C4R
Capacity for Rail

Rail-Road, Rail-Sea, Marshalling Yards: Enhancement of Interfaces

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SEVENTH FRAMEWORK PROGRAMME

Team

C4R
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Introduction and scopes: answers

Contributions of terminals to future rail freight systems 2030 and 2050

1. Features and role of typical terminals and yards = ***What the terminals should do***
2. Key Performance Indicators (KPI) = ***How the terminals performances can be measured***
3. Case studies = ***How the terminals are working today***
4. Innovations = ***What the terminals can take onboard and integrate***
5. Effects of innovations = ***How the terminals could work***
6. Economical and financial feasibility = ***To what extent the terminals will be economically and financially sustainable***

Features and role: standards

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Equipment	Common standard 2010	Incremental change 2030 *	System change 2050 *
Infrastructure			
Rail Freight Corridors Signalling systems Standard rail weight Speed ordinary freight Speed fast freight	18.000km Different UIC 60 kg/m 100 km/h 100 km/h	25.000km ERTMS L2 in RFC 70 kg/m 100 -120 km/h 120 -160 km/h	50.000km ERTMS L3 in RFC 70 kg/m 120 km/h 120 -160 km/h
Traffic system			
SWL	Marshalling - feeder	Marshalling – feeder Some liner trains	Automatic marshalling Liner trains – duo -loco
Train load		Remote controlled	All remote controlled
Inter Modal	Endpoint -trains	Endpoint -trains Liner trains with stops at siding	Endpoint -trains Liner trains fully automated loading
High Speed Freight	National post trains	International post and parcel -trains	International post and parcel -train network
IT /monitoring systems			
	Some different	Standardized control system	Full control of all trains and consignments
Wagons			
Running gears Brakes Brake control Couples Max Speed Max Axle load Floor height lowest IT-system	Different Casted-brakes Pneumatic Screw couples 100 km/h 22,5 tonnes 1100 mm Way-side	50% Track-friendly LL-brakes Radio controlled EOT Automatic couplers on some trains 120 km/h 22,5-25 tonnes 1000 mm Some in wagons	All track friendly Disc-brakes Fully Electronic Automatic couples on all trains 120-160 km/h 22,5-30 tonnes 800 mm All radio controlled
Locomotives			
Tractive effort kN Axle load Propulsion Fuel Engineers	300 20 tonne Electric Diesel Always drivers	350 22,5 tonne Some duo-locos LNG/Diesel Some driverless	400 25 tonne Most duo-locos LNG/electric All driverless
Trains			
Train lengths in RFC Train weight	550-850 m 2 200 tonnes	750-1000 m 4 400 tonnes	1000-2000 m 10 000 tonnes

Features and role: typical terminals

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Rail-Road: interchange interchange

DB DUSS Riem – Munich (Germany)

IFB Zomerweg – Antwerpen (Belgium)

NV Combinant – Antwerpen (Belgium)

HUPAC HTA – Antwerpen (Belgium)

Typical small scale automatic linear terminal

DB DUSS Duisburg (Germany)

Rail-Rail: marshalling yard

Hallsberg (Sweden)

Rail-Sea: port rail terminal

Valencia Principe Felipe (Spain)

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KPI: selection criteria

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Capability to display the present performances

- Meeting requests of operators
- Effectiveness to describe terminal operation performances

Sensibility to potential changes introduced by innovations

- Capability to assess effects of new technologies
- Capability to assess effects of innovative operational measures
- Homogenization with forecasting methods and models

Large scale identification

- Rail-Road: 13; Rail-Rail: 15; Rail-Sea: 14

Fine tuning

- Most effective from operation performances viewpoint
- Most reliable method (algorithms and/or simulation) for KPI calculation
- Rail-Road: 4/13; Rail-Rail: 4/15; Rail-Sea: 4/14

Case studies: Riem today

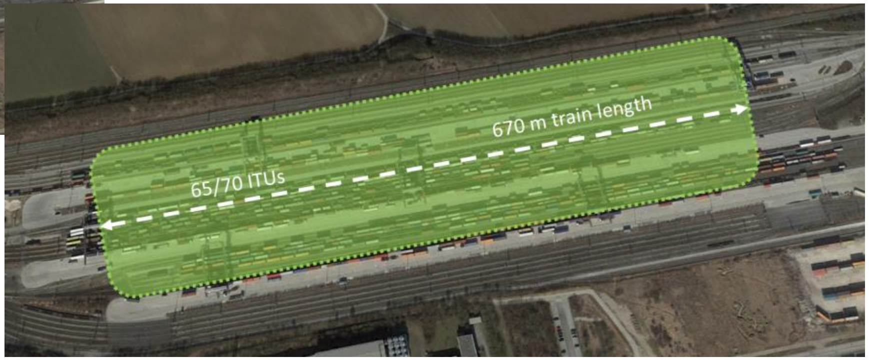
DB DUSS Riem Terminal – Munich (Germany)

5 arrivals tracks in the holding area
3 operative modules
14 loading/unloading tracks
6 trucks lanes
8 storage lanes
6 RMG cranes

24 trains/day

Case studies: Riem tomorrow

Mean number of containers: 65 (10.36 m per ITU)
Long Train: 670 m
H24 working time
Direct access of train in operative area
Automatic coupling/uncoupling loco
Multi lift spreader handling
ITU and vehicles automatic control and data exchange



Case studies: Hallsberg today

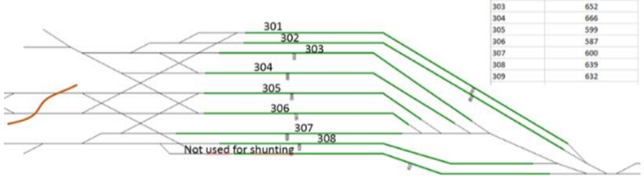
Hallsberg marshalling yard (Sweden)

Arrival sidings: 8 tracks (590÷690 m)
Double Hump
Direction sidings: 32 tracks (374÷760 m)
Departure sidings: 12 tracks (562÷886 m)
Capacity: 1370 wagons/day

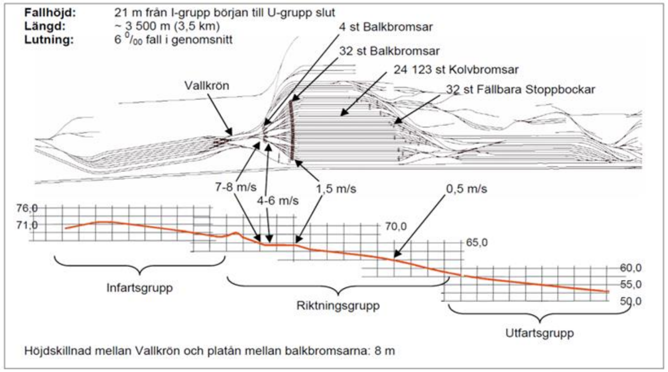
836 wagons/day

Technical Specifications	
Shunted volume (2002)	305 000 wagons/year
The capacity of the marshalling yard per year	500 000 wagons/year
Available shunting capacity over the hump (theoretical maximum value)	2 900 wagonmeters/hour
Humping Speed	Max. 1.2 meter/second
Wagongroup length	9-125 meters
Number of axles per group of wagons	Max. 20 axles
Axle Load	4.5 - 22.5 tonnes
Wheel Load	2 - 12.25 tonnes/meter
Highest allowed weight per meter (Stvm)	6.4 tonnes/meter
Max weight over hump	450 tonnes
Total Lenth of the Yard (arrival, direction and departure tracks	3.5 kilometers
Slope- Gradient ration of the yard	Average 6 meters/km. 21 meters in total, i.e. 6 ‰
Meters of track (total)	60 km
Number of point switches	170
Number of piston brakes	24 123
Number of beam rail brakes, double sides. (located at the entrance to the direction sidings)	32
Number of beam rail brakes, one side. (direction beam rail brakes).	32
Number of buffer stops	32

Hallsberg – Arrival group



Track No	Lenght of track (meter)
301	683
302	688
303	652
304	666
305	599
306	587
307	600
308	639
309	632



Innovations: Hallsberg tomorrow

Capacity for Rail

Tracks operative length till 1500 m
MMM (Multi Modal Marshalling) Yard: classification tracks accessible not only via hump
Automatic wagon identification
Automatic coupling and uncoupling
Automatic brakes on wagons
Self-propelled wagons
Duo propulsion and driverless locomotives
Working time 24 hours

Case studies: Valencia Principe Felipe today

Valencia Principe Felipe port rail terminal (Spain)

Total area: 50,000 m2

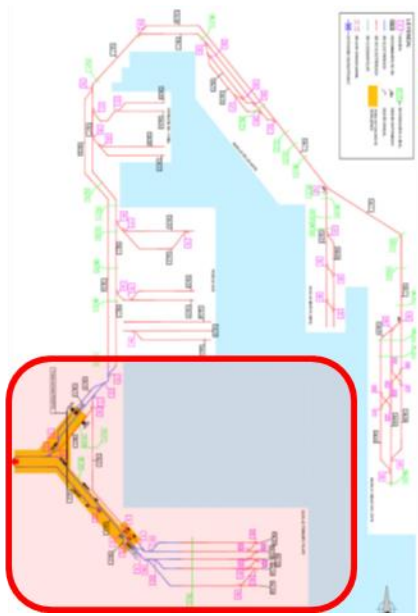
4 loading/unloading tracks

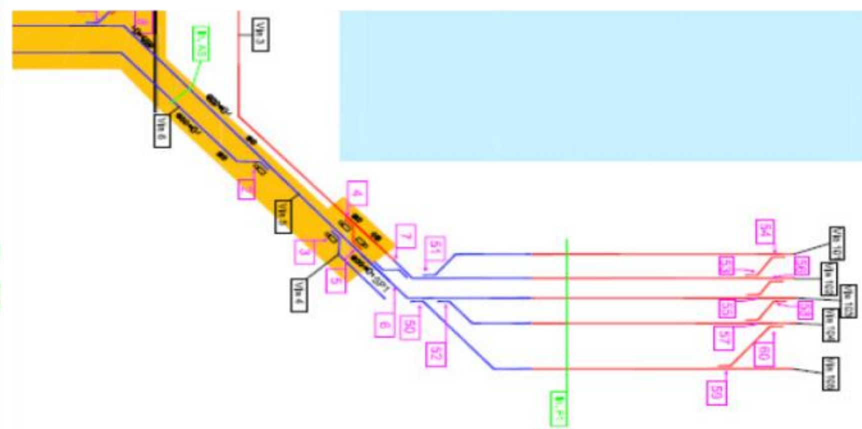
Extra track to shunt locomotives

Electrified tracks until approaching loading/unloading area

Two road access

Two storage areas (9,000 + 20,000 m^2)





Case studies: Valencia Principe Felipe tomorrow

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Long Train: 850 m / 1000 m
H24 working time
Automatic coupling and uncoupling loco
Number of containers: 80/100 (10.36 m per ITU)
Multi lift spreader handling
ITU and vehicles automatic control and data exchange

Effects of innovations: evaluation

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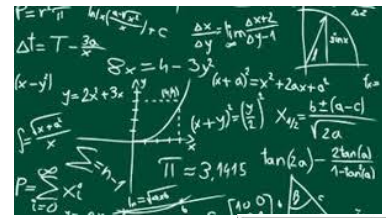
Requirement: capability to reproduce terminals' operation

Analytical methods based on combined algorithms (e.g. queuing theory)

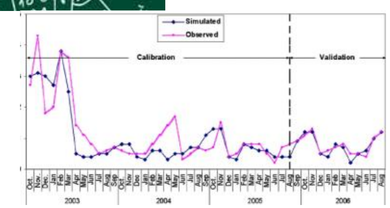
Simulation models based on event-based processes reproduction



Calibration on typical terminals

Subset of data describing the typical operation

Cross analysis of typical/calculated /simulated KPI



Tests for validation on case studies

More extended set of data describing the present operation

Cross analysis of real world/calculated /simulated KPI

Extended application to selected scenarios for case studies

Effects of innovations: analytical methods and simulation models

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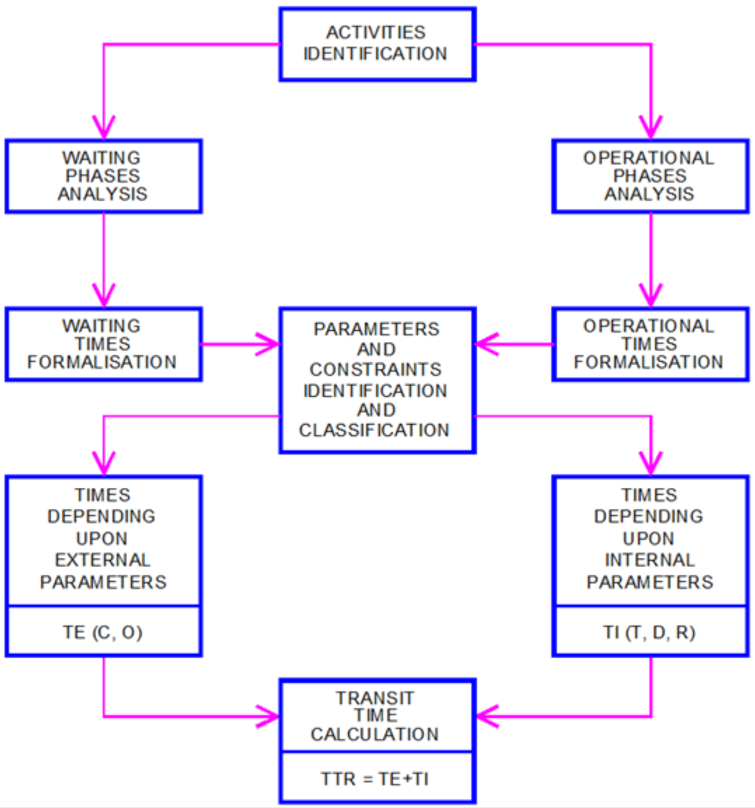
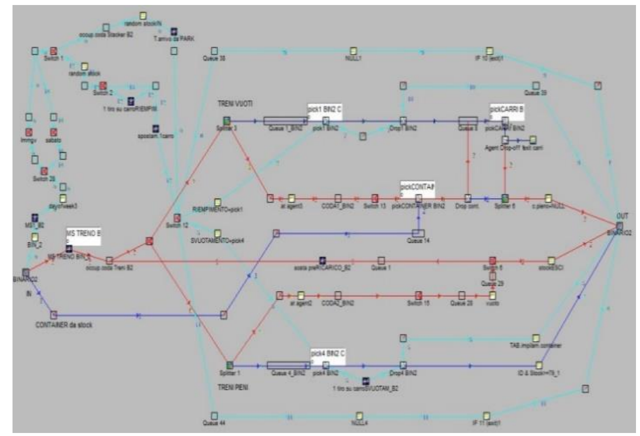
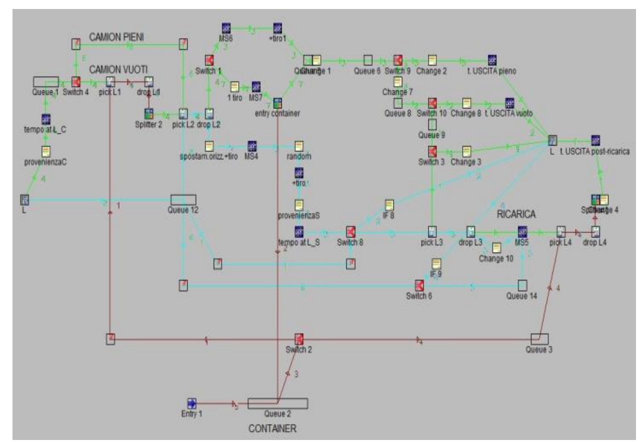
Examples of calculation flows



Examples of hierarchical layers

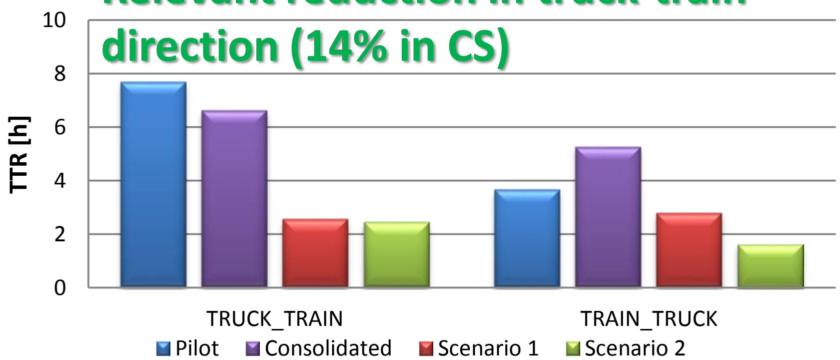




Effects of innovations: Riem

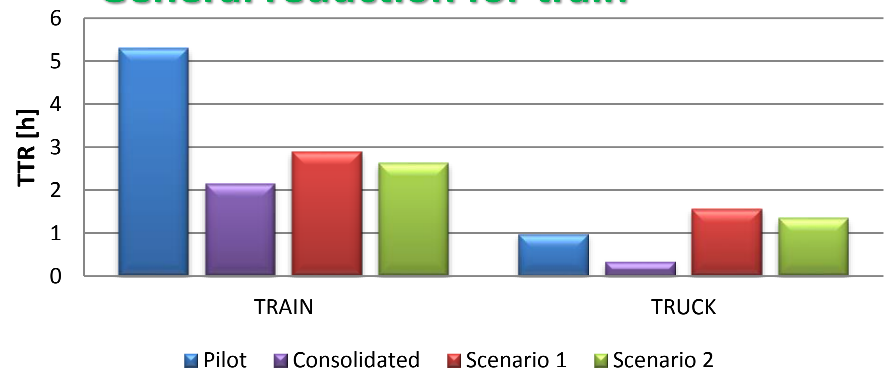
ITUs total transit time

Relevant reduction in truck-train direction (14% in CS)



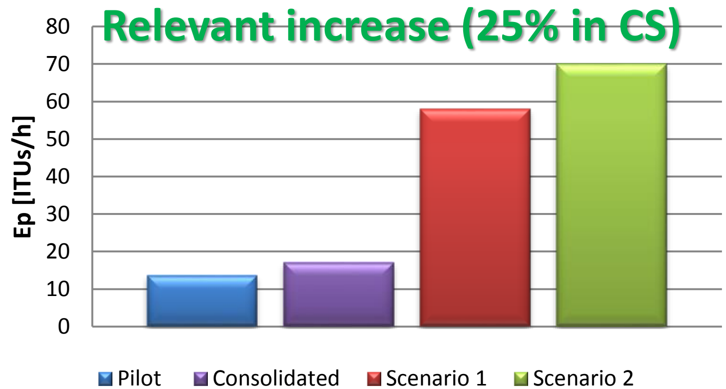
Vehicles total transit time

General reduction for train



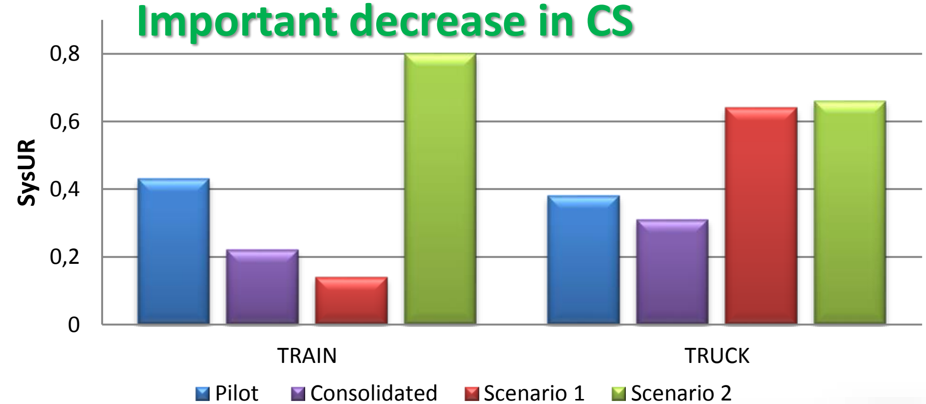
Equipment performance

Relevant increase (25% in CS)



Vehicles utilisation rate

Important decrease in CS

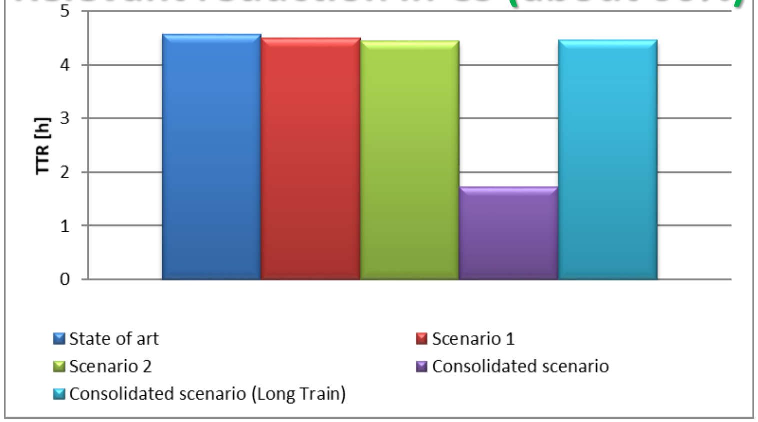


Effects of innovation: Hallsberg

Capacity for Rail

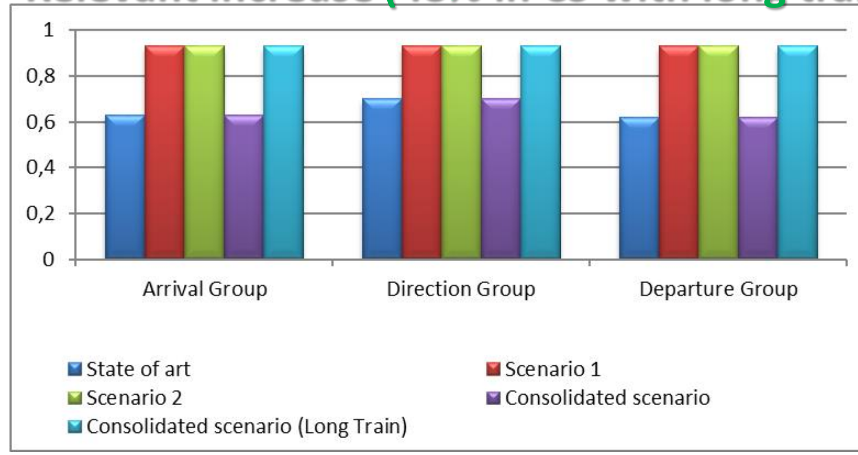
Average wagon transit time

Relevant reduction in CS (about 60%)



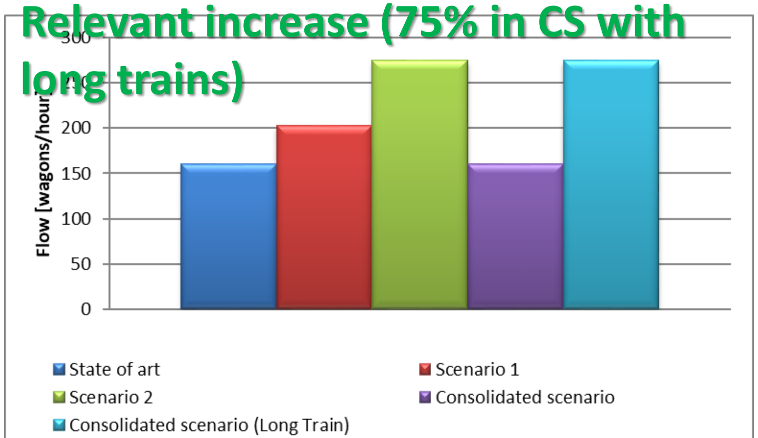
Tracks utilization rate

Relevant increase (48% in CS with long trains)



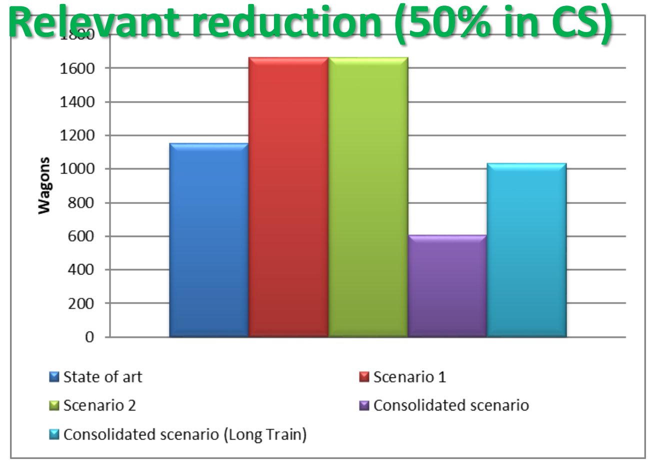
Maximum flow through the yard

Relevant increase (75% in CS with long trains)



Average number of wagons in the yard

Relevant reduction (50% in CS)



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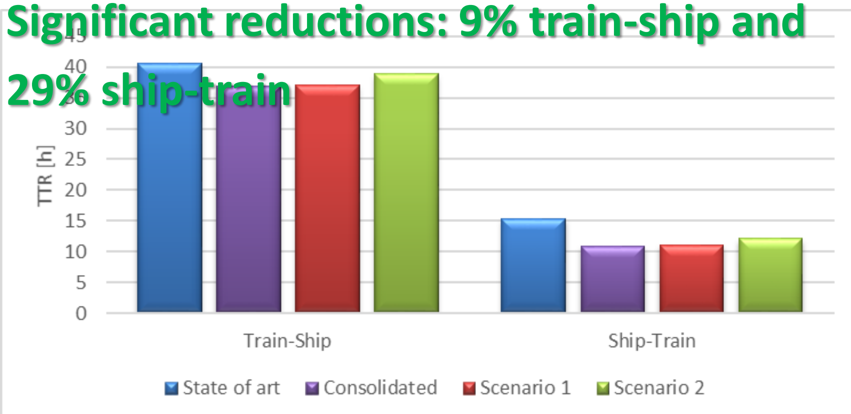
Effects of innovation: Valencia

Capacity for Rail

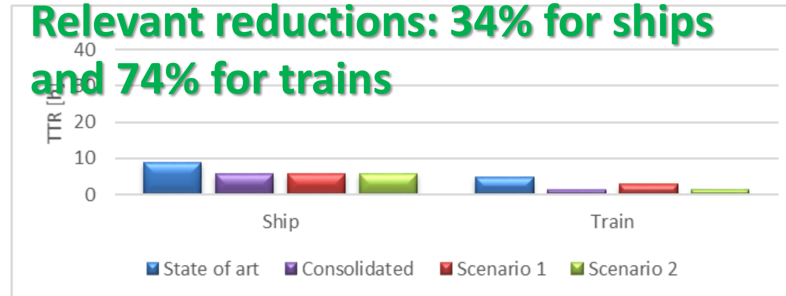
ITUs total transit time

Significant reductions: 9% train-ship and 29% ship-train



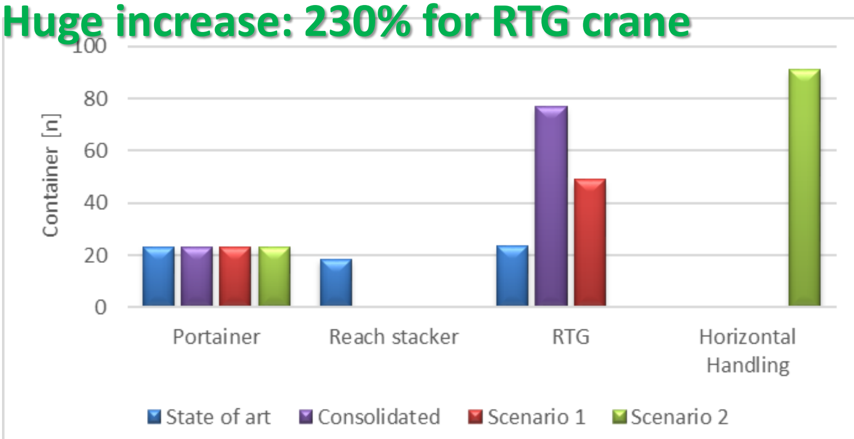
Vehicles total transit time

Relevant reductions: 34% for ships and 74% for trains



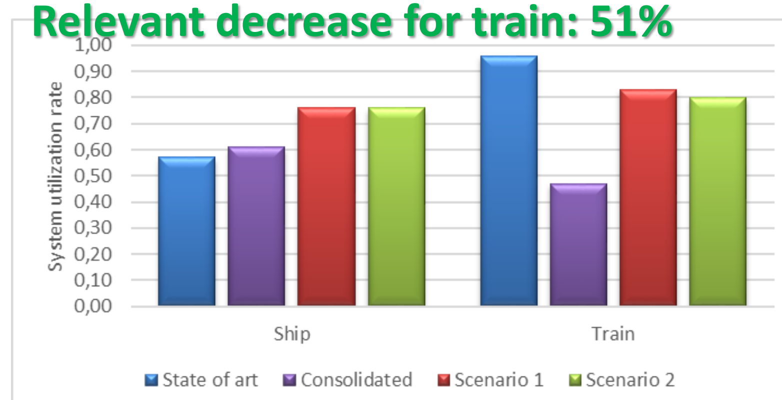
Equipment performance

Huge increase: 230% for RTG crane

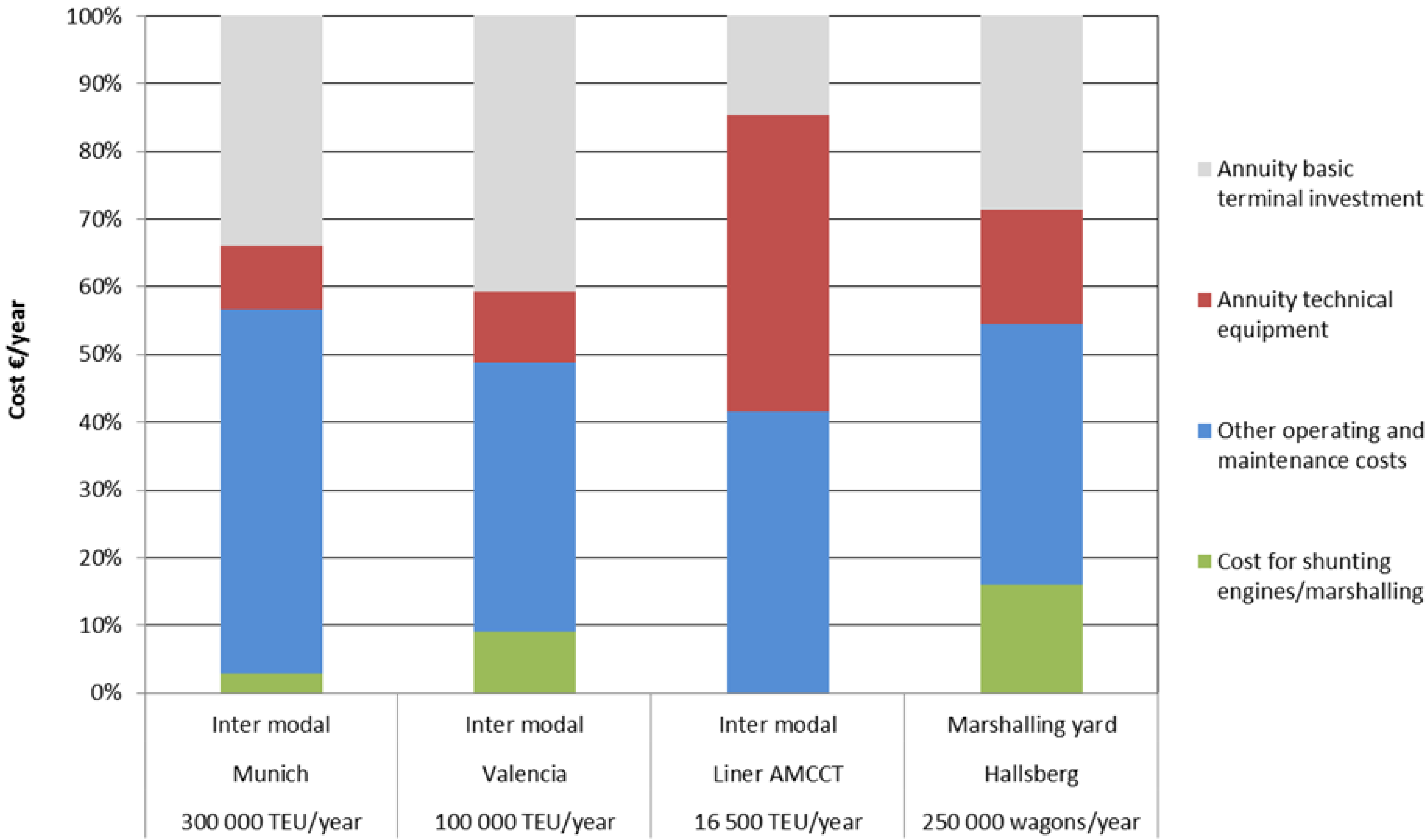


Vehicles utilization rate

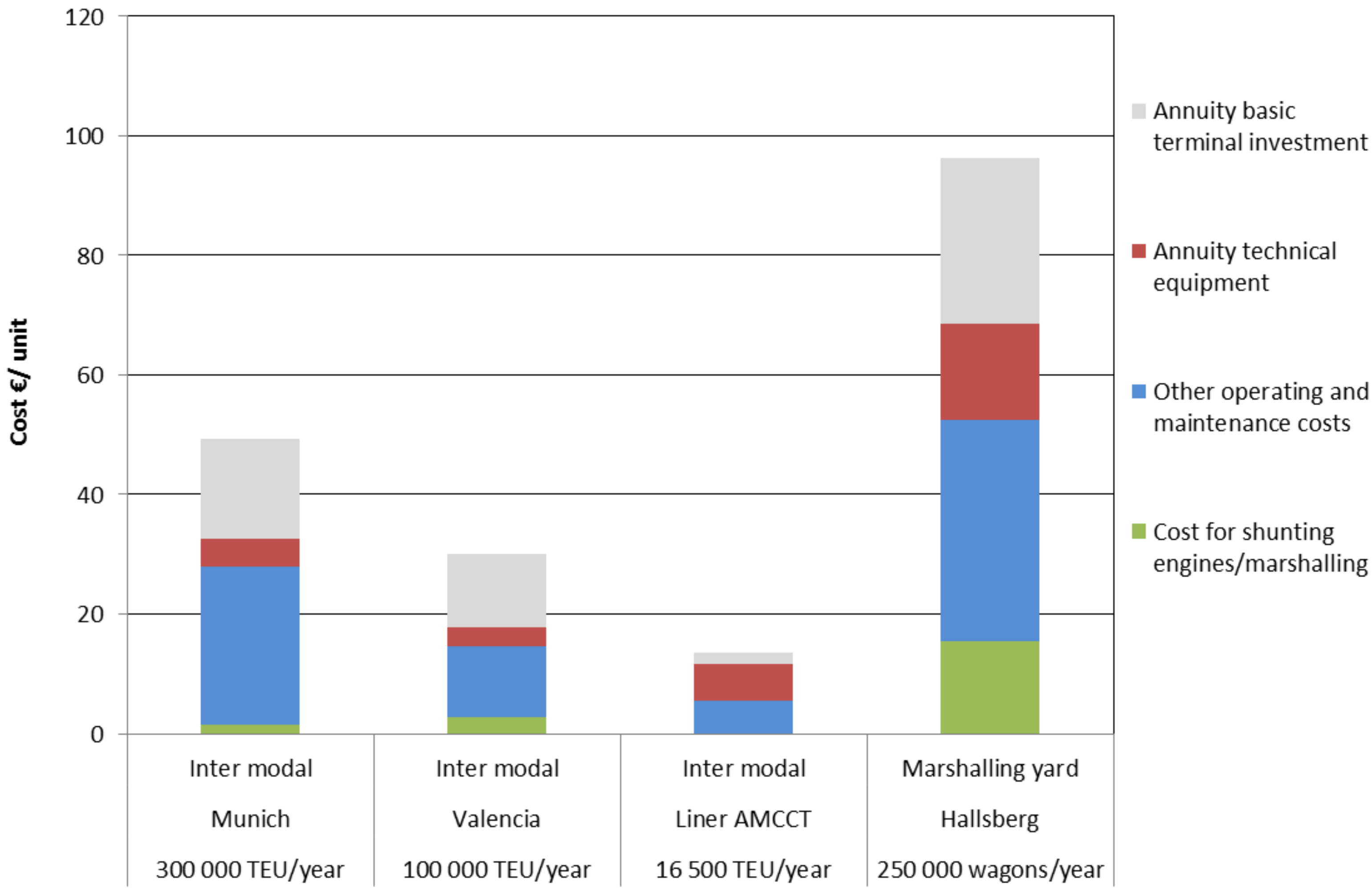
Relevant decrease for train: 51%



Feasibility: total costs %



Feasibility: unit costs



Feasibility: Net Present Value

Riem

Net Present Value [Billion €]									
	Consolidated Scenario			Scenario 1			Scenario 2		
Rate of Return	BAU	Low	High	BAU	Low	High	BAU	Low	High
2%	139	189	267	348	429	578	418	501	652
3%	117	158	222	288	354	475	354	422	545
5%	85	113	156	198	242	324	259	305	387

Hallsberg

Net Present Value *[Billion €]*									
	Consolidated Scenario			Scenario 1			Scenario 2		
Rate of Return	BAU	Low	High	BAU	Low	High	BAU	Low	High
2%	-133	-117	-104	-204	-203	-202	-176	-174	-173
3%	-115	-102	-91	-179	-178	-177	-155	-154	-152
5 %	-88	-79	-71	-141	-140	-140	-123	-122	-121

Valencia

Net Present Value *[Billion €]*									
	Consolidated Scenario			Scenario 1			Scenario 2		
Rate of Return	BAU	Low	High	BAU	Low	High	BAU	Low	High
2%	360	410	501	464	527	642	467	529	644
3%	305	346	420	394	445	538	396	447	540
5 %	224	251	301	288	322	384	290	326	387

Feasibility: confirmed subjects

CONFIRMED

C4R Capacity for Rail

Objectives

a) Definition of terminals typologies capable to cover large majority of rail freight traffic
b) Identification of KPIs capable to represent operational modes of terminals and to be sensitive to effects of innovations
c) Focused and enlarged case studies to comply with all typologies
d) Identification of innovations suitable to be included in consolidated scenarios for each terminal typology and case study
e) Identification of innovations suitable to increase global efficiency of logistic chains
f) Assessment of future terminals including effects of innovative technologies and operational measures
g) Calculation of operational and capital costs of newly designed terminals
h) Consolidation of a suitable methodology for future traffic estimation

Quantitative results

1) Achievable operational standards of intermodal and wagonload terminals;
2) Financial business case of future terminals
3) Economic results from societal viewpoint useful to select future European actions in freight transport and rail systems fields

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Thank you for your kind attention

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