



# Ro-Ro Terminal Simulation

13.11.2020

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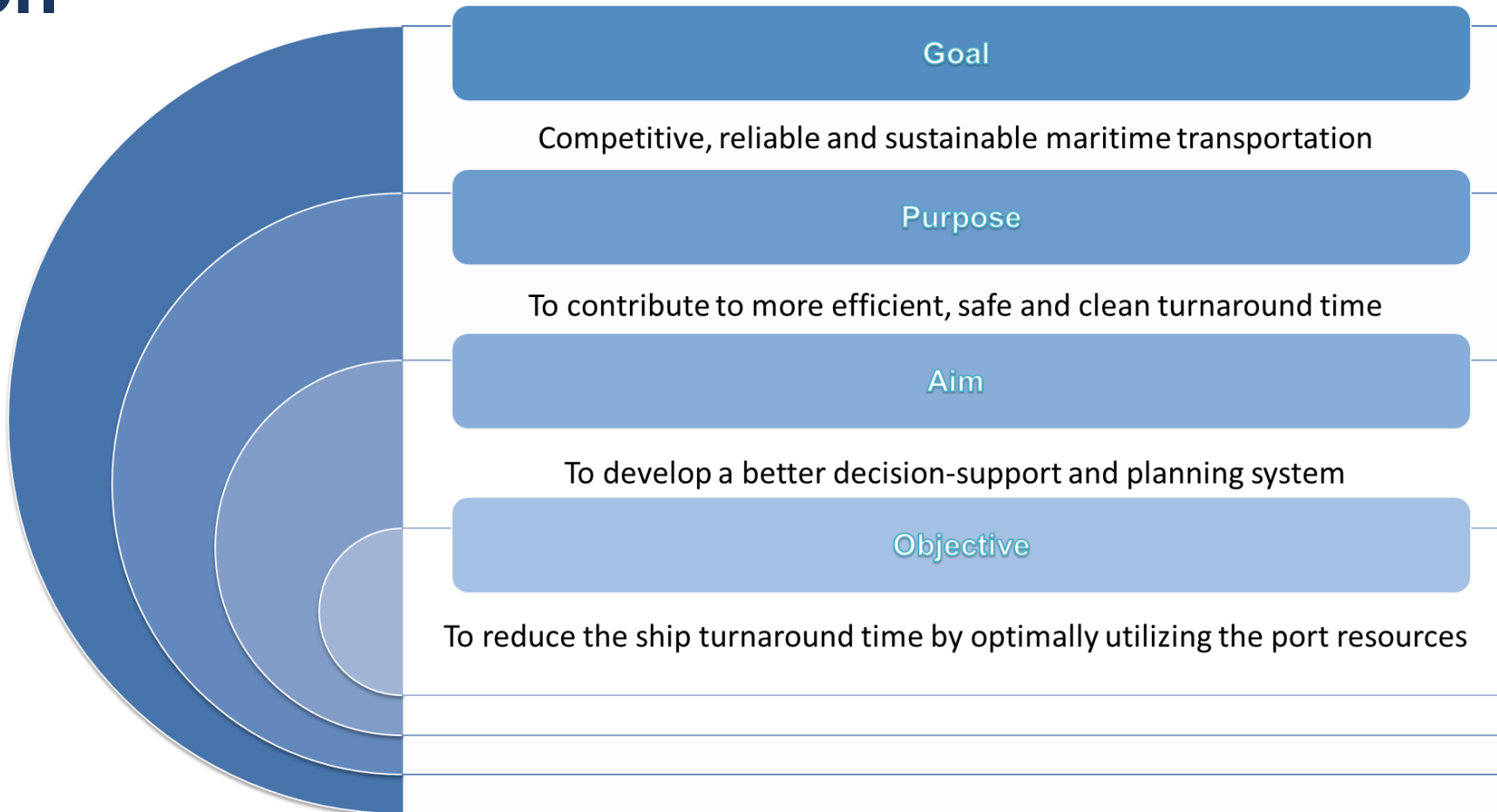
# Motivation

- **Air Pollution**



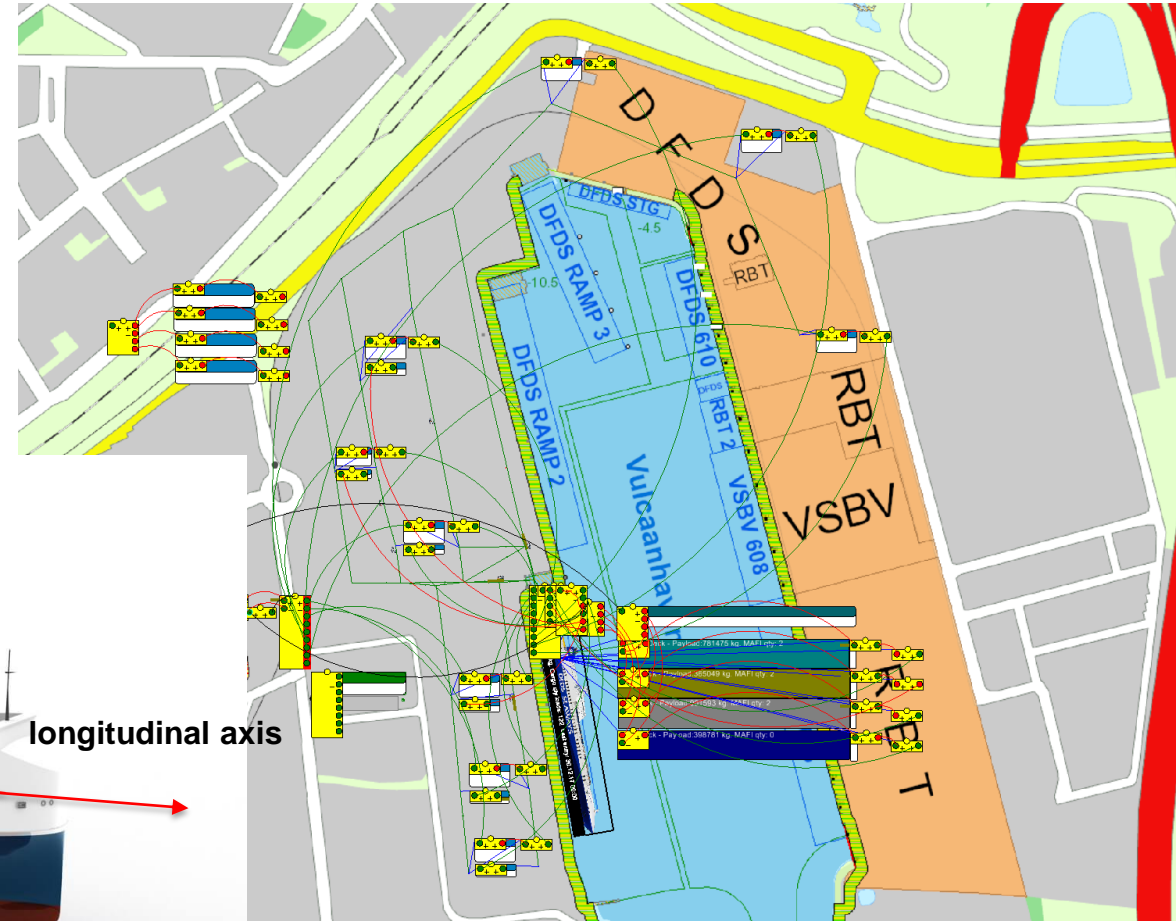
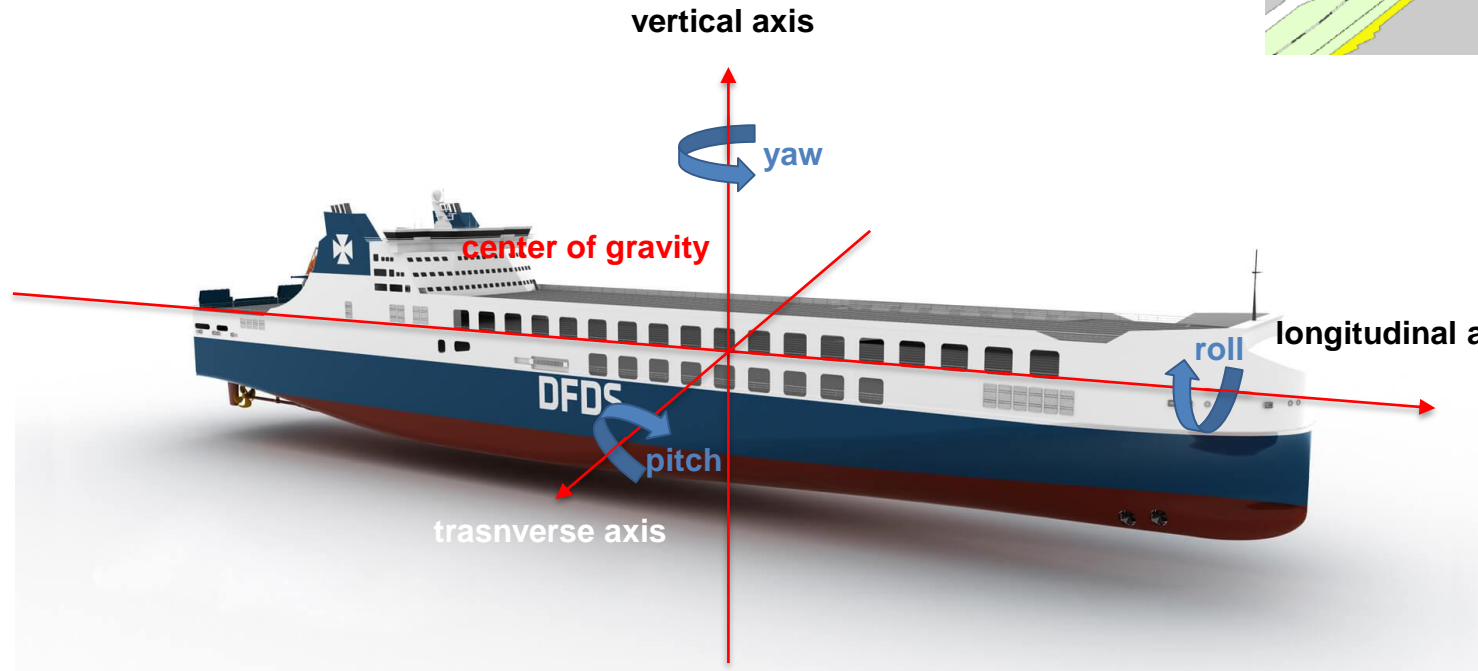
- 70% of emission, related to shipping activity, occurs within 400 km from coastline;
- port-related emission accounted for 18 million tonnes of CO<sub>2</sub> in 2011, and this amount is expected to quadruple by 2050 (International Transport Forum, 2014);
- cargo handling equipment accounts for 23% of NO<sub>x</sub> and 24% of PM<sub>10</sub> emissions (Kura, Dunn et al. 2014).

# Motivation



# Method

- Discrete-Event Simulation



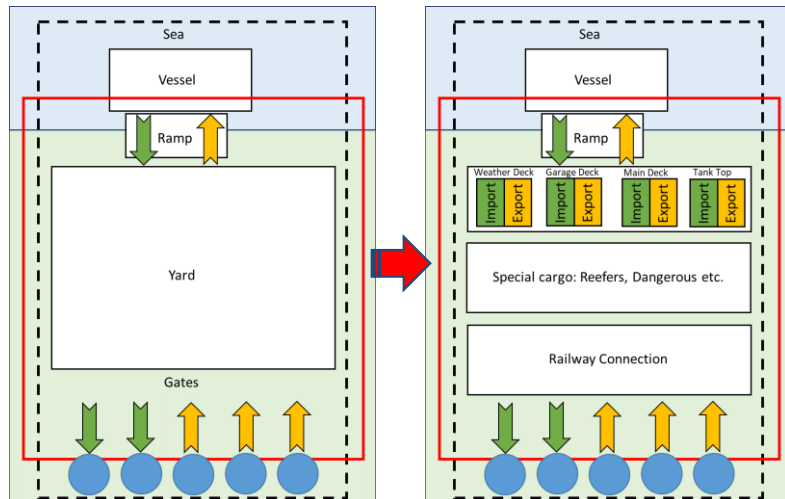
# Potential solutions



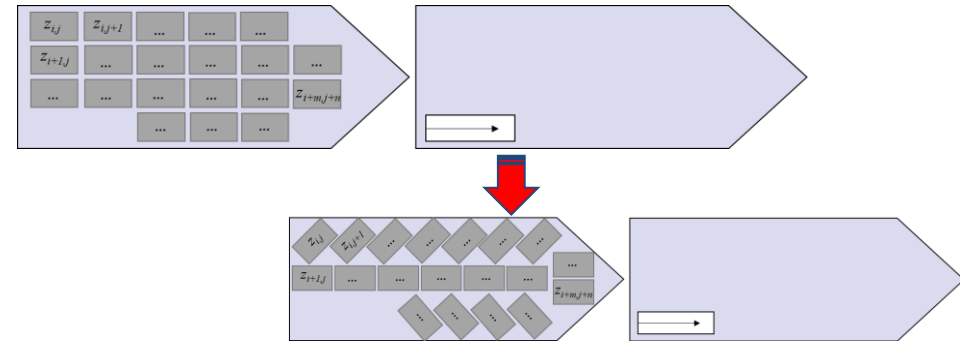
- More efficient utilization of resources



- Operation strategy



- Terminal Design



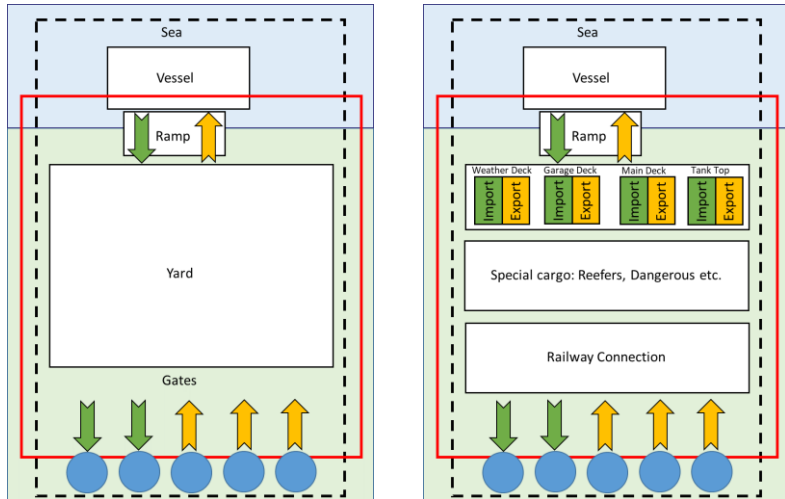
- Vessel Design



# More efficient utilization of resources

Number of TT	Time worked, hrs	Export loaded, units	Idle time, hrs	Empty runs, km	Distance travelled, km	Distance per cargo unit, km
1	12	-42			150,48	0,68
2	12	62	0,8	78,64	206,94	0,64
3	12	130	1,1	86,26	269,55	0,69
4	12	195	1,3	95,67	329,90	0,72
5	11,75	262 at 19:27	1,5	102,71	380,40	0,73
6	10,73	262 at 18:14	2,1	91,93	383,04	0,73
7	9,8	262 at 17:18	3,0	72,41	362,04	0,69
8	9,08	262 at 16:35	3,5	62,04	364,95	0,70
9		262 at 16:09			363,99	0,69
10		262 at 15:45			365,45	0,70

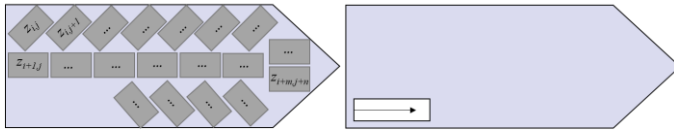
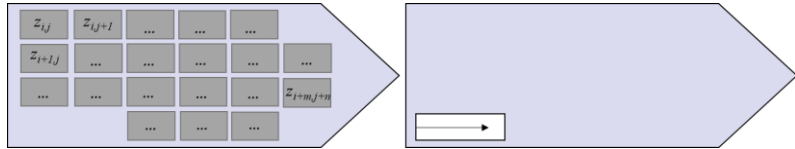
# New Terminal Design



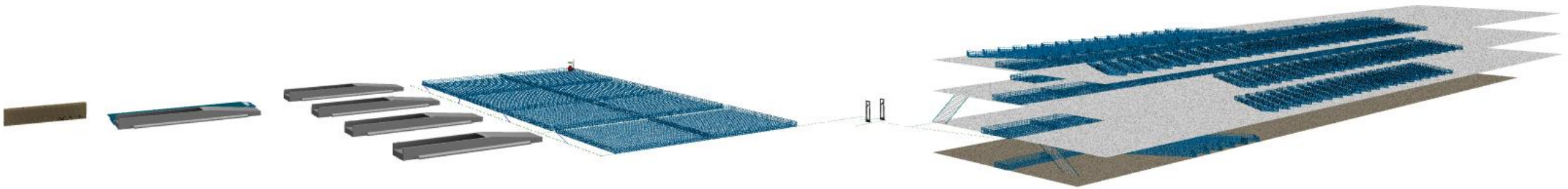
- Cross-docking concept
- 29,19% less turnaround time
- 52,47 % less distance travelled

8 MAFIs	Traditional	Cross-Docking
Status Idle	39 %	57 %
Status Busy	25 %	29 %
Status Travel Full	18 %	7 %
Status Travel to Job	17 %	7 %

# New Vessel Design

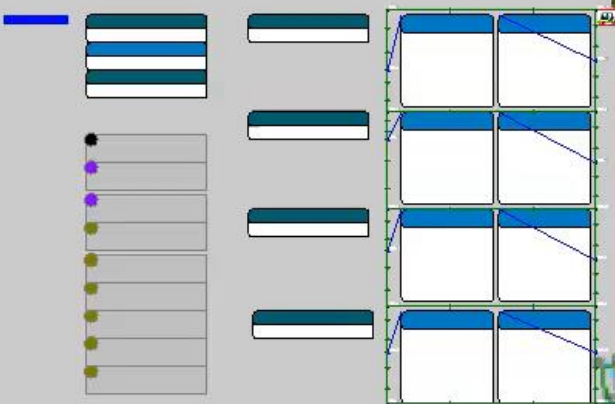
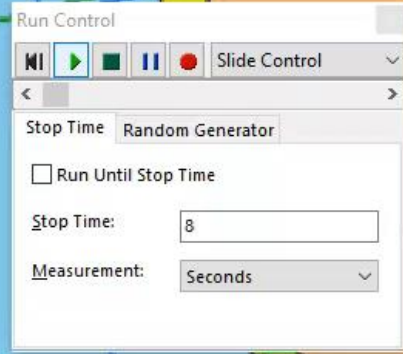
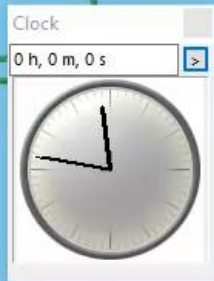
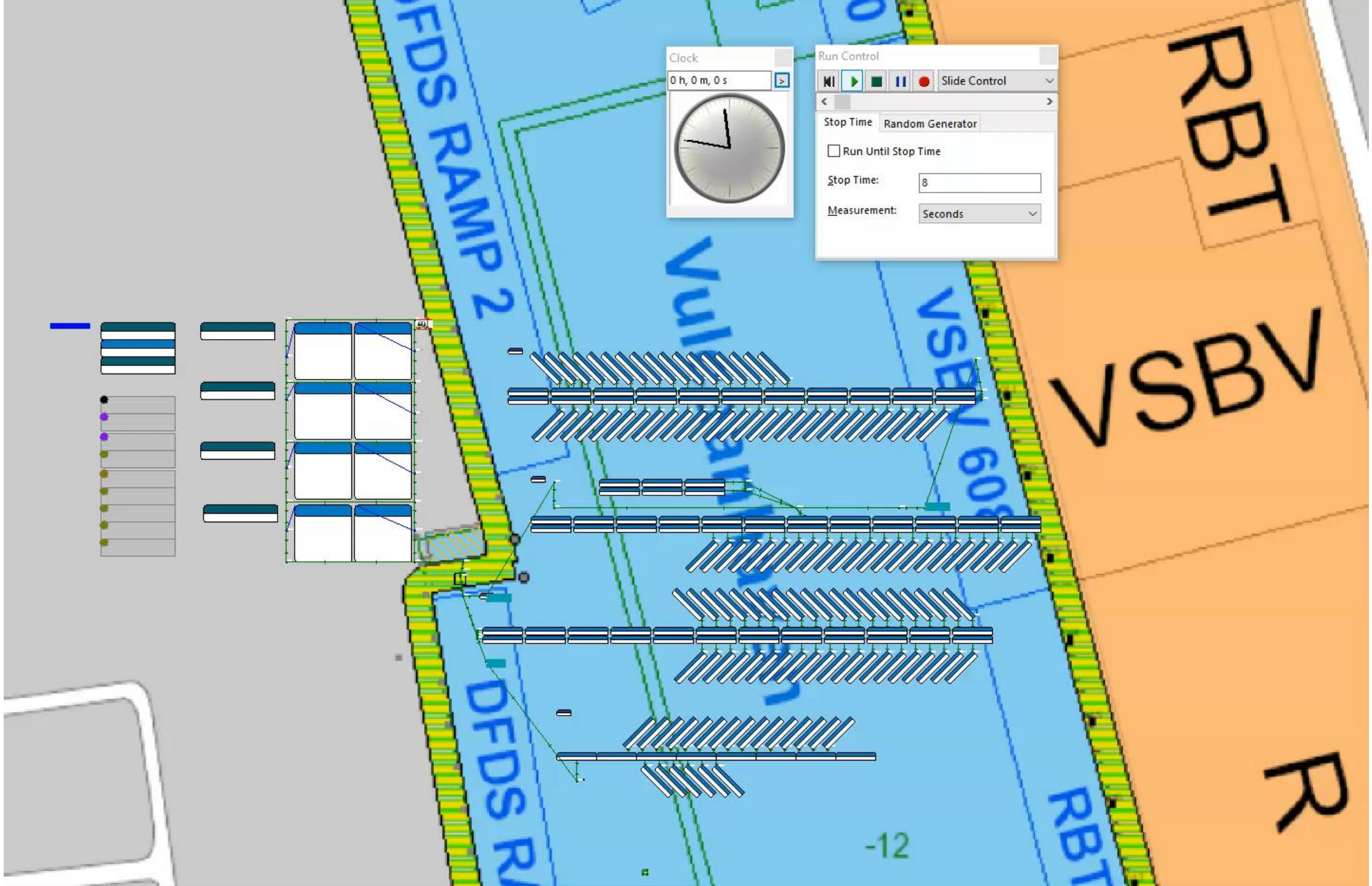


- approx. **22%** reduction of the vessel capacity
- reduction of the constraints for dual-cycling

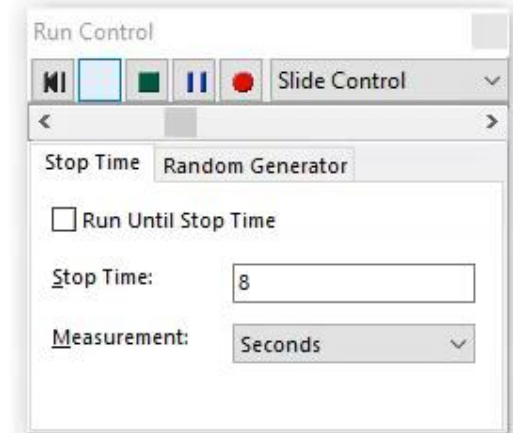
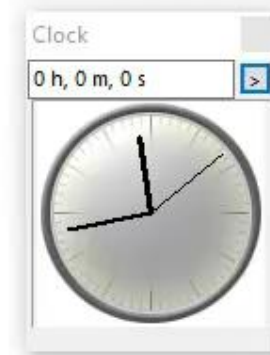




# Dual-Cycling



-12



# Thank you!

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