Costs & Price Calculation in Rail Transport

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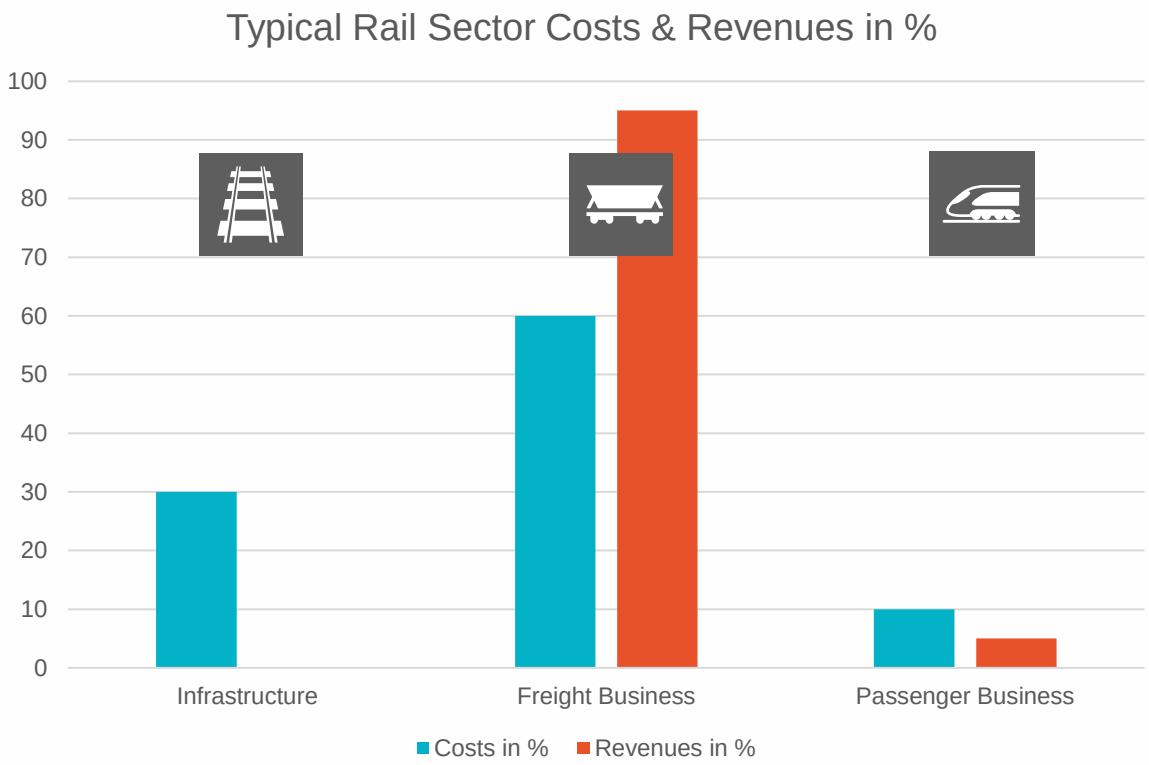
Agenda

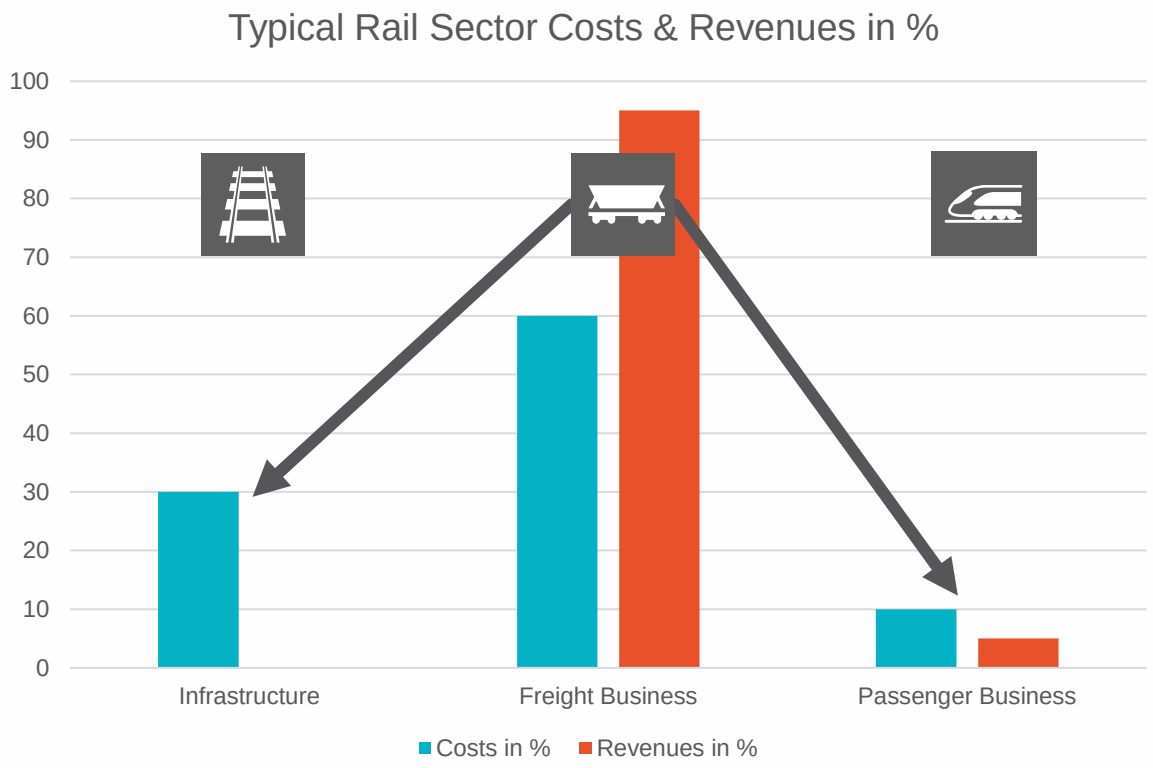
- Overview of Costs in Rail Transport
- Examples for Infrastructure Costs
- Examples for Freight Transport Costs
- Examples for Passenger Transport Costs
- Price Calculation Strategies

Rail Sector Cost and Revenue Structure



Freight business is "**cash cow**" whereas passenger is unprofitable and infrastructure is cost centre only.

Rail Sector Cost and Revenue Structure



Freight profit needs to contribute to infrastructure and passenger „loss“.

Rail Sector Main KPI

Infrastructure KPI:

$ / track-km
$ / train-km
$ / (t+p/km)

Freight KPI:

$ / ton or TEU
$ / train-km
$ / tkm

Passenger KPI:

$ / seat-km
$ / train-km
$ / pkm

Rail Sector Costs

Infrastructure Cost Driver:

- Maintenance costs / track-km
- tons / track-km
- CAPEX – Renewal requirements
- Electrification, CCS*, tunnels/ bridges, stations

Freight Cost Driver:

- Traction / km
- Energy / km
- Asset utilization
- Slot quality
- Asset reliability & availability
- Staff cost

Passenger Cost driver:

- Traction / km
- Energy / km
- Asset utilization
- Slot quality
- Asset reliability & availability
- Staff cost

*CCS: Command, Control and Signalling Systems

Rail Sector Costs

Infrastructure Costs:

$ / track-km p.a. = 30.000 – 90.000

$ / train-km = 10-15

Freight Train Costs:

$ / train-km = 15 – 30

Passenger Train Costs:

$ / train-km = 10 – 25

Infrastructure Costs

- Rail infrastructure costs can be divided in several blocks

Track & Structures* CAPEX	Track & Structures Maintenance	Infrastructure Operations**
Staff	Energy	Administration & Organisation

* Structures: Electrification, CCS, Bridges, Tunnels, Stations
** Time tabling, capacity allocation and dispatching

Rail Infrastructure Cost Shares

Track & Structures* CAPEX	Track & Structures Maintenance	Infrastructure Operations**
30-50%	40-60%	10-20%

Staff	Energy	Administration & Organisation

10-20%

* New Construction, Modernization, Renewal, Upgrade

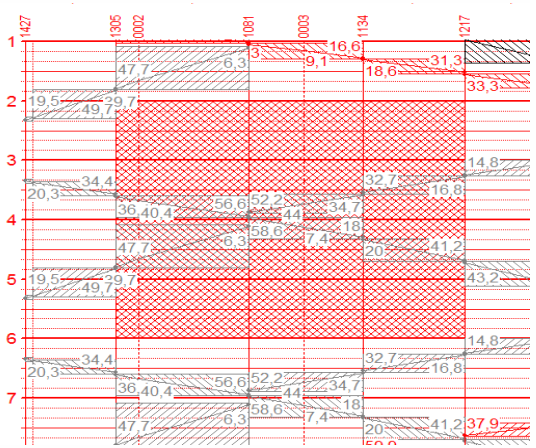
Rail Infrastructure Maintenance Costs

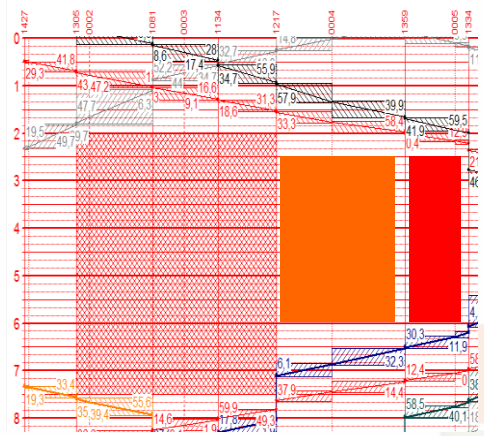
Quality level of Infrastructure

Track & Structures Maintenance

Mechanization level & equipment

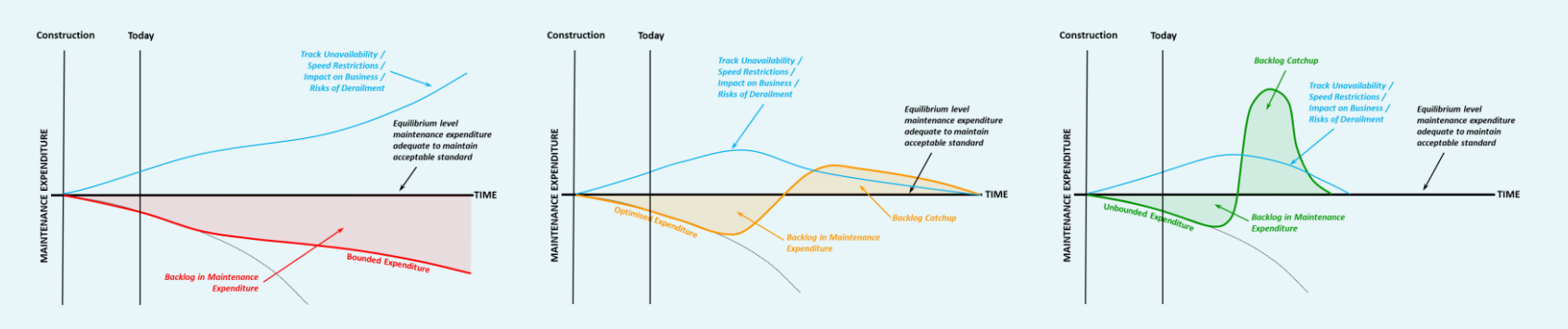
Possession times





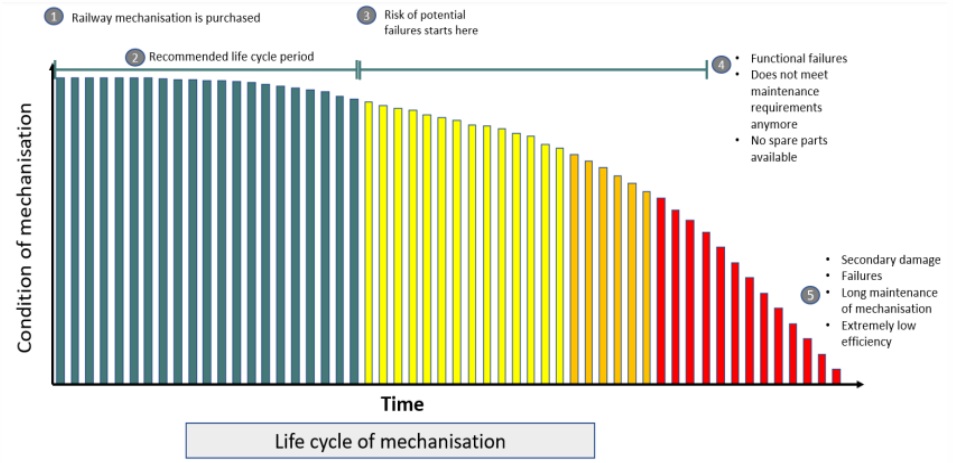
Rail Infrastructure Maintenance Costs

Maintenance/Repair	Traffic	Maintenance Intervals
Tamping	40 - 70 Mio. tons	3 - 5 years
Track grinding	20 - 30 Mio. tons	1 - 3 years
Track renewal	300 - 1000 Mio. tons	10 - 15 years
Renewal of wooden sleeper	250 - 600 Mio. tons	20 - 30 years
Renewal of concrete sleeper	350 - 700 Mio. tons	30 - 40 years
Fixings	100 - 500 Mio. tons	10 - 30 years
Ballast renewal	200 - 500 Mio. tons	20 - 30 years
Substructure renewal	> 500 Mio. tons	> 40 years



Rail Infrastructure Maintenance Equipment Costs Example: Tamping

Capital expenditure	**new** (costs in $/km)	**old** (costs in $/km)
Depreciation	114,26	-
Financing cost	51,42	-
Overhaul	7,62	37,55
Repayment	-	-
Total CAPEX	173,30	37,55
Operating expenditure		
Maintenance cost	85,70	422,47
Personnel cost	240,64	790,86
Energy cost	29,07	63,00
Total operating costs	355,41	1.276,33
Total costs per km	528,71	1.313,88



Rail Infrastructure Maintenance Equipment Costs

- Modern tamping machines can tamp up to 4-5 km per day
- The higher the machine utilization, the lower the cost per km

Machine	km performed	No of days worked	km per working day	Share of working days
CSM 3006	163,5	170	0,96	77%
CSM 3506				0%
CSM 6486	213,45	195	1,09	89%
CSM 6782	379,9	288	1,32	131%

2019 situation

	Preventive Tamping	BaU Tamping	
Total tamping	770	252	km/a
Costs per km per year	1.254	3.614	AZN/km
Total costs per year	965.580	910.728	AZN

Suggested improvement

The Infrastructure Cost Situation - Example

	Spent today			Incl. Maintenance needs		
USD p.a.	Total cost p.a.	Costs per Train-km	Costs share	Total cost p.a.	Costs per Train-km	Costs share
Maintenance costs lines	4.606.561	0,56	11%	34.090.909	4,15	36%
(Maintenance costs catenary)	0	0,00	0%	18.181.818	2,21	19%
Depreciation lines	13.692.629	1,67	32%	13.692.629	1,67	14%
Personnel costs	10.401.104	1,27	25%	10.401.104	1,27	11%
Energy costs	506.973	0,06	1%	506.973	0,06	1%
Administration costs	9.090.909	1,11	22%	11.363.636	1,38	12%
Overhead headquarters & security	3.965.604	0,48	9%	5.000.000	0,83	7%
Total costs	**92.980.316**	5,15	100%	**209.035.901**	11,57	100%
Revenue	0			0		
Result	-92.980.316			-209.035.901		
Train-km p.a.	18.068.720			18.068.720		
Costs per train-km	4,66			10,74		
Line km	2.068,00			2.068		
electrified line km	1.233,00			1.233		
Costs per line km	30.394,84			86.514,56		

Freight Costs: Track Access Charges

Marginal costs
Costs directly caused by the operation of each train

+

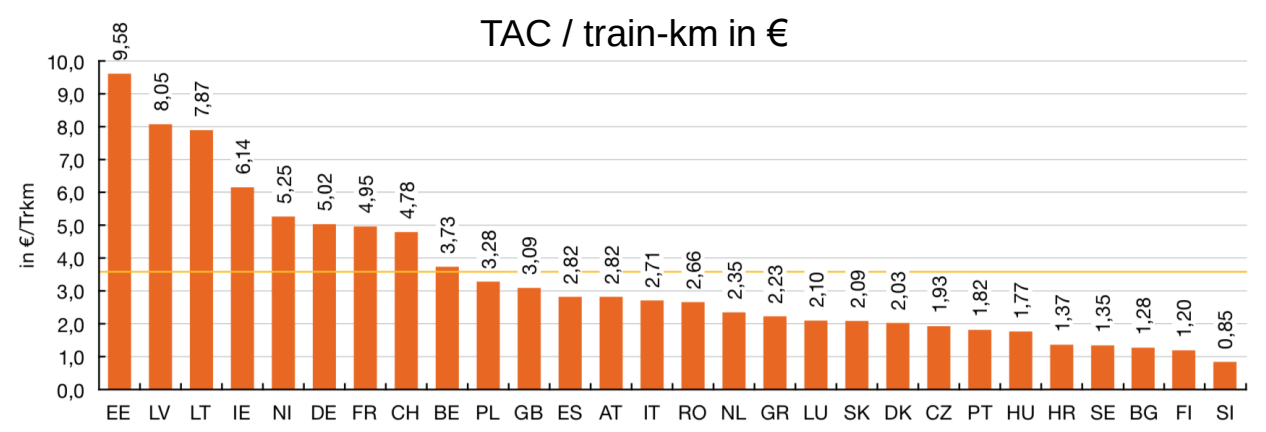
Full costs
Additional levies to cover all infrastructure costs, only to the extent which the market can bear

+
-

Other elements
E.g. incentive schemes for trouble-free operations or environmental protection

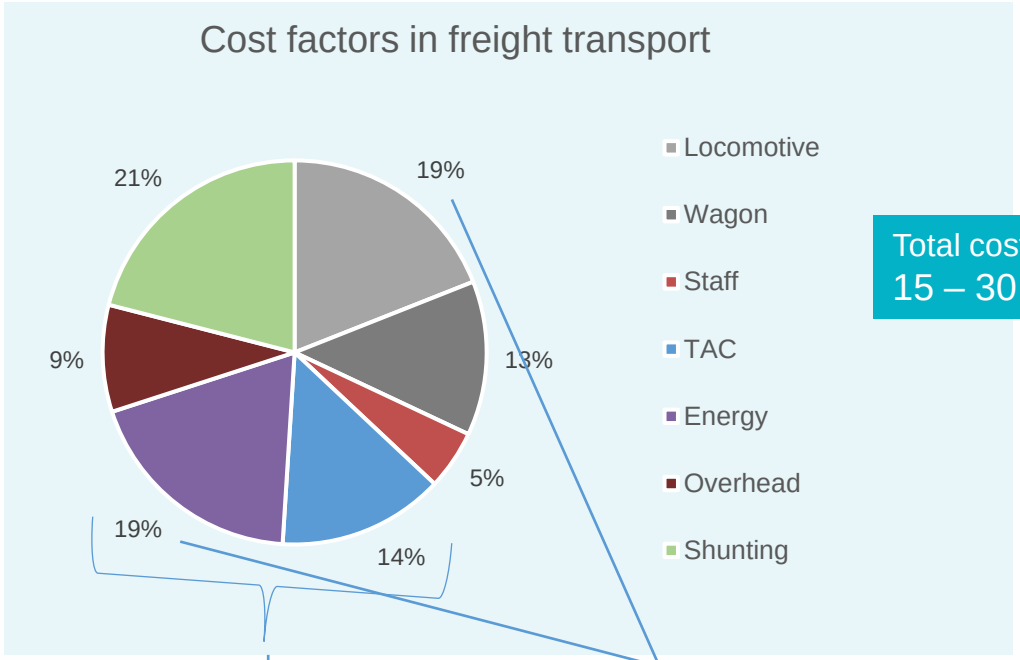
=

Track Access Charges



Freight is unlikely to cover full infrastructure costs!

Freight Costs



Total costs of:
15 – 30 $ / train-km

Variable costs:
33%
Other costs are **fix** costs

Modern E-loco:
Fix-costs of 60.000 $/month
98% availability!

Energy costs
Vary by 25% depending on slot quality

Freight Costs: Allocation of Fix Costs

Knowing the full asset cost is the key!

Example: Locomotive

Purchase price: 5.000.000 $

Costs p.a.:	
Depreciation (25 y):	200.000 $
Financing (5%):	250.000 $
Overhaul (700k after 10 y):	70.000 $
	520.000 $
Maintenance (4%):	200.000 $
Annual costs:	720.000 $
Per month:	60.000 $
Per day:	**2.000 $**

Performance of locomotive:

250 km per day:	8 $ / km
500 km per day:	4 $ / km
1000 km per day:	2 $ / km

Performance depends on:

- Slot quality / avrg. Speed (Infrastructure)
- Maintenance time / availability of locomotive (Workshops)
- Loading / unloading facilities (turnaround-time) (Terminals)

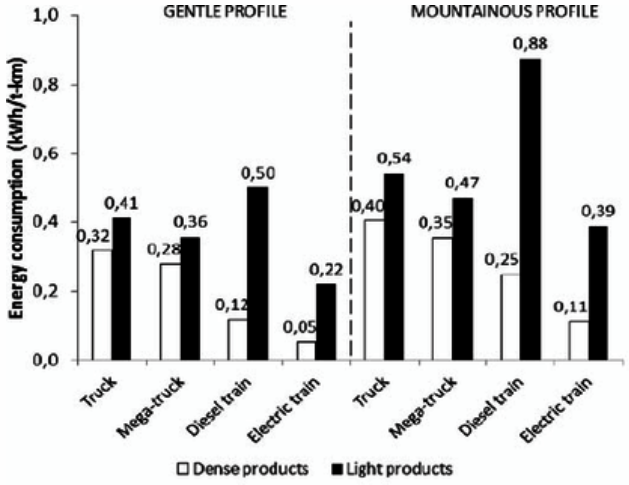
For assets **TIME** is deciding factor!

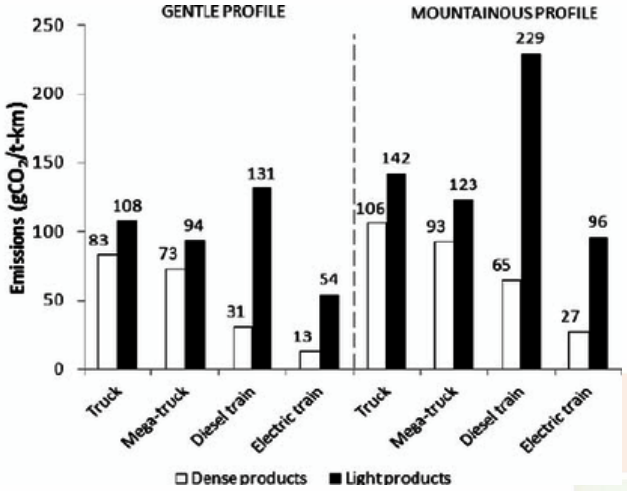
Freight Costs: Energy Consumption

Energy costs are one of the main variable costs factors.
Influencing factors are:

- Diesel or Electric Energy makes a big investment difference
- Profile of the line / track quality
- Driver skills
- Slot quality / number of stops
- Weight of train

Example: Spain

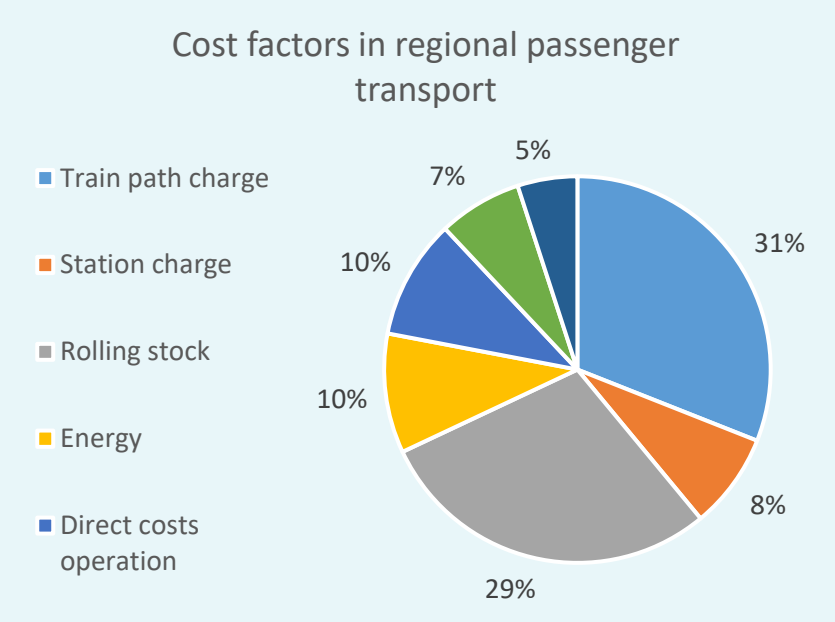




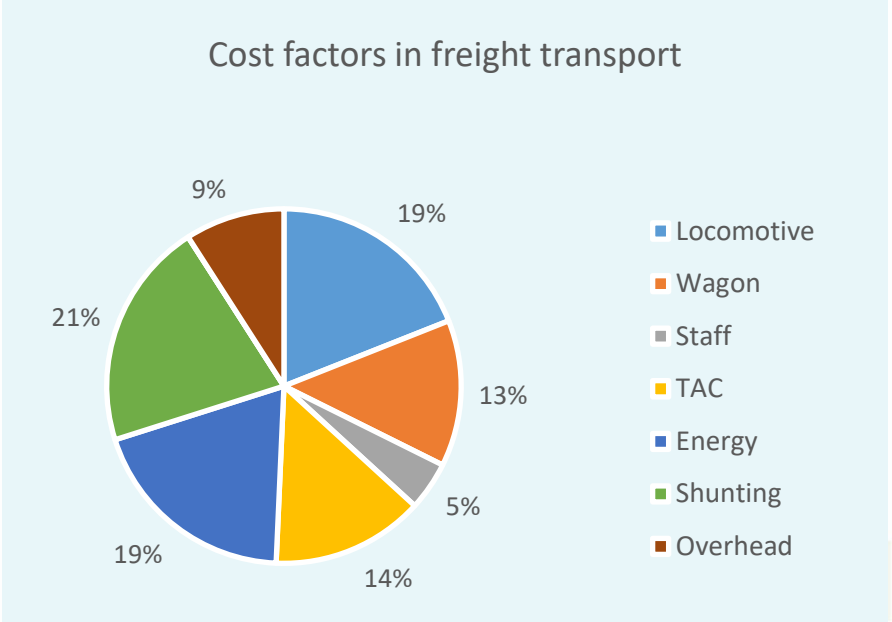
Source: Perez-Martinez; 2012, Journal of int Transportations systems

The Distribution of Cost Factors

Depending on the type of rail service offered, the share of cost types is different



Numbers from BAG-SPNV (German regional transport association)



Numbers from an exemplarily rail freight transport case

The Calculation of Costs

Three cost allocations need to be done

Infrastructure department	Freight department	passenger department	
▪ Track maintenance ▪ Station maintenance ▪ Bridges and civil works ▪ Signalling ▪ Capacity management ▪ Etc.	▪ Locomotives ▪ Freight wagons ▪ Drivers, engineers, staff ▪ TAC ▪ Energy ▪ Etc.	▪ Locomotives or EMU ▪ Passenger wagons ▪ Drivers, conductors, staff ▪ TAC ▪ Energy ▪ Etc.	costs
▪ TAC ▪ (Subsidies)	▪ Freight revenues	▪ Ticket revenues ▪ (PSO revenues)	revenues

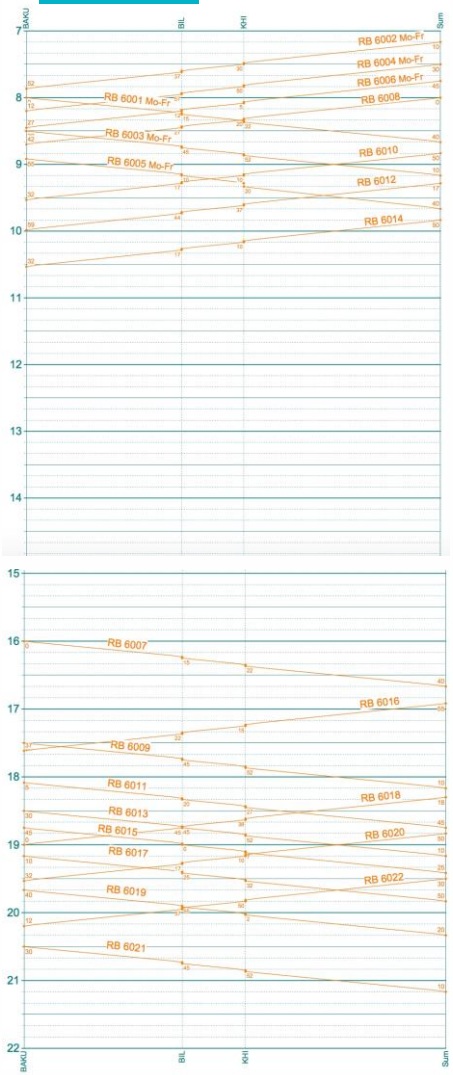
The ‘KPI Cockpit’

Financial view	Operating view	Customer view	Commercial view
Revenues/costs (monthly basis)	Train-km performed	Passengers/ freight transported	Revenues per ton/passenger
Costs per train-km	km per unit/asset	Number of clients in freight	Revenues per ton-km / pax-km
Costs per ton-km & pax-km	tons / tkm / pax / pkm per year	Punctuallity	Revenues per seat-km / wagon
Costs per ton & per passenger	Trips per year	Travelers satisfaction	Revenues per line
Costs per operating hour	Asset required		Revenues per staff

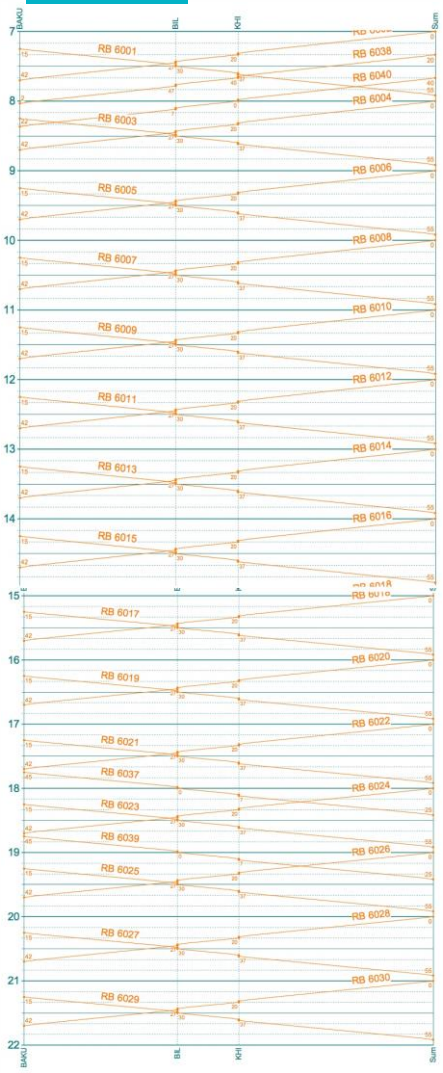
Measure and observe their development!

The Calculation of Costs

11 trips



17 trips



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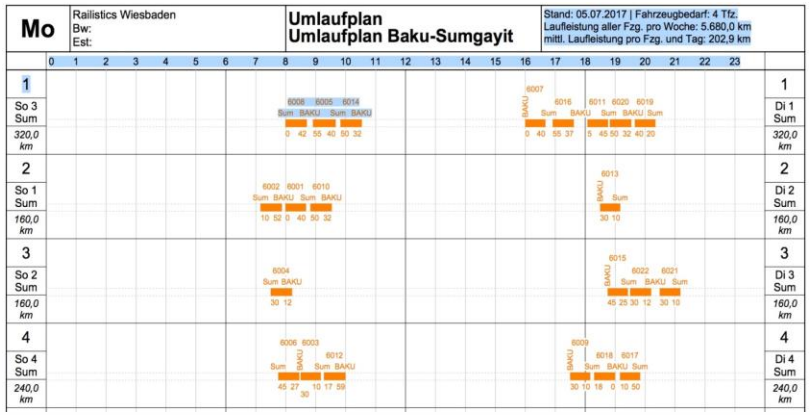

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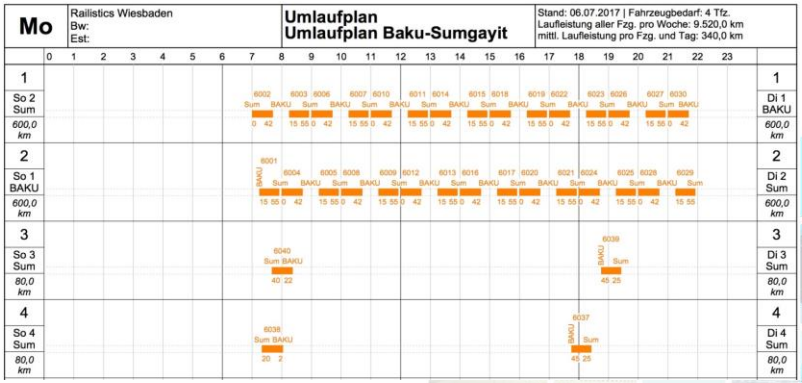
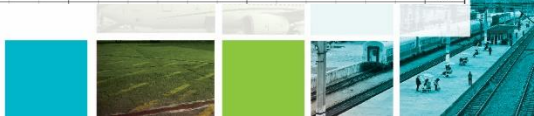




The Calculation of Costs

	11 trips			17 trips		
USD p.a.	Total cost 11 trips p.d.	Costs per Train-km	Costs share	Total costs 17 trips p.d.	Costs per train-km (optimized)	Costs share optimized
Depreciation rolling stock	1.834.848	6,25	65%	1.834.848	3,70	61%
Interest Rolling Stock	0	0,00	0%	0	0,00	0%
Maintenance costs	108.098	0,37	4%	182.765	0,37	6%
Personnel costs	54.218	0,18	2%	59.640	0,12	2%
Energy costs	86.520	0,29	3%	146.283	0,29	5%
Cleaning costs	43.440	0,15	2%	57.483	0,12	2%
Marketing/Sales costs	159.534	0,54	6%	171.076	0,34	6%
Administrative costs	342.999	1,17	12%	367.814	0,74	12%
Overhead headquarters & security	182.231	0,62	6%	200.000	0,68	7%
Total costs	**2.811.889**	**9,58**		**3.019.911**	**6,36**	
Revenue	438.893	1,5		548.616	1,1	
Result	**-2.372.997**	**-7,5**		**-2.271.295**	**-4,58**	

The Calculation of KPI

	11 trips	17 trips
Train-km p.a.	293.600	496.400
Nu. of op. staff (driver and conductors)	20	22
Roundtrips per year	3.670	6.205
Operating hours p.a.	4.893	8.273
Personnel hours p.a.	32.296	36.403
Seat km available per year	117.440.000	198.560.000
passenger km per year	34.899.920	43.624.900
Number of EMU	5	5
No of roundtrips	10	17
No of conductors per train	4	2
No of passengers	1.163.331	1.454.163
Manat per trip	1	1
Manat per year	965.564	1.206.956
Average travel distance (km)	30	30
Capacity utilization	30%	22%

KPI		
train km Costs in Manat	8,96	5,68
Km per EMU Unit	58720	99280
Costs per seat km (Manat)	0,0224	0,0142
revenue per passenger km	0,0126	0,0126
Costs per operating hour	537,40	340,84
Costs for staff per train/km	0,18	0,12
Average passenger per train	317	234

Costs per passenger	2,42	2,08
revenues per passenger	0,38	0,38

Price Calculation Strategy

Revenue management can maximise the earnings

In the ideal situation:

price = willingness to pay (WTP)

In a monopoly situation the RU can achieve the full producer surplus

WTP is low for products in hard price competition (e.g. products suitable for trucking)

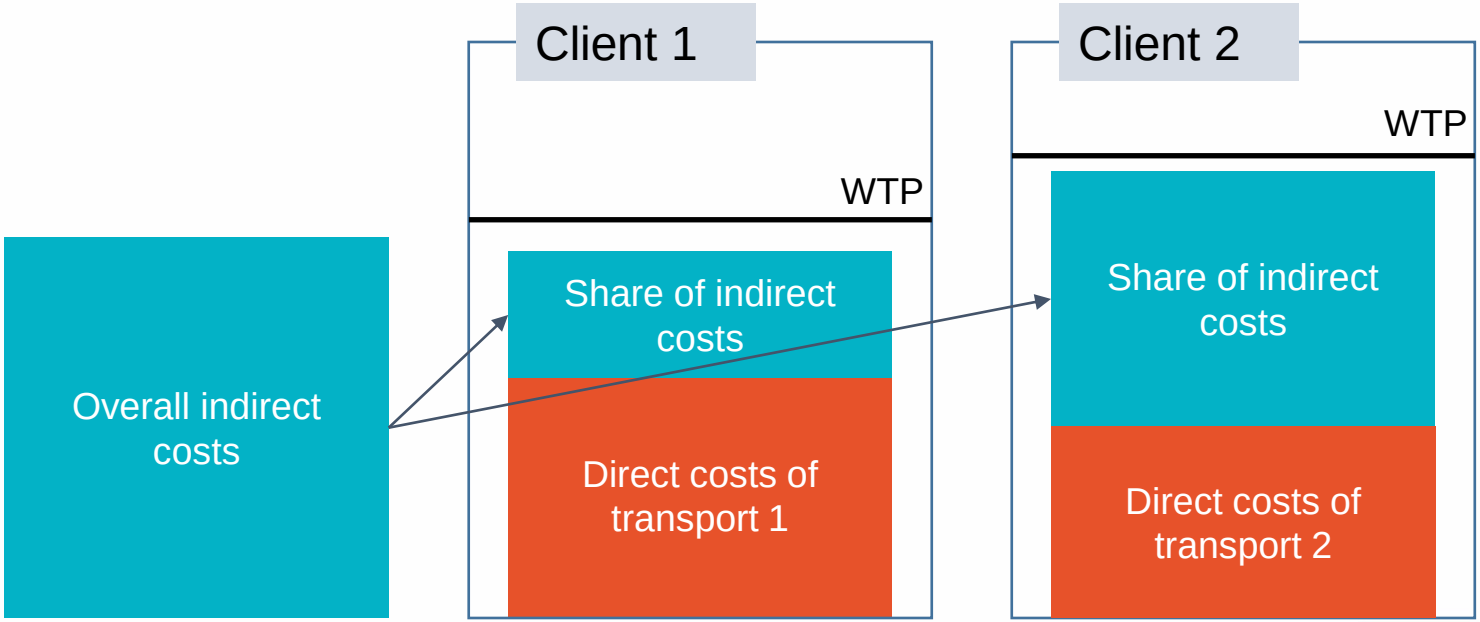
WTP is high if rail is without any alternative (e.g. heavy mass goods)

WTP is low for new clients

WTP is high for additional services

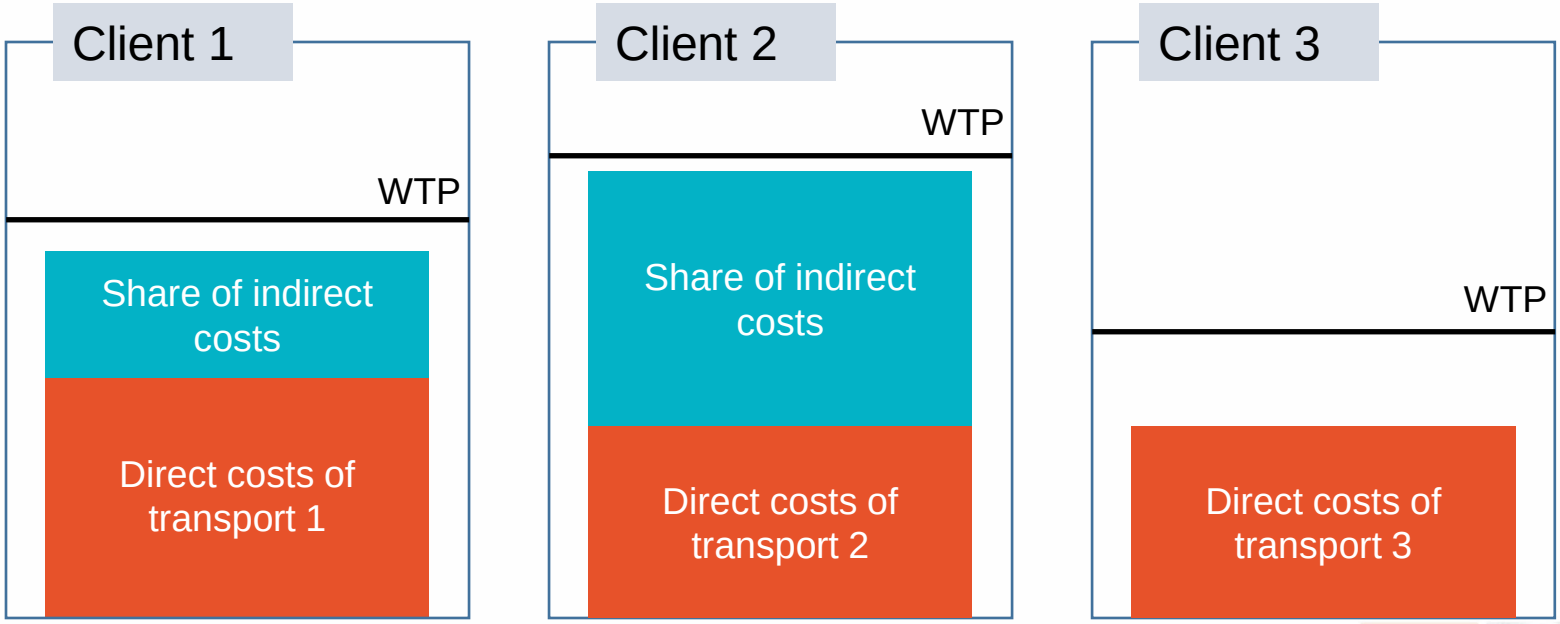
Price Calculation Strategy

Example for setting prices according to costs and WTP of clients



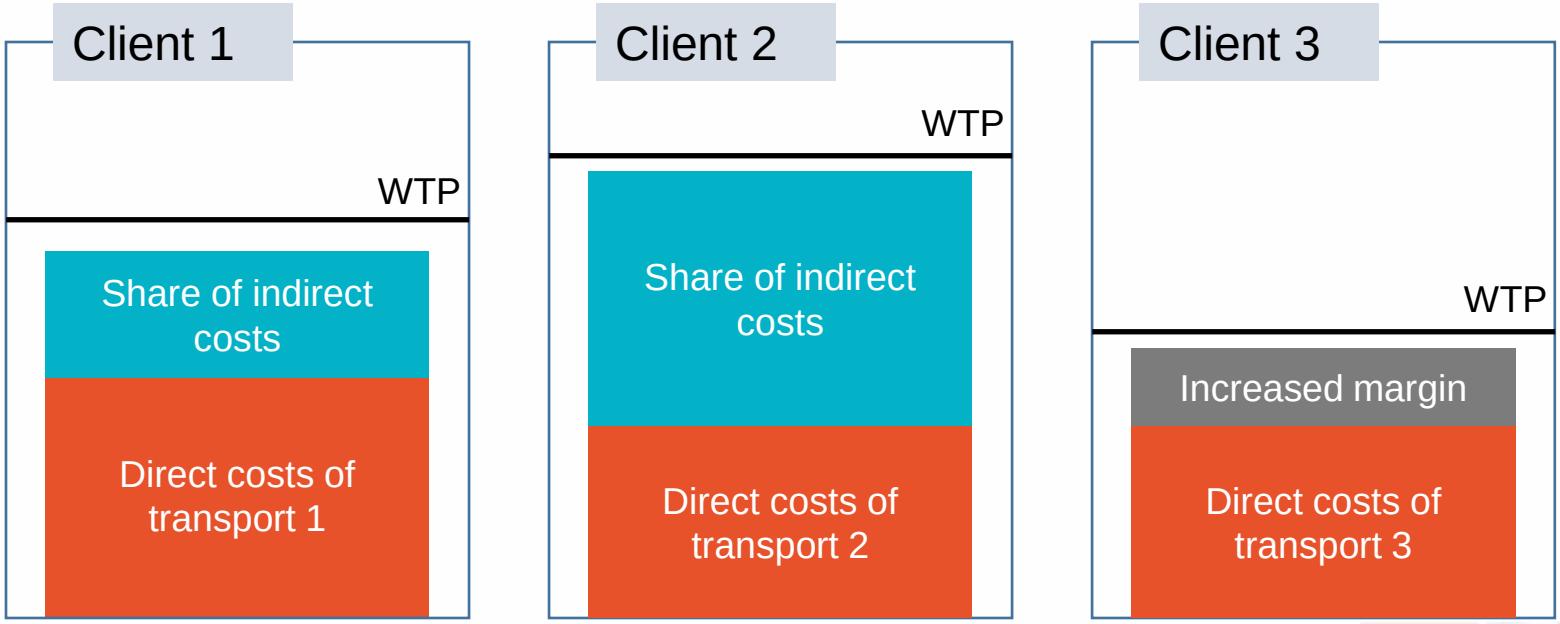
Price Calculation Strategy

Example for gaining new clients with dynamic pricing



Price Calculation Strategy

Example for increasing margin with monopoly prices



In a competitive market environment the margin is reduced

Price Calculation Strategy

- The willingness to pay is sometimes hard to determine
- Trucking rates are a good indicator
- Often WTP for rail is significantly below the trucking rate
  - due to a reduced flexibility
  - and often reduced punctuality with rail transport

To initiate the modal shift, a benefit is necessary!