

Managing Risk and Cost with an EA Approach

Centre for Railway Research and Education and
Atego

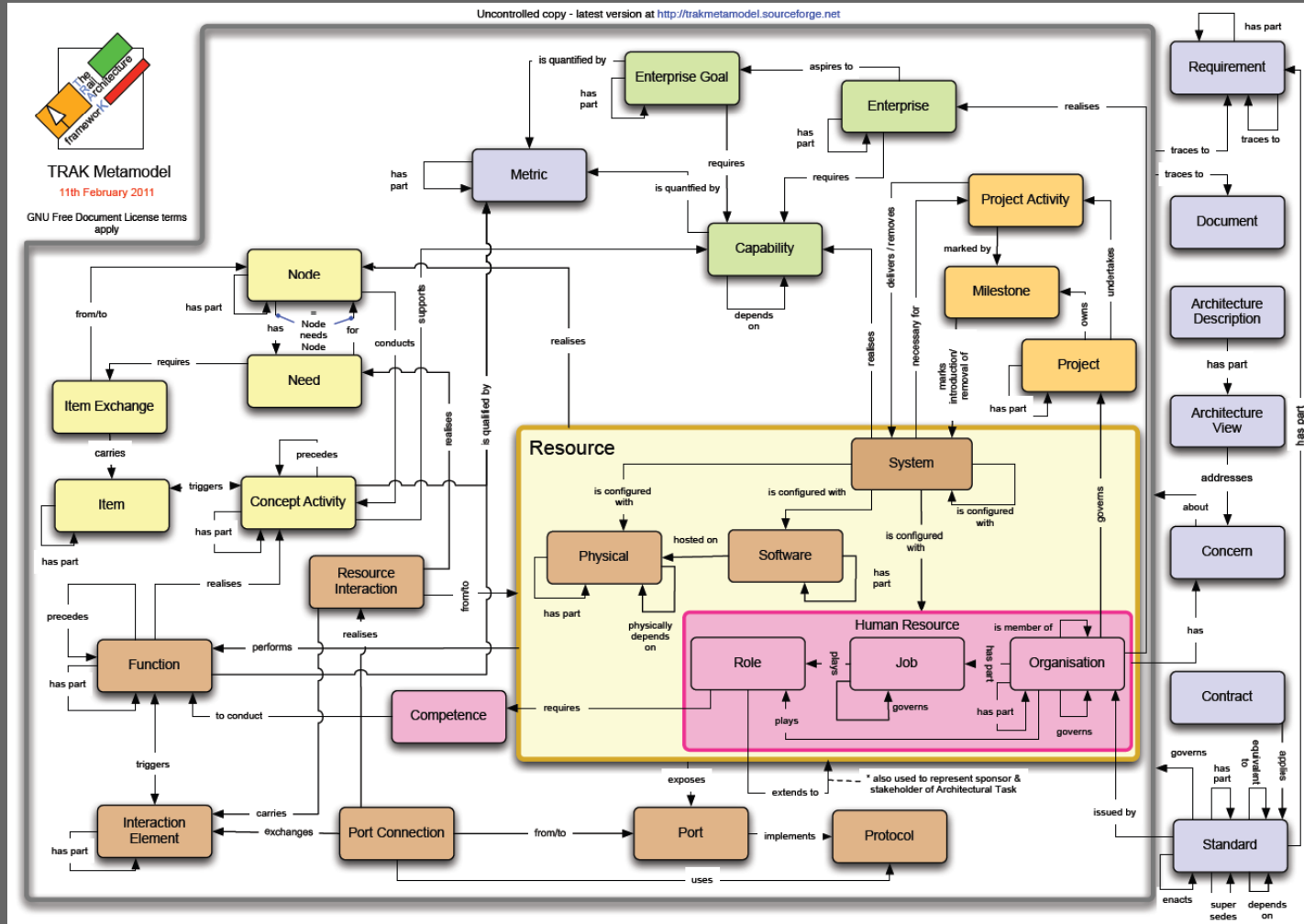
Overview

- Introduction
- Architecture
- Solutions
- Analysis
- Conclusions

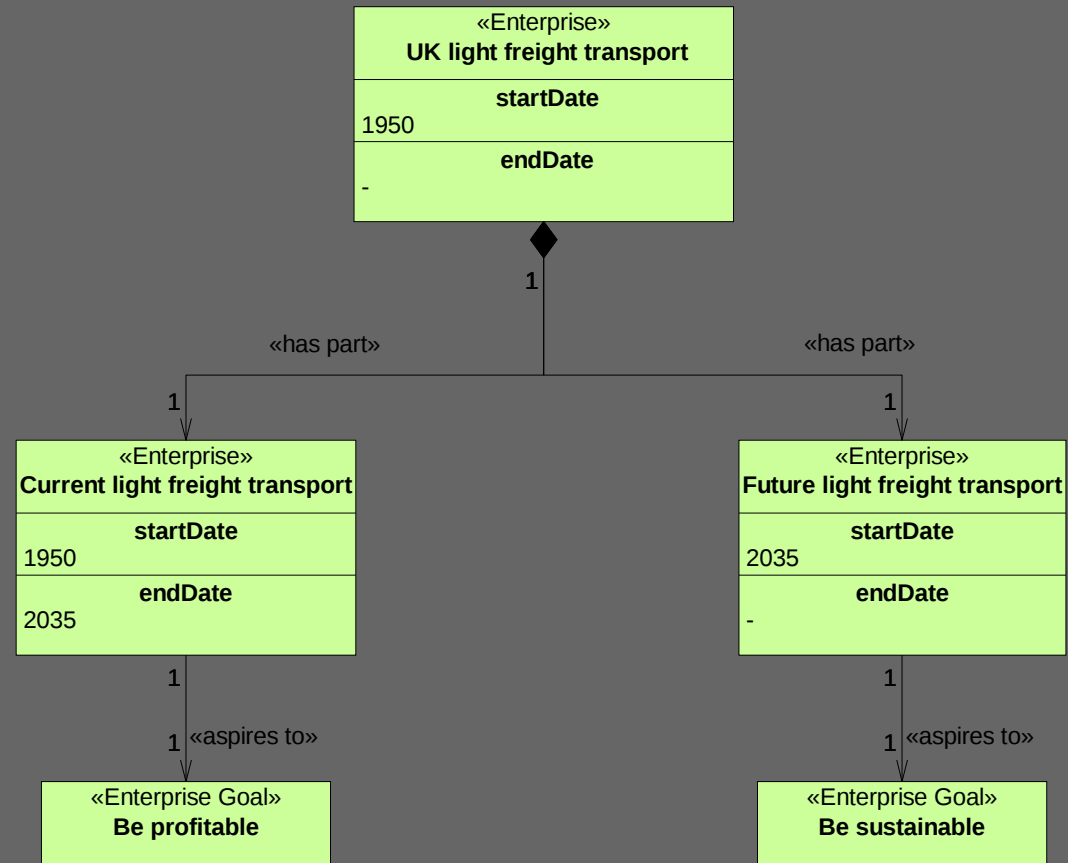
Introduction

- Current Freight Transport
 - Road
 - Rail
- Future Freight Transport
 - Multi modal
 - Trunk Movement

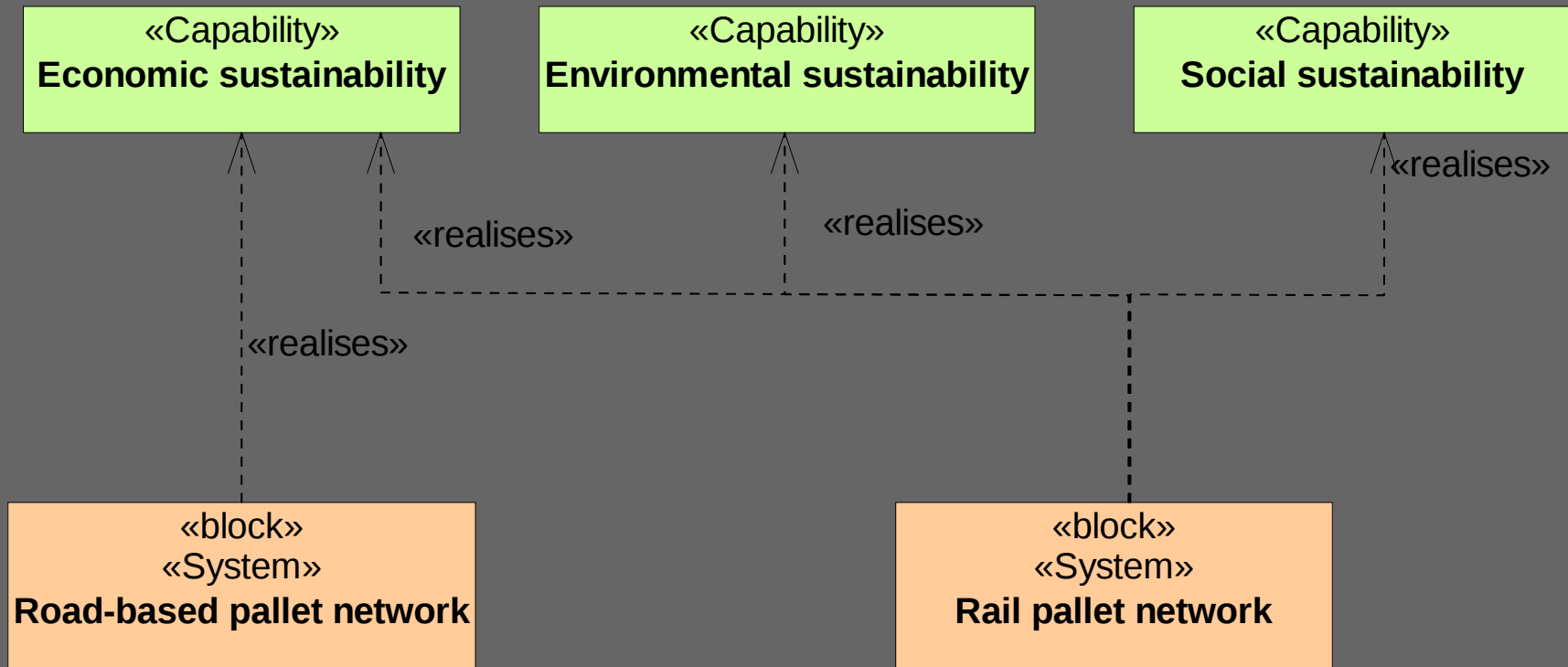
Architecture: the TRAK metamodel



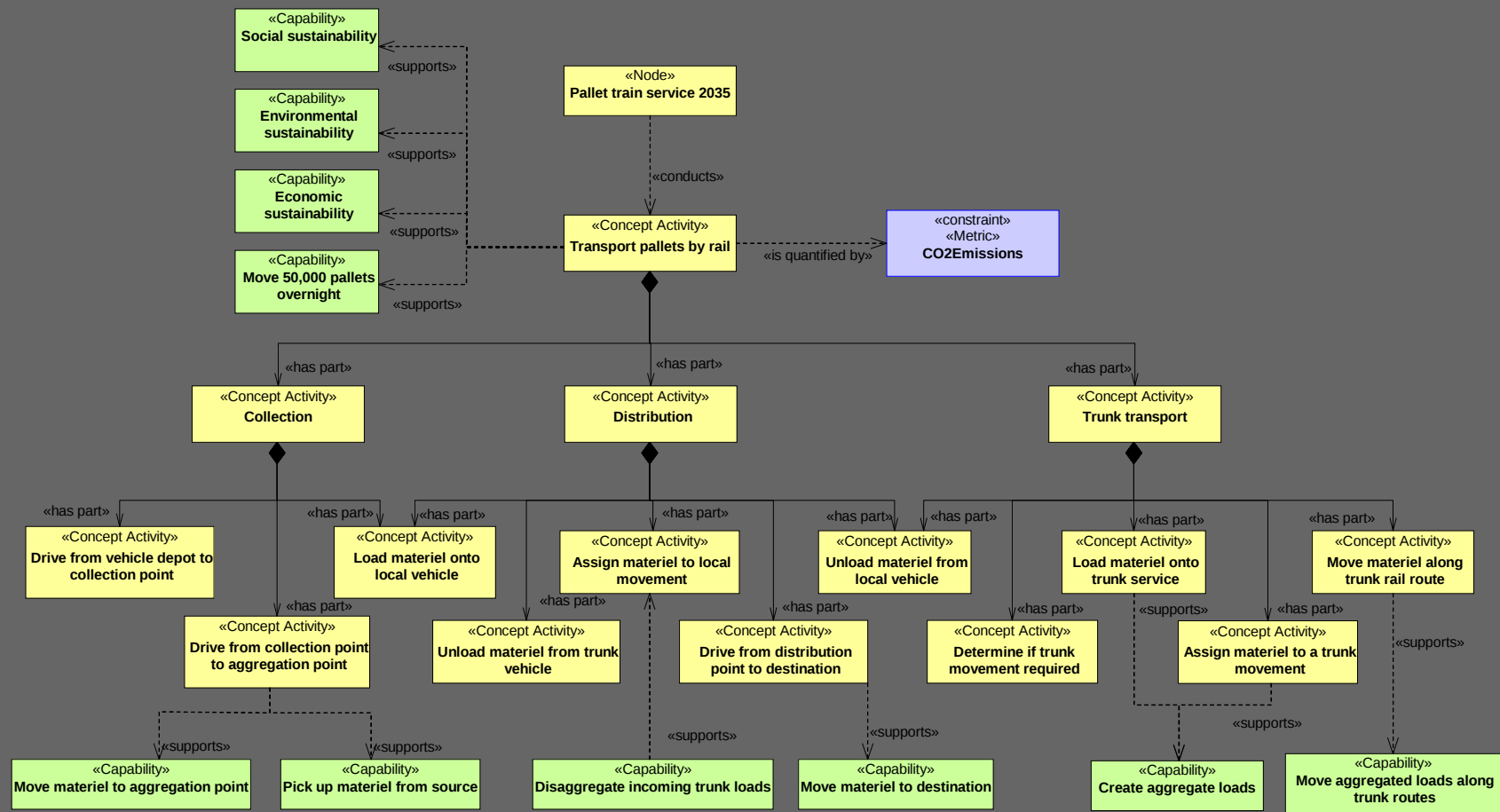
Enterprise



Enterprise Change



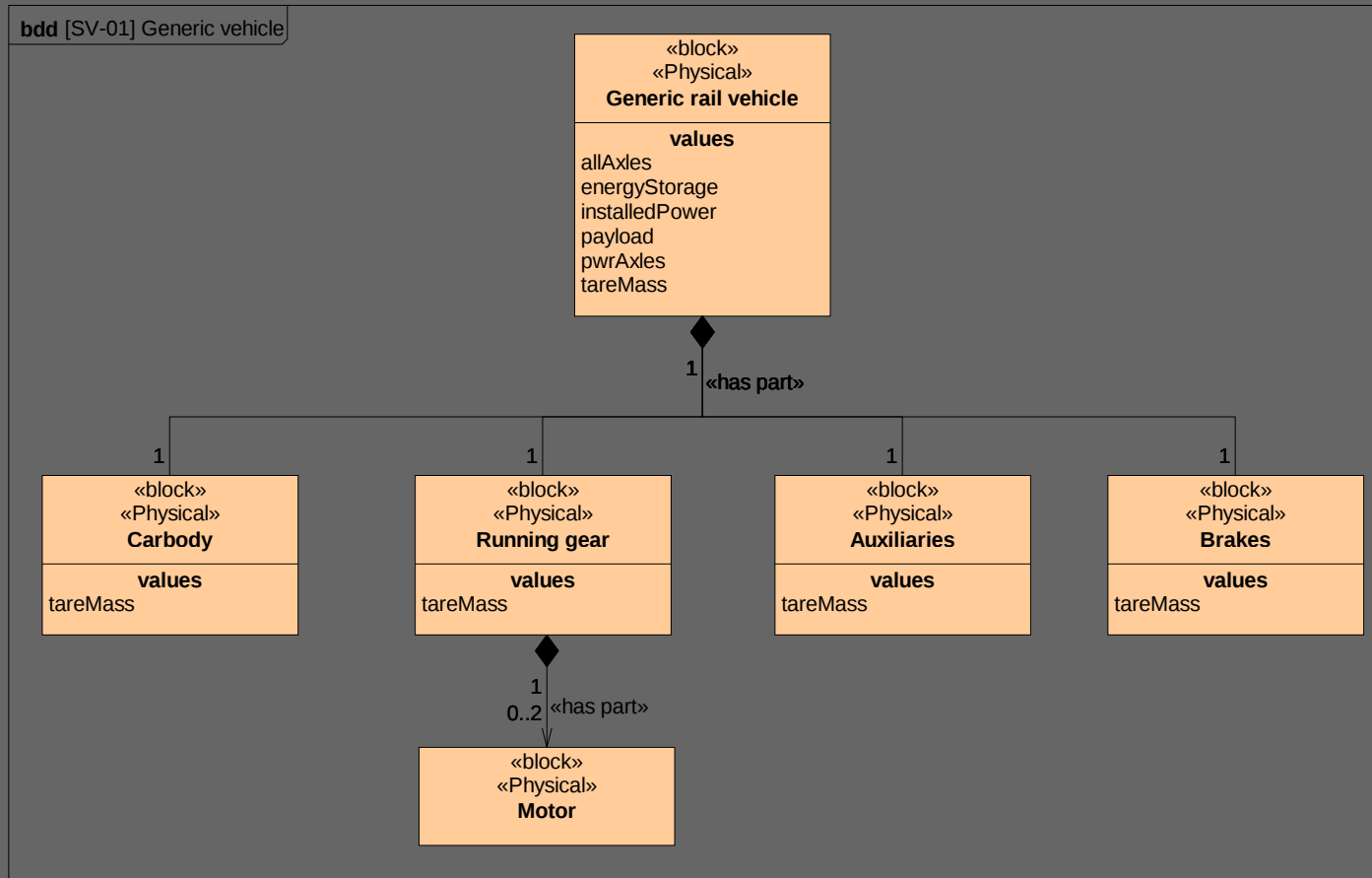
Concept Activity



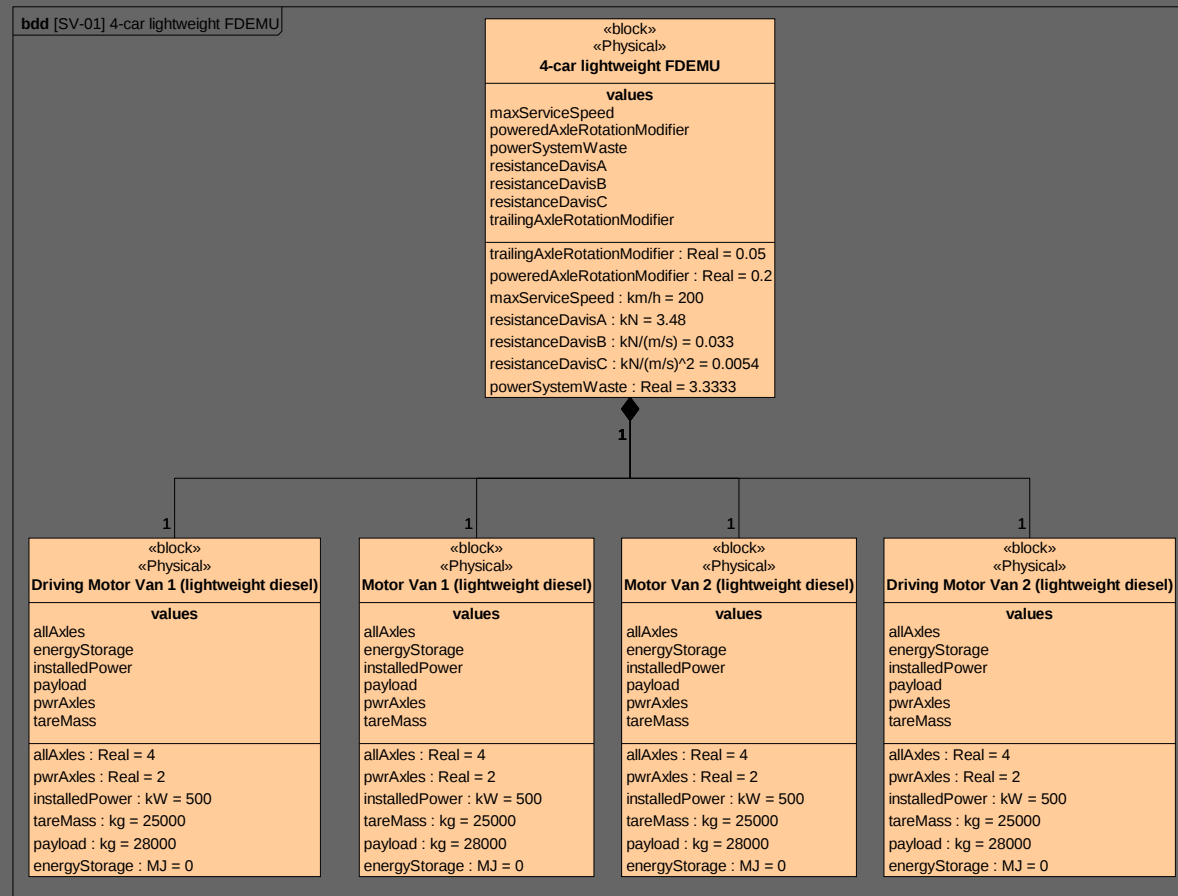
Solution

- Generic vehicles with common attributes
- Candidate solutions
 - Multiple-unit vs locomotive-hauled
 - Independent vs articulated bogies
 - Electric vs diesel
 - Projected changes in tare mass

Generic Vehicle



4-car lightweight FDEMU



Analysis

- Budget and Power
 - High level, Studio to Excel
- Parametric
 - Adds consistency to the repetition of analysis
- MATLAB simulation
 - Integrated with the TRAK model

Budget Report (comparison)

Book1 - Microsoft Excel

File Home Insert Page Layout Formulas Data Review View Developer

Normal Page Layout Page Break Custom Full Gridlines Formula Bar Zoom 100% Zoom In Zoom Out New Window Arrange All Freeze Panels Hide Split View Side by Side Synchronous Scrolling Reset Window Position Save Workspace Windows Switch Workspace Windows Macros

Formula Bar: =CalculateMargin(L4,SA:SA,SB:SB,LL,K4)

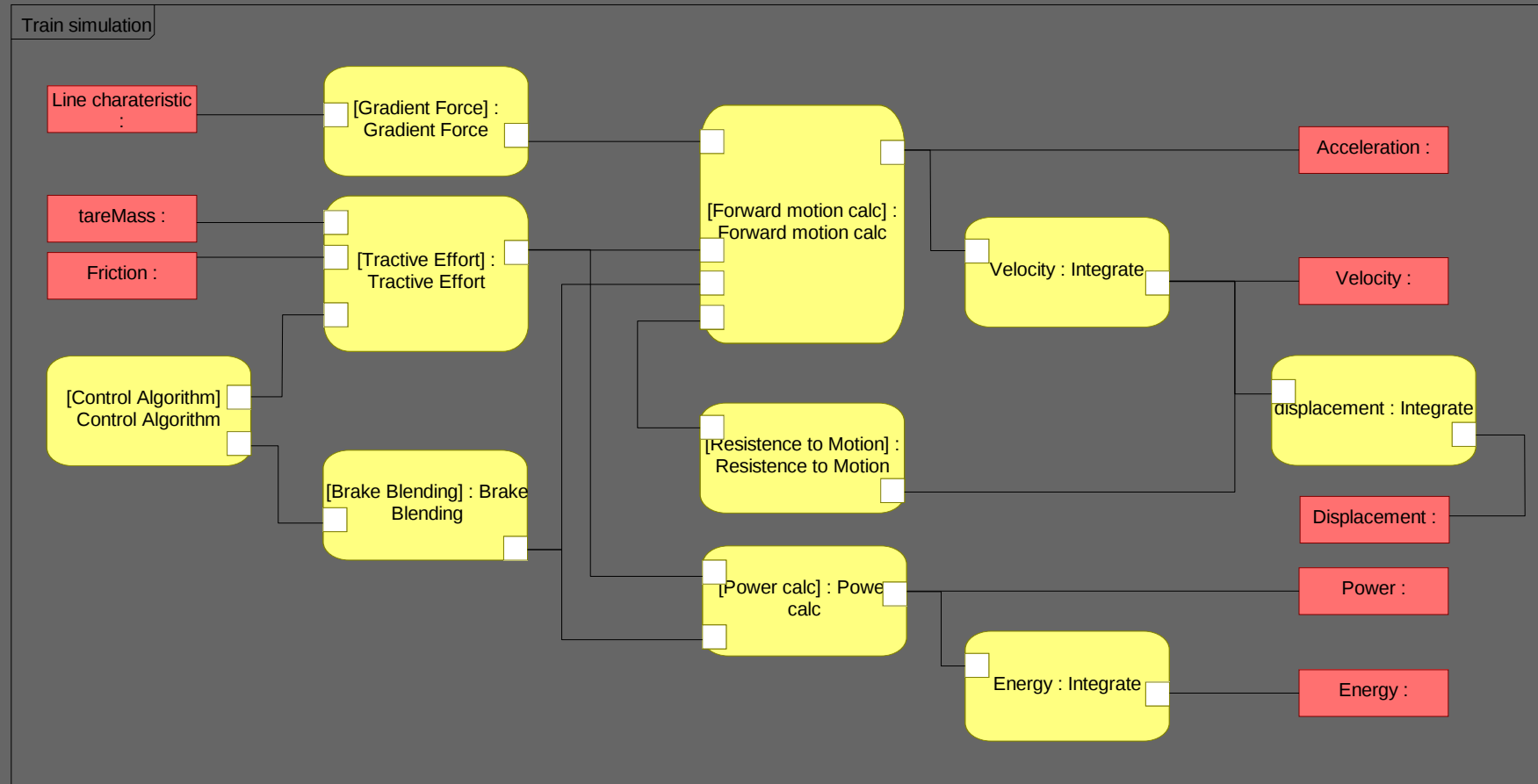
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	Name	Quantity	Ver (in kW)	Duty Cycle (%)	Average Power	Budget	Estimate	No Margin	Margin (%)	With Margin	Budget	Estimate	No Margin	Margin (%)	With Margin	Budget	Q
1	FDEMU Comparison (LFBR:Solution Perspective)	n/a	4000	0.00%	0	4000	0	250000	3.83%	270000	250000						
2	4-car heavy FDEMU (LFBR:Solution Perspective)	1	2000	0.00%	0	2000	0	160000	0.00%	160000	160000						
3	Motor Van 1 (heavy diesel) (LFBR:Solution Perspective)	1	500	100.00%	500	500	40000	40000	0.00%	40000	40000						
4	Motor Van 2 (heavy diesel) (LFBR:Solution Perspective)	1	500	100.00%	500	500	40000	40000	0.00%	40000	40000						
5	Driving Motor Van 2 (heavy diesel) (LFBR:Solution Perspective)	1	500	100.00%	500	500	40000	40000	0.00%	40000	40000						
6	Driving Motor Van 1 (heavy diesel) (LFBR:Solution Perspective)	1	500	100.00%	500	500	40000	40000	0.00%	40000	40000						
7	4-car lightweight FDEMU (LFBR:Solution Perspective)	1	2000	0.00%	0	2000	0	100000	10.00%	110000	120000						
8	Driving Motor Van 2 (lightweight diesel) (LFBR:Solution Perspective)	1	500	100.00%	500	500	25000	25000	10.00%	27500	30000						
9	Motor Van 1 (lightweight diesel) (LFBR:Solution Perspective)	1	500	100.00%	500	500	25000	25000	10.00%	27500	30000						
10	Motor Van 2 (lightweight diesel) (LFBR:Solution Perspective)	1	500	100.00%	500	500	25000	25000	10.00%	27500	30000						
11	Driving Motor Van 1 (lightweight diesel) (LFBR:Solution Perspective)	1	500	100.00%	500	500	25000	25000	10.00%	27500	30000						

Ready

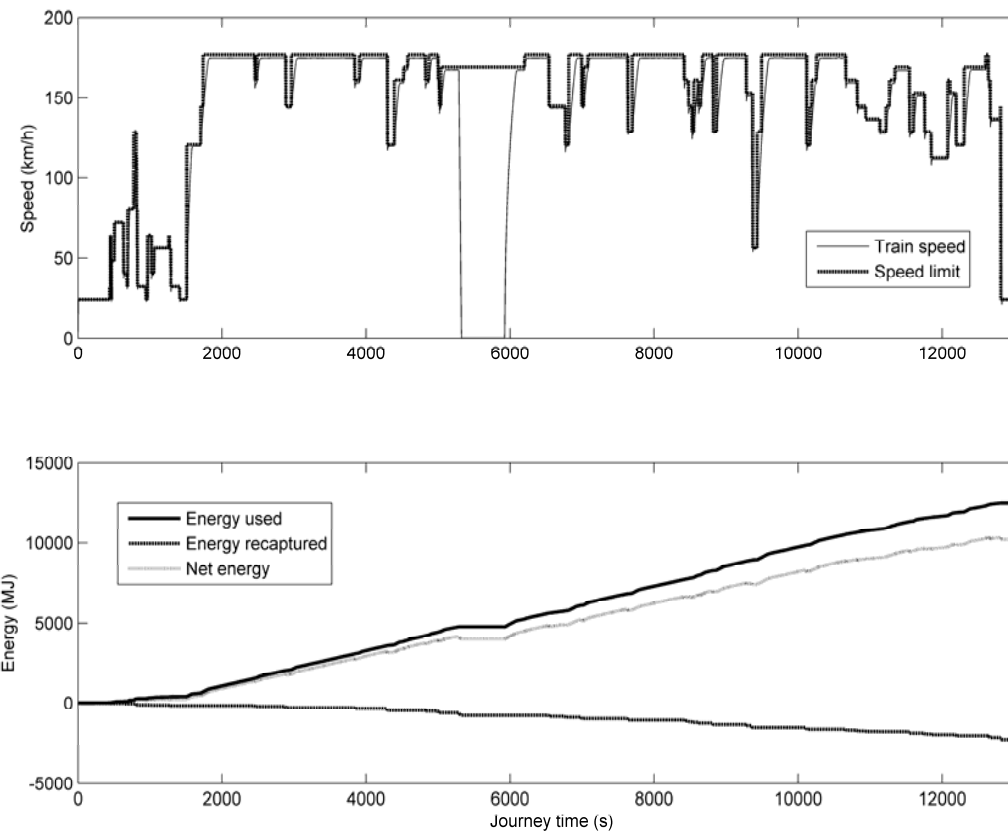
Budget Report (Detail)

Book2 - Microsoft Excel													
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A28													
	Name	Quantity	Estimate	tareMass (in kg)			Budget	Quantity On	Estimate	No Margin	Margin (%)	Power (in KW)	Average Power
				No Margin	Margin (%)	With Margin						With Margin	Duty Cycle (%)
1	4-car container EMU (LFBR::Solution Perspective)	n/a	0	8000	0.00%	8000	8000	0	0	2000	10.00%	2200	0.00%
2	Driving Motor Flat 2 (LFBR::Solution Perspective)	1	0	2000	0.00%	2000	2000	1	1000	1000	10.00%	1100	100.00%
3	Running gear (LFBR::Solution Perspective)	1	900	900	0.00%	900	900	0	0	0	0.00%	0	0.00%
4	Motor (LFBR::Solution Perspective)	2	0	0	0.00%	0	0	0	0	0	0.00%	0	0.00%
5	Auxiliaries (LFBR::Solution Perspective)	1	100	100	0.00%	100	100	0	0	0	0.00%	0	0.00%
6	Brakes (LFBR::Solution Perspective)	1	100	100	0.00%	100	100	0	0	0	0.00%	0	0.00%
7	Carbody (LFBR::Solution Perspective)	1	900	900	0.00%	900	900	0	0	0	0.00%	0	0.00%
8	Pantograph Trailer Flat (LFBR::Solution Perspective)	1	0	2000	0.00%	2000	2000	0	0	0	0.00%	0	0.00%
9	Running gear (LFBR::Solution Perspective)	1	900	900	0.00%	900	900	0	0	0	0.00%	0	0.00%
10	Motor (LFBR::Solution Perspective)	2	0	0	0.00%	0	0	0	0	0	0.00%	0	0.00%
11	Auxiliaries (LFBR::Solution Perspective)	1	100	100	0.00%	100	100	0	0	0	0.00%	0	0.00%
12	Brakes (LFBR::Solution Perspective)	1	100	100	0.00%	100	100	0	0	0	0.00%	0	0.00%
13	Carbody (LFBR::Solution Perspective)	1	900	900	0.00%	900	900	0	0	0	0.00%	0	0.00%
14	Trailer Flat (LFBR::Solution Perspective)	1	0	2000	0.00%	2000	2000	0	0	0	0.00%	0	0.00%
15	Running gear (LFBR::Solution Perspective)	1	900	900	0.00%	900	900	0	0	0	0.00%	0	0.00%
16	Motor (LFBR::Solution Perspective)	2	0	0	0.00%	0	0	0	0	0	0.00%	0	0.00%
17	Auxiliaries (LFBR::Solution Perspective)	1	100	100	0.00%	100	100	0	0	0	0.00%	0	0.00%
18	Brakes (LFBR::Solution Perspective)	1	100	100	0.00%	100	100	0	0	0	0.00%	0	0.00%
19	Carbody (LFBR::Solution Perspective)	1	900	900	0.00%	900	900	0	0	0	0.00%	0	0.00%
20	Driving Motor Flat 1 (LFBR::Solution Perspective)	1	0	2000	0.00%	2000	2000	1	1000	1000	10.00%	1100	100.00%
21	Running gear (LFBR::Solution Perspective)	1	900	900	0.00%	900	900	0	0	0	0.00%	0	0.00%
22	Motor (LFBR::Solution Perspective)	2	0	0	0.00%	0	0	0	0	0	0.00%	0	0.00%
23	Auxiliaries (LFBR::Solution Perspective)	1	100	100	0.00%	100	100	0	0	0	0.00%	0	0.00%
24	Brakes (LFBR::Solution Perspective)	1	100	100	0.00%	100	100	0	0	0	0.00%	0	0.00%
25	Carbody (LFBR::Solution Perspective)	1	900	900	0.00%	900	900	0	0	0	0.00%	0	0.00%
26													
27													
28													
29													
30													
31													
32													
33													
34													

Parametric Diagram



Matlab Results



Conclusion

- Modelling exercise showed CO₂ emission reductions
 - Based on modal shift
 - Much greater improvement if UK energy mix moved from fossil fuels
- Demonstrating integration of TRAK and analysis tools.
- Benefits of MBSE – allowing simulation of changes to architecture and parameters