

Overview: Port and Digital Twin (Hyper-)Parameters

Parameter	Value	Description / Add. Information
<i>Port and Cargo Parameters</i>		
Number of Instances	100	Cargo units differ in assigned positions and complexity
Deck Layout	7×13	7 lanes and 13 rows
Vessel Positions	91	Total capacity of 91 import and 91 export cargo units
Yard Positions	212	Positions closer to the vessel are more likely to be assigned
Share Type 2 Cargo	20%	Share of cargo units with 2 nd level complexity
Share Type 3 Cargo	10%	... 3 rd level complexity
Factor Type 2 Cargo	1.3	} Factor for the exp. (un-)coupling times
Factor Type 3 Cargo	2	
<i>Stevedoring Operations Parameters</i>		
Tugs Available at Start	3	Number of tugs that operate the deck
Precedence Rule	<i>mp</i>	Two positions in front of the target must be empty (portside)
Buffer Time	30 s	Required time between handling operations with precedence constraints
<i>H</i> : Required preheating time	15 min	Required time to preheat the vessel engines before departure
<i>Coupling, Processing and Travel Times</i>		
Exp. Coupling Time (Vessel)	30 s	} Expected time for coupling on/in the vessel/yard
Exp. Coupling Time (Yard)	30 s	
Exp. Uncoupling Time (Vessel)	35 s	} Expected time for uncoupling on/in the vessel/yard (incl. parking)
Exp. Uncoupling Time (Yard)	25 s	
Exp. Unladen Travel Time (Vessel)	2 s	} Expected time required per position
Exp. Laden Processing Time (Vessel)	3 s	
Exp. Unladen Travel Time (Yard)	1.5 s	
Exp. Laden Processing Time (Yard)	2 s	
<i>Digital Twin Configuration</i>		
<i>n</i> : Number of Simulations	51	17 per level of randomness
<i>w</i> _{avg} : Weight Average	0.5	Weight for average simulated makespan in the objective function
<i>w</i> _{maxs} : Weight Outliers	0.5	Weight for the <i>m</i> % largest makespans in the objective function
<i>m</i> : Outlier Threshold	5%	Percentage of largest makespans considered
<i>k</i> : Engine Decision Quantile	45%	Used as proxy for the estimated time of departure
<i>p</i> : Factor for Checkpoint	40%	Part of <i>p</i> -of- <i>q</i> rule
<i>q</i> : Next Checkpoint Quantile	20%	Part of <i>p</i> -of- <i>q</i> rule
Snapshot Buffer per Tug	2 to 100%	≥ 2 operations, up to 100% original length