

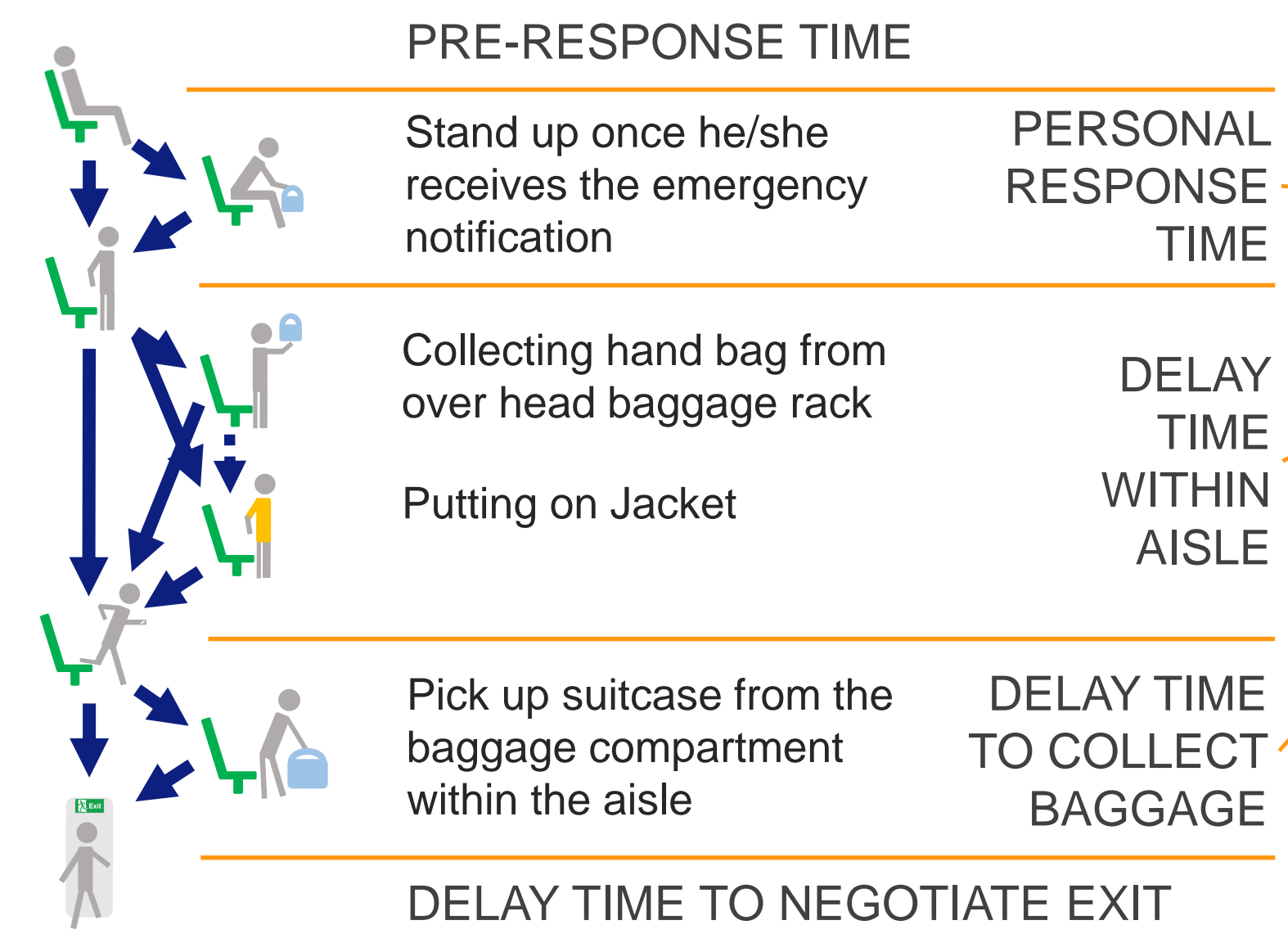
INTRODUCTION

Fatalities and injuries reported in train fires disasters highlights the importance of safe and efficient evacuations. Modelling human behaviours, crowd dynamics and evacuation procedures will allow improving evacuation time in train fire disasters. In this study, a methodology is proposed to compare the space-continuous force-based model implemented in MassMotion 8.0 (developed by Ove Arup) to available cell-based models for train evacuation procedures using a number of case studies. In this research a high speed train Alvia S-130 runs between Madrid and Valladolid is considered.

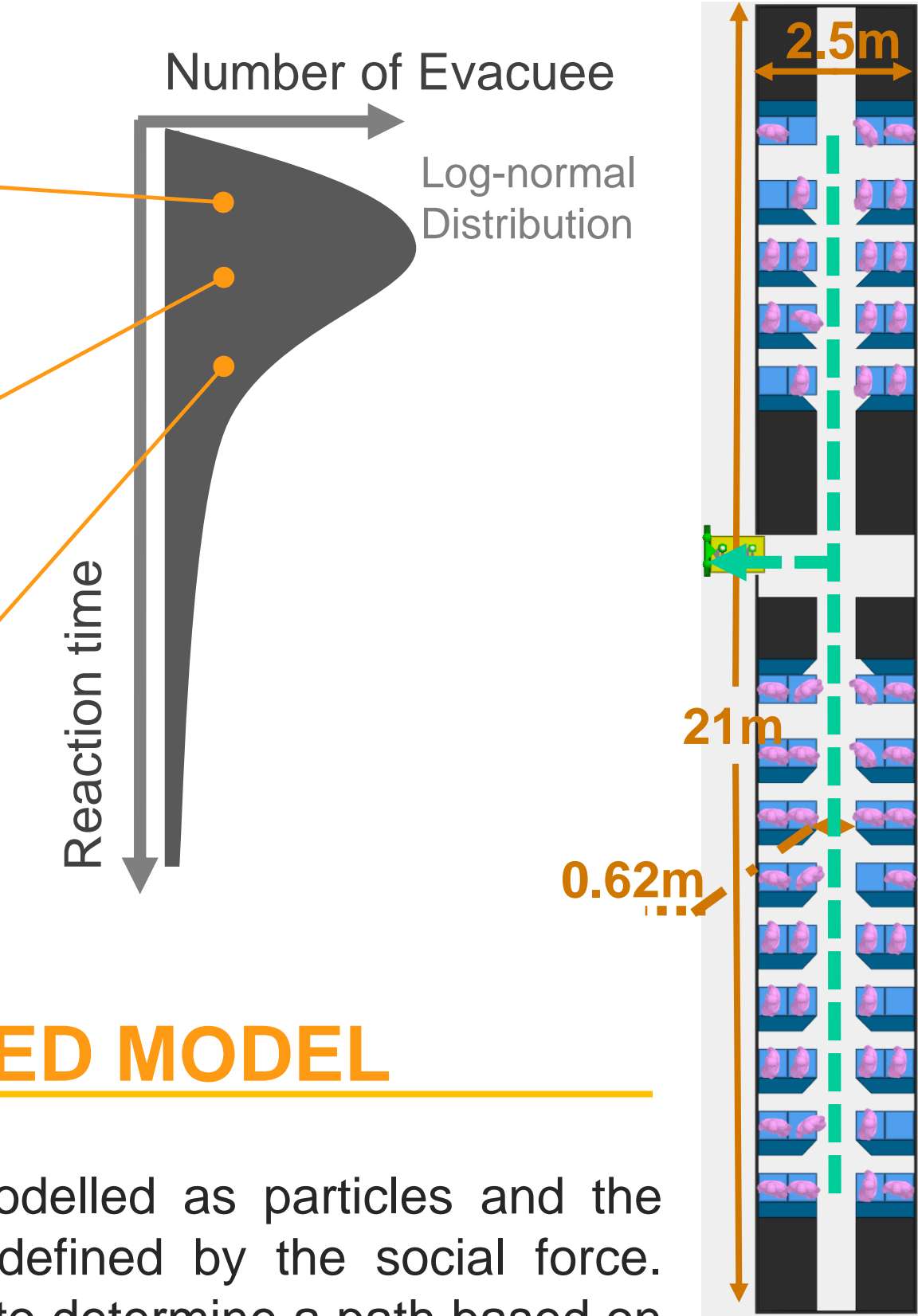


TRAIN EVACUATION

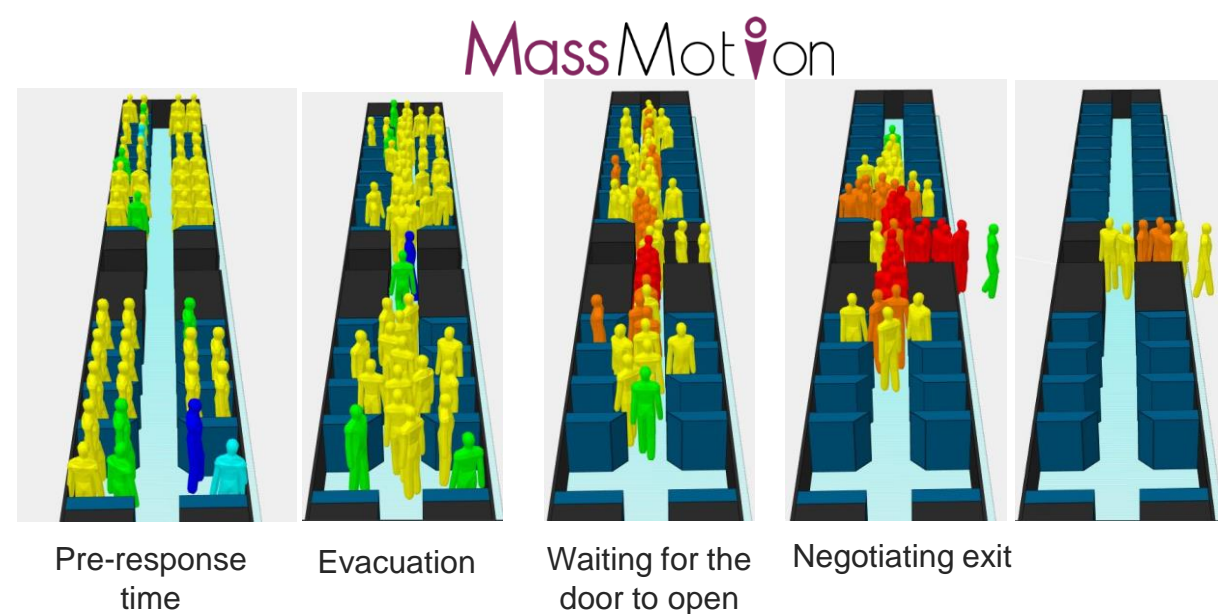
PASSENGER BEHAVIOUR
VARIABLES



DIVERSITY ON PRE-
MOVEMENT TIME



SPACE-CONTINUOUS FORCED-BASED MODEL



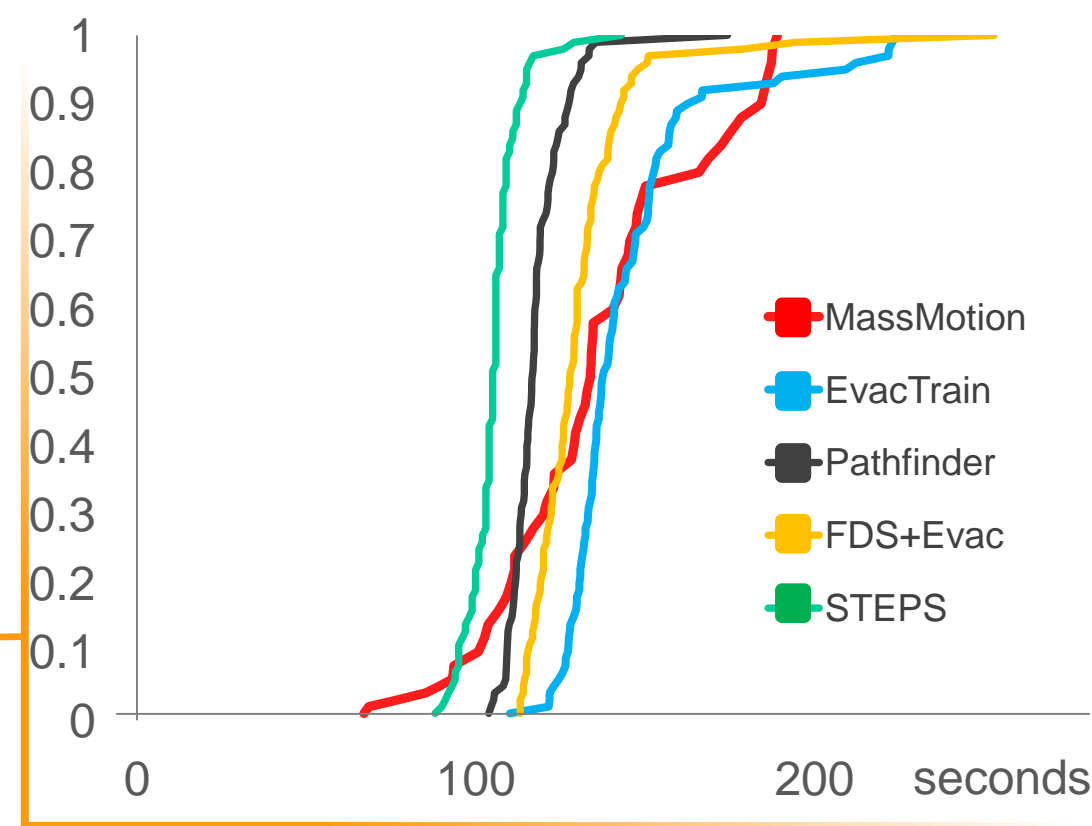
Agents are modelled as particles and the movement is defined by the social force. They are able to determine a path based on **MINIMIZING** the cost function (time). Individual agent's physical attributes (e.g. Body size, speed profile) can be assigned in MassMotion 8.0

RESULTS

COMPARISON WITH OTHER MODELS

Scenario	Model	Exit flow rate (per/s)	Mean Egress Time (s)	S.D (s)	Max. (s)	Min. (s)
A	STEPS	0.79	69.0	-	-	-
	Pathfinder	0.66	80.3	-	-	-
	FDS+Evac	Undetermined	68.0	-	-	-
	EvacTrain	0.79	68.8	-	-	-
		0.66	80.6	-	-	-
	MassMotion 8.0	0.79	61.8	-	-	-
B	STEPS		105	7.7	143	88
	Pathfinder		118	8.8	174	104
	FDS+Evac	0.58	130	17.5	253	113
	EvacTrain		145	22.7	224	110
	MassMotion 8.0		135	29.4	189	69
			137	36.0	203	57
C	EvacTrain	0.44	137	13.0	178	117
	MassMotion 8.0		137	36.0	203	57

Table 1: Summary of the results from fine network model and continuous network model



CONTINUOUS NETWORK MODEL (MassMotion and FDS+Evac) provides a wider range of possible evacuations time.

FLOW RATE of passengers at the exit door highly influences the egress time

More reasonable MINIMUM TIME and DIVERSE evacuation time represented by MassMotion 8.0

Only 2s difference (1.65%)

COMPARISON WITH REAL DATA

	Mean Evacuation Time (s)	Standard Deviation (s)	Max. (s)	Min. (s)	Percentile 95%
MassMotion 8.0	119	30	172	49	171
Evacuation drill	121	-	-	-	-

Table 2: Summary of the results from a Social Force model and evacuation drill

It can be concluded that space-continuous force-based models are capable of performing an accurate projection of evacuation times in trains in comparison to other available cell-based

models. However, verification and validation is an on-going process, further validation tests are required to reinforce the usage of MassMotion in train evacuation scenarios

ACKNOWLEDGEMENTS

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REFERENCES

Oasys Arup (2015). MassMotion Oasys 8.0.