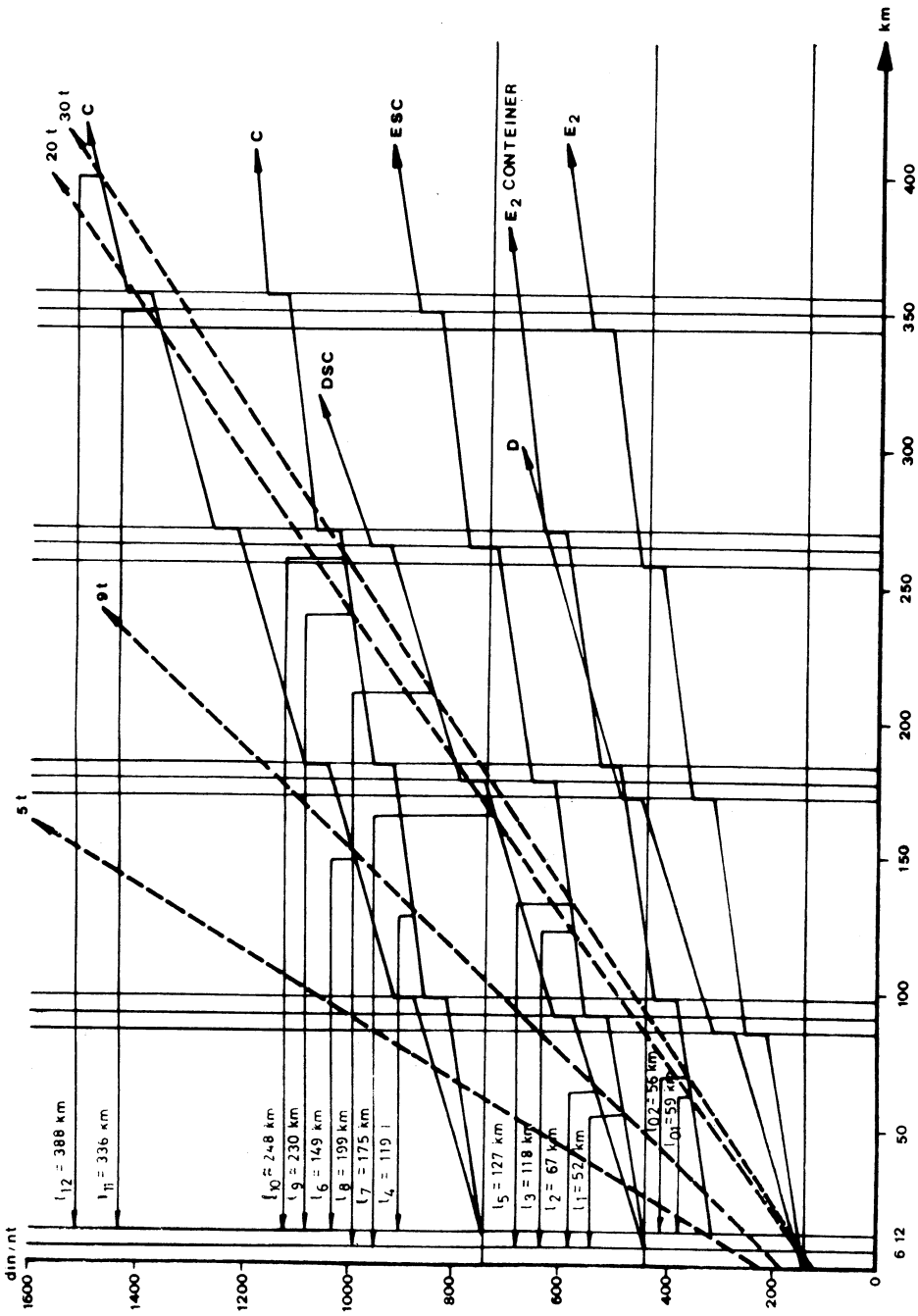

FIGURE 2

Cost comparison of railway, semi-combined and road freight transport

TABLE 2

Distance Limits for the Economic Transport of Goods by Road or by Combined Road and Rail*

Truck carrying capacity	*Semi-combined transport road–rail*		*Combined transport road–rail–road*		*Combined container transport*
	Diesel traction	*Electric traction*	*Diesel traction*	*Electric traction*	*Electric traction*
Tons	km.	km.	km.	km.	km.
9	67	52	149	119	–
20	175	118	336	230	50
30	199	127	388	248	56

* Below these distances road transport is more economic; above them, combined transport is to be preferred.

transport by 20-ton trucks is more rational than the combined mode on a route of up to 230 km; with 9-ton trucks this limit is reduced to 119 km. The use of diesel rail traction increases these limits proportionally.

Where there are no industrial sidings, the cost of combined transport is substantially reduced if goods are transported on the road section in containers which are delivered to a railway terminal which is also a railway station. For example, intermodal container transport is more rational than road transport by 30-ton trucks for any haul longer than 56 km. (See Table 2.)

The results of this study are qualitatively similar to those obtained from similar studies in Western countries, but the breakeven length of haul for rail is substantially shorter, and remarkably so in the case of container transport.

REFERENCES

Dorsch Consult (München) and Louis Berger, Inc. (USA) (1974): *Guidelines for Highway Feasibility Study,* elaborated in co-operation with Yugoslav experts in Ljubljana. München, West Germany, and East Orange, USA.

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