ABMS & DES for Modelling an Emergency Department

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Objective

The main aim of this research is to investigate how to use the strengths of discrete event simulation and agent based modelling and simulation for modelling the operational and human factors of emergency departments.

Discrete Event Simulation (DES)

DES allows modelling individual entities, which have characteristics that determine their flow inside the model. The entities engage some activities and need resources to complete the process. In DES the simulation executive is in charged of scheduling and sequencing the activities.

Agent Based Modelling and Simulation (ABMS)

ABMS also allows modelling individual entities called agents. Those agents have behaviors that are determined by rules that can be simple (reactive behavior) or more complex (proactive or deliberative behavior). The agents interact with each other and with the environment based on those rules.

Computer Model Development: Implementation in Simul8

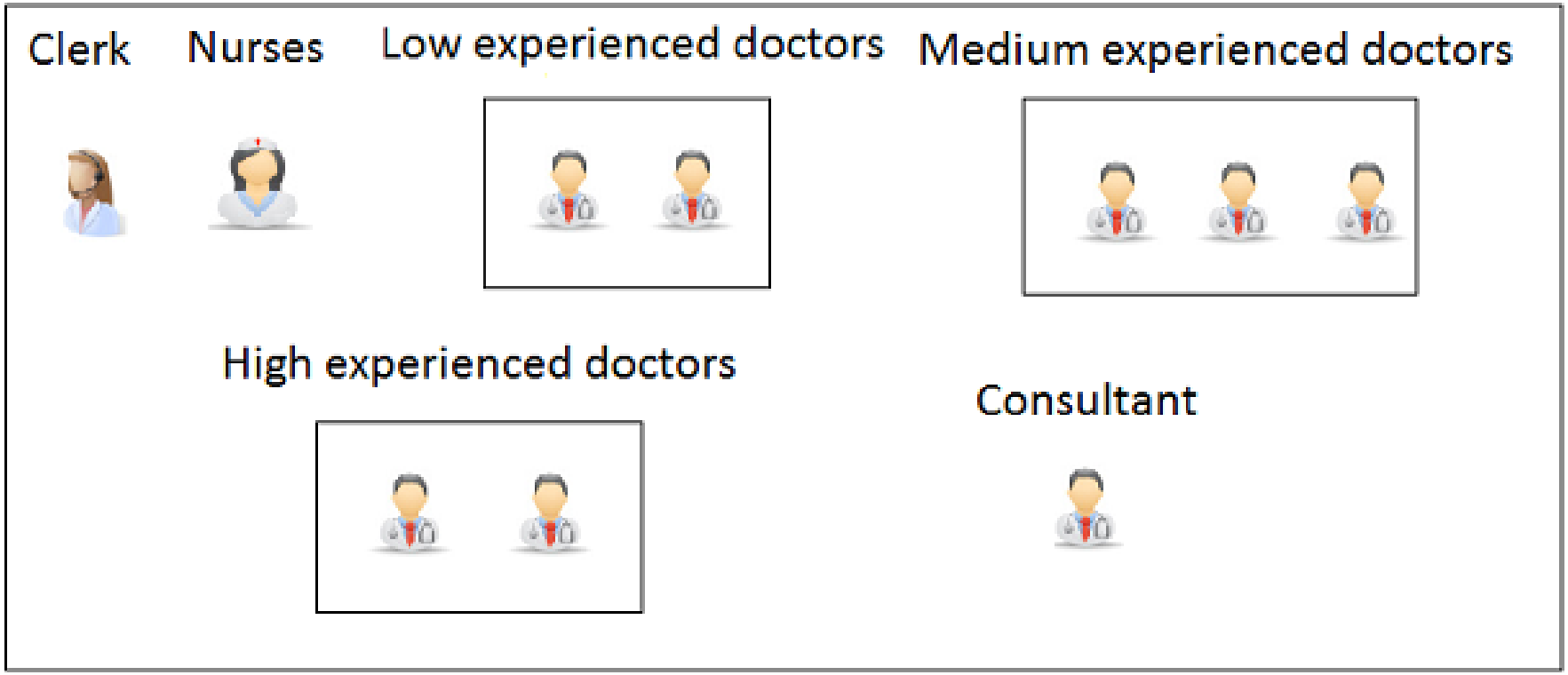


Figure 1: Resources in [Simul8, 2014]

Computer Model Development: Implementation in Simul8

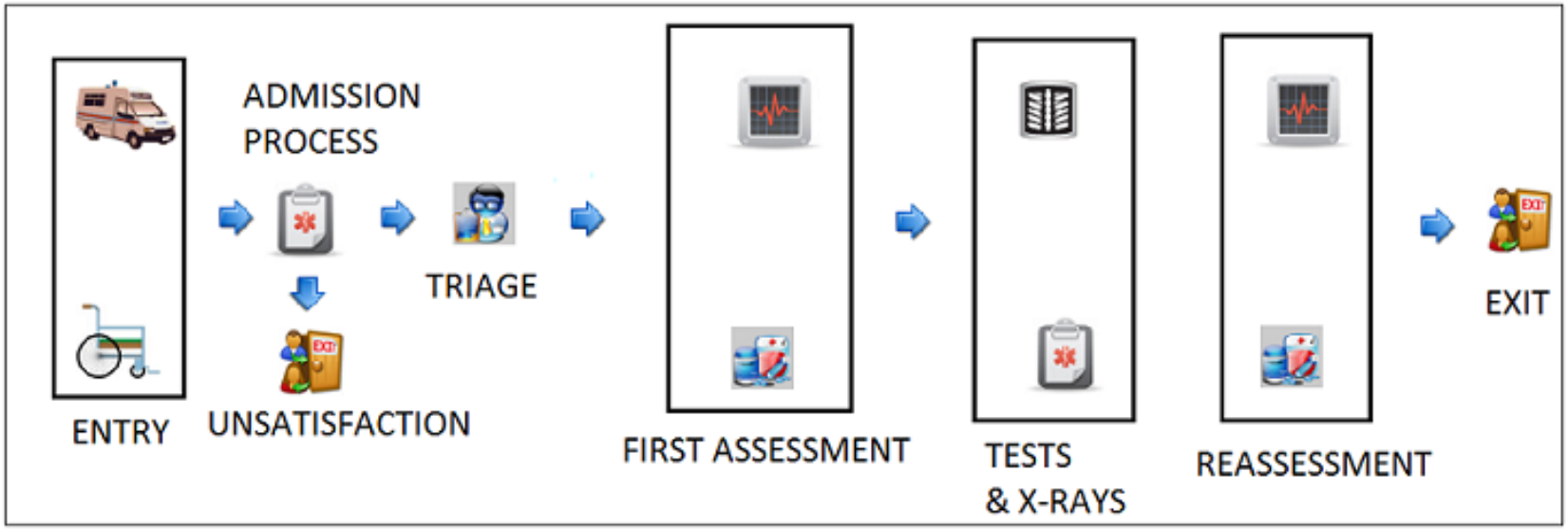


Figure 2: Discrete event simulation model. Adapted from [Gunal and Pidd, 2006]

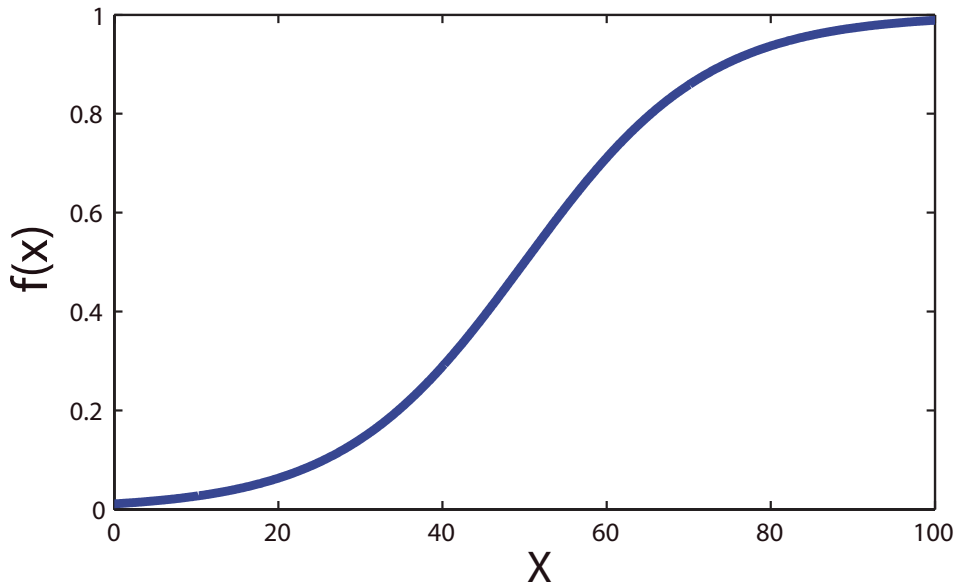
PECS Framework

PECS is a standard model of human decision-making that has been used for modelling human behavior. PECS basis grounds on the assumption that integrating physical, emotional, cognitive and social attributes and their intensities, it can define agent's personality.

Computer Model Development: PECS

For modelling states variables, physical and emotional states, it was used the logistic function:

$$f(x) = \frac{1}{1 + e^{-\alpha(x-c)}}$$



where α is the growth rate and c is the value of x at which the curve reaches the 50% of the maximum intensity.

Computer Model Development: PECS

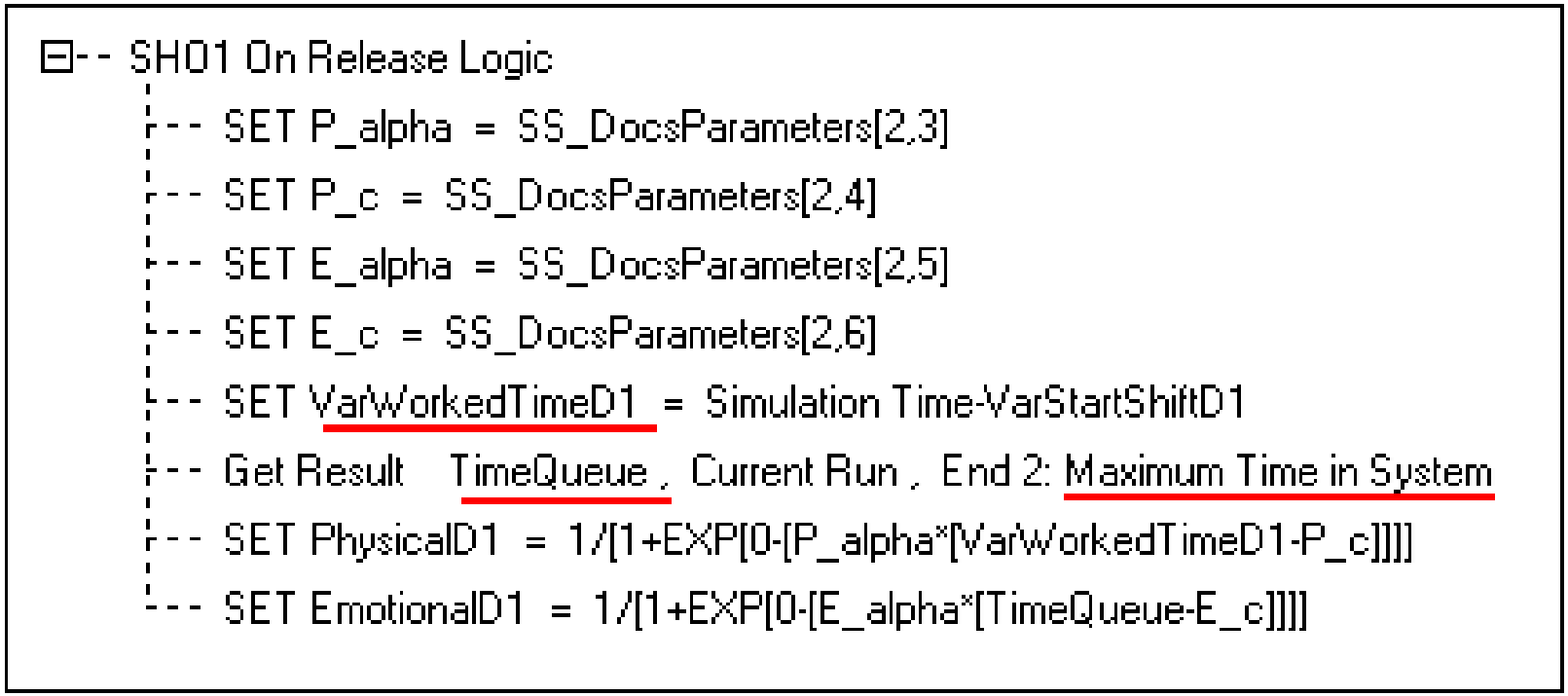


Figure 3: PECS implementation in Simul8

Computer Model Development: PECS

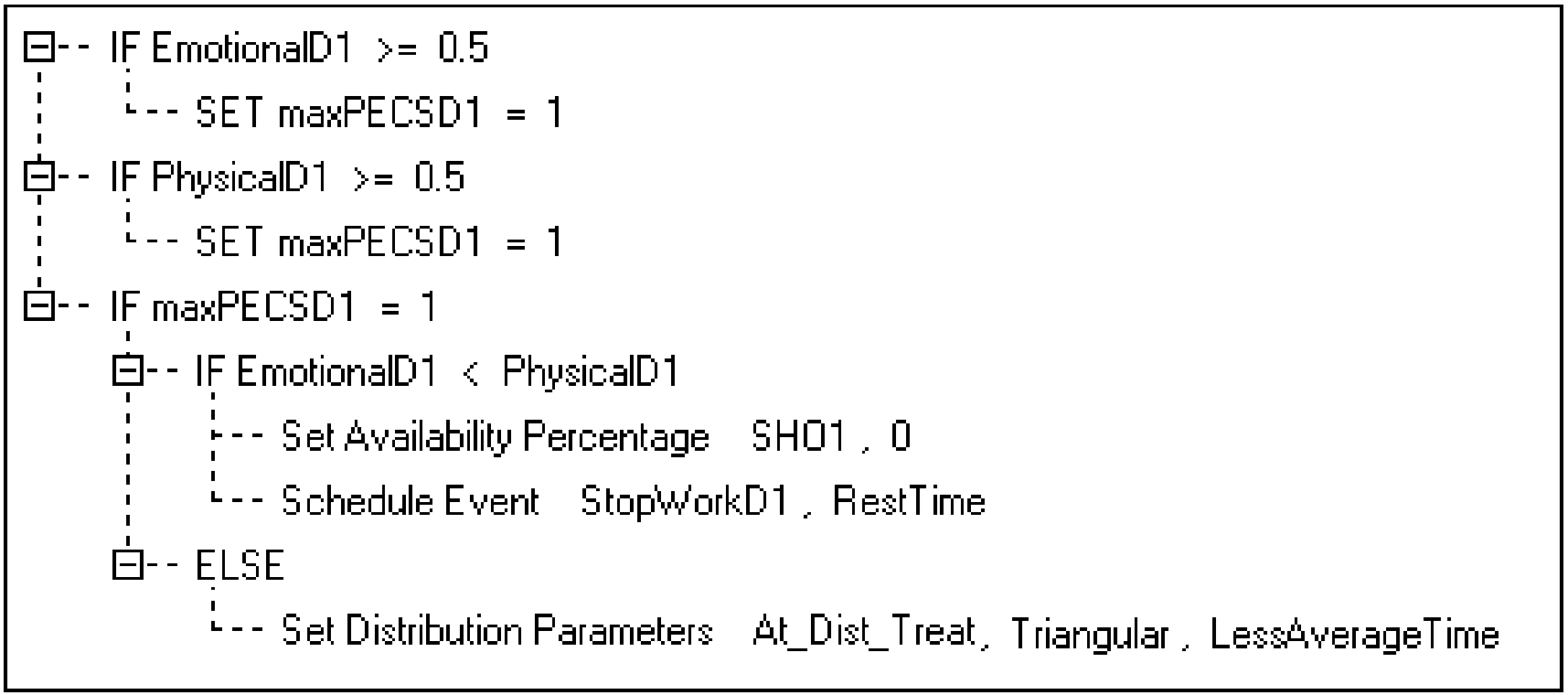


Figure 4: PECS implementation in Simul8

Results

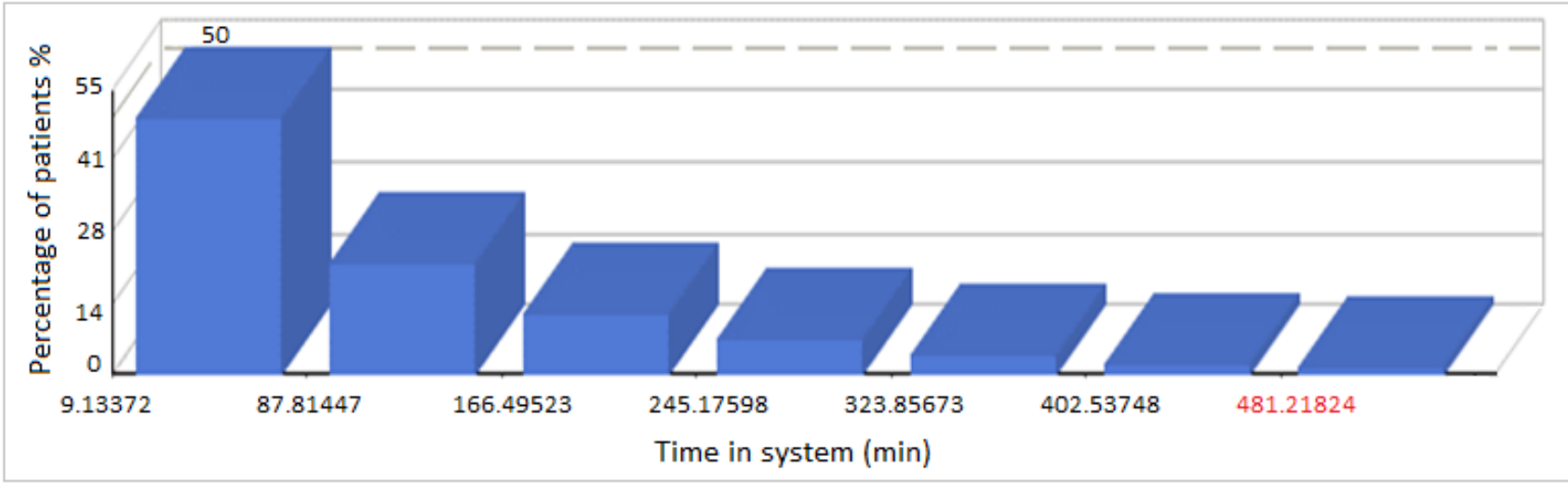


Figure 5: Histogram of time in system without PECS implementation

Results

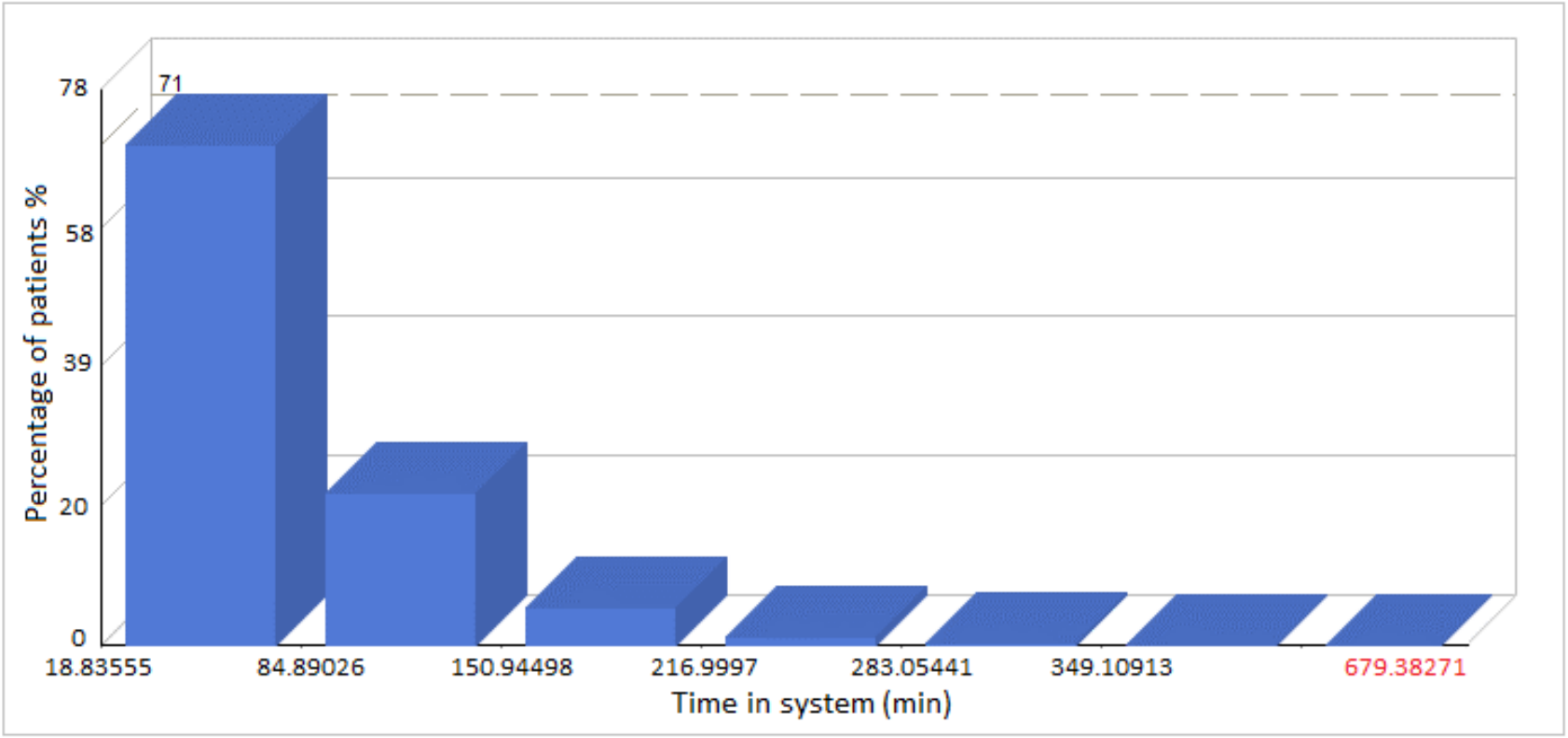


Figure 6: Histogram of time in system with PECS implementation

Results

	PECS		
	-95%	**Average**	**95%**
Average Time in System	134,48608	135,75952	137,03296
Maximum Time in System	1201,09015	1272,69871	1344,30728

Table 1: Confidence intervals of model without PECS

Results

	PECS		
	-95%	**Average**	**95%**
Average Time in System	72,29761	72,55588	72,81414
Maximum Time in System	546,73301	618,13306	689,53312

Table 2: Confidence intervals of model with PECS

Further Work

- To implement the other two states variables of PECS framework in the model (cognitive and social states).
- To estimate the parameters' values of PECS functions

References

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