
Systemic Conceptual Modeling of Patient Flow in a Hospital Emergency Department: A case example

Gaute Tarning, gaute.terning@uis.no
PhD Candidate

Institute for Safety, Economics, and Planning
Faculty of Technology and Natural Sciences
University of Stavanger, Norway

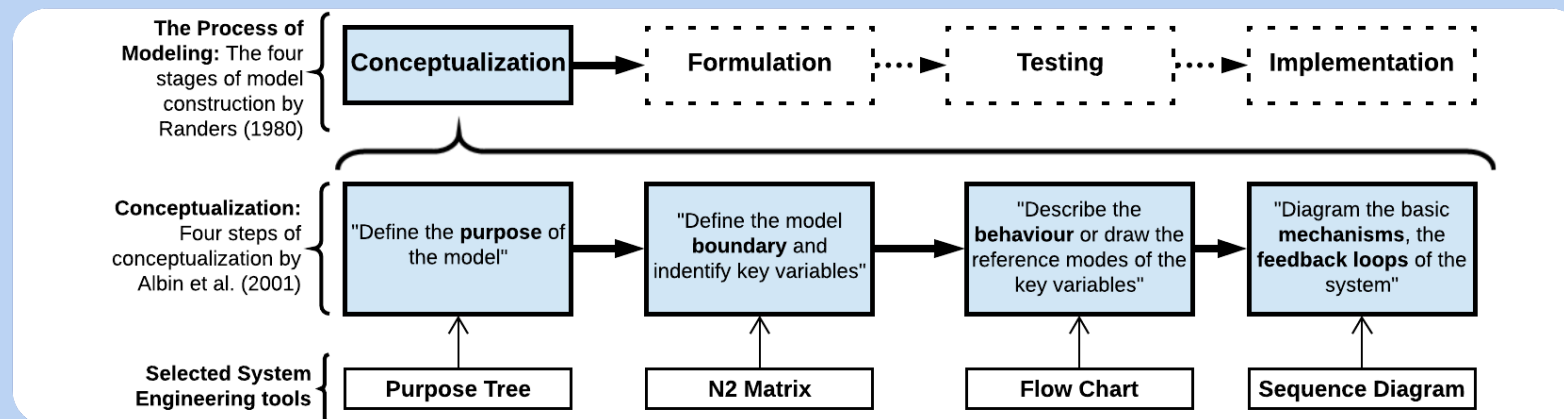
Eric Brun, eric.brun@uis.no
Professor

Institute for Safety, Economics, and Planning
Faculty of Technology and Natural Sciences
University of Stavanger, Norway

Introduction

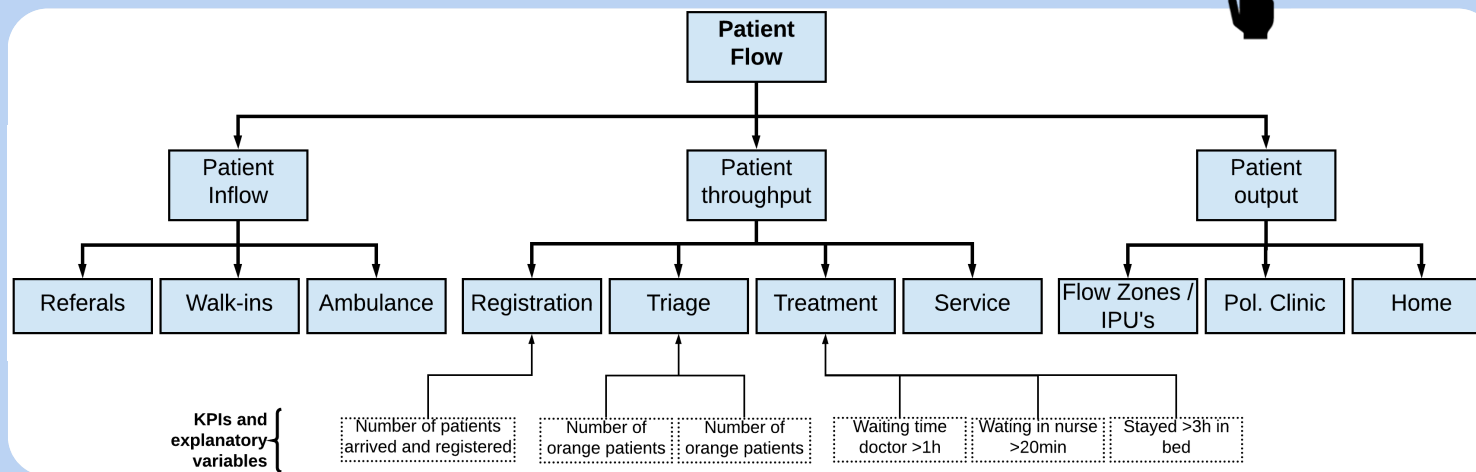
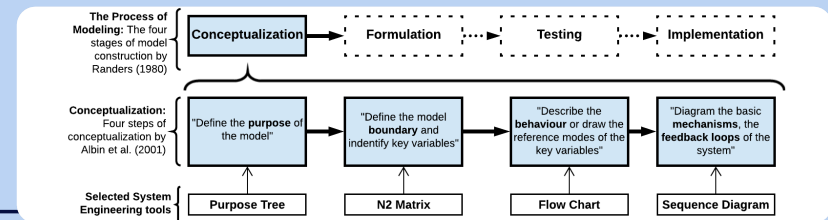
- Surveying the literature of modeling patient flow in emergency departments, the works found do usually not how their conceptual models have been constructed.
- This paper suggests a formalized methodology for constructing the conceptual model of a complex system such as the emergency department of a hospital.
- Furthermore, improvement in computer hardware has given modelers more and more options of how to conceptualize a system.
- This highlights the usefulness of a structured conceptual model building approach, as following such an approach will be useful to exploit this potential.

Research design



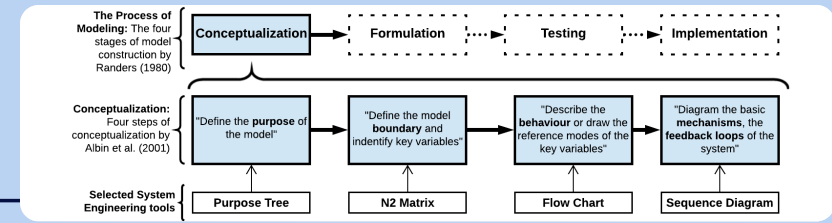
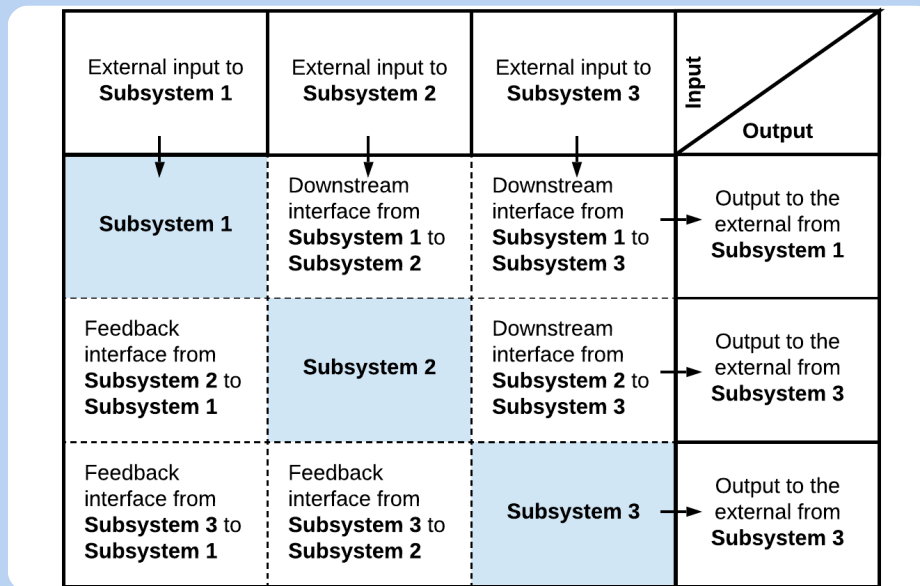
- Albin et al.'s (2001) decomposition of Randers' (1980) 'Process of modeling' related to the selected System engineering tools.
- Empirical case: The Emergency Department (ED) of Stavanger University Hospital (SUS); a medium-sized Norwegian hospital.

Purpose tree



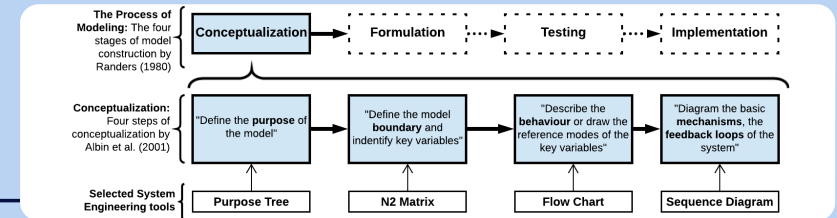
- The purpose tree is expounding on what the key variables of the model are and not only the purpose of it. The identified variables might be targeted to be a part of a dashboard in the modeling software.

Interface diagram



- The interface diagram shows the interfaces between the patient flow subprocesses of the ED in a systemic manner.

Interface diagram - Case

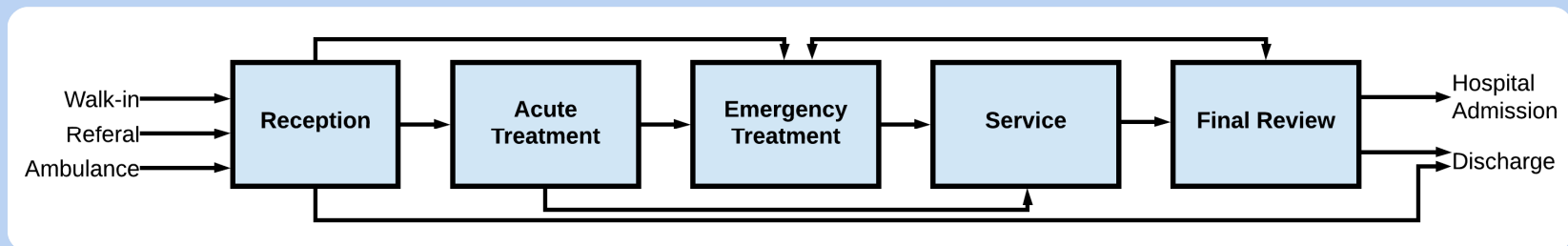
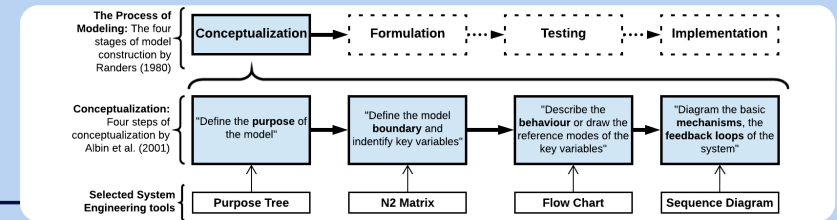


					Input / Output
- Walk-in - Referrals - Ambulance					
Reception	- Classification of patient type/severity >AB/KI/ME/NE/OR; >Yell., Orang, Red	- Plan for treatment - Assigning room / bed - Fast-track	- Fast-track		- Patient data system
	Acute Treatment	- Patient transfer		- Examination - Consultation	- Discharge - Fast-track specialized treatment
		Emergency Treatment	- X-ray - Blood tests etc.	- Examination - Consultation	- Admission to (AB, KI, ME, NE, OR or ICU)
				Service	- Hospital Admission to (AB, KI, ME, NE, OR or ICU)
		- Re-classification - New Treatment plan	- Re-classification	Final Review	- Discharge - Admission to (AB, KI, ME, NE, OR or ICU)

		Sickness and accident in General population	Workforce		Input / Output
Hospital Building	Physical layout: - Process effectiveness			Constraints on amount of equipment; beds, x-ray etc.	
	ED - Patient flow process	Registration			
	Patient demand	Patients	Conditions Re-checks		Hospital Admission Discharge
	Schedules	Triage Treatment: -AB/KI/ME/NE/OR	Healthcare staff -16 nurses, 7med, 3kir, 2nev, 1ort	Ordering	
	Availability of services	- Beds - Lab - Radiology		Medical Equipment and Services	

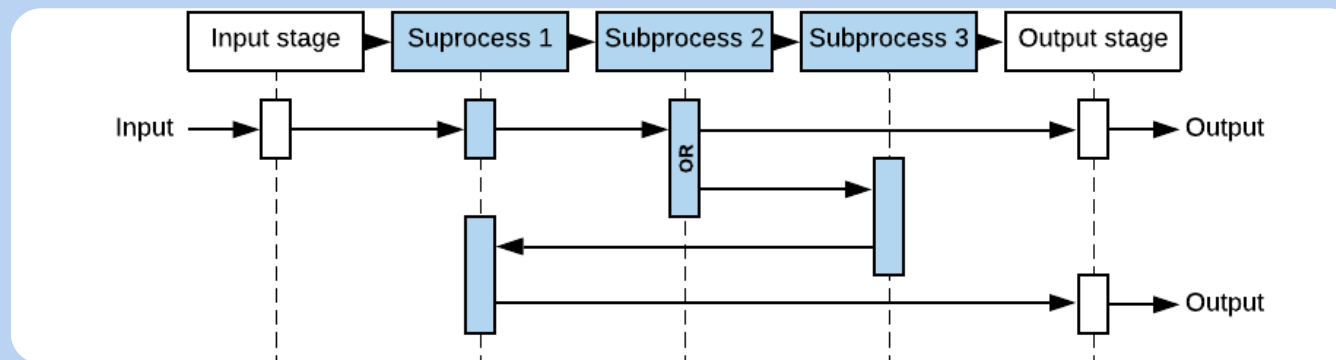
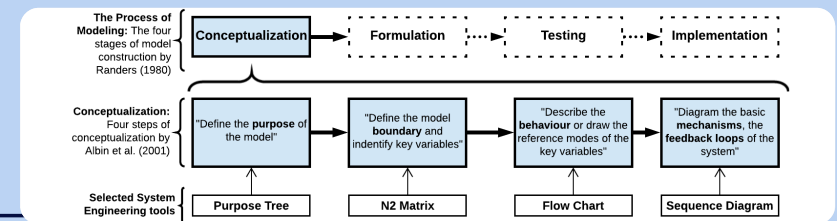
- Interface diagrams illustrating (left): the interfaces between the patient flow subprocesses of the ED (right): on the overall organization of the ED, here the patient flow process as a subprocess.

Flow chart



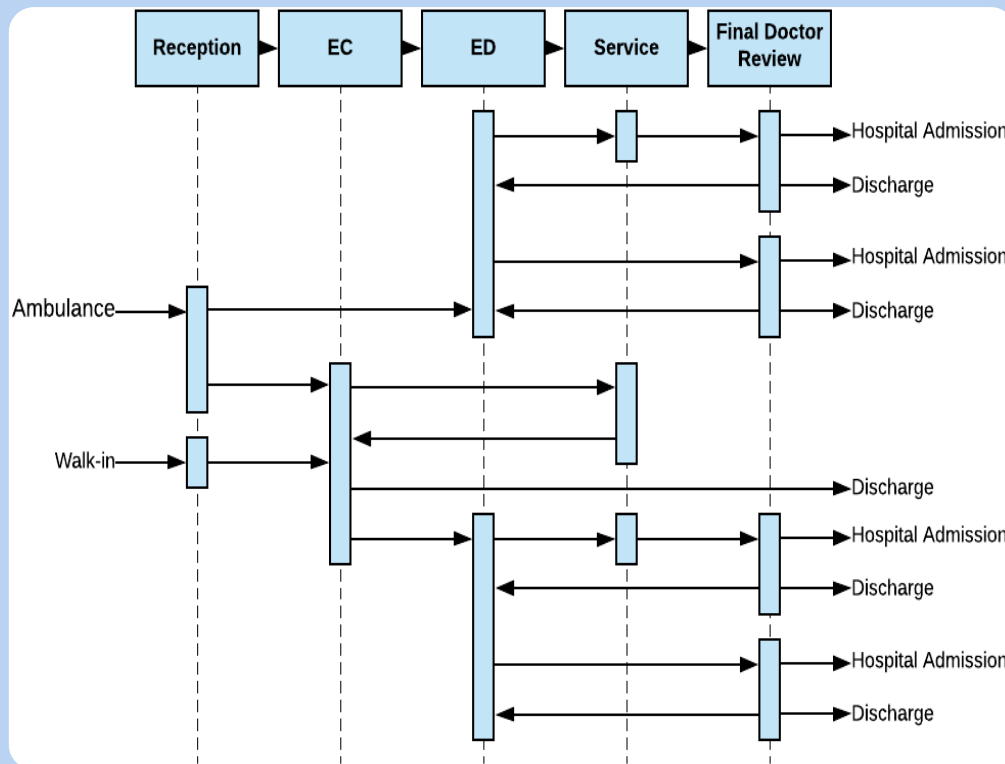
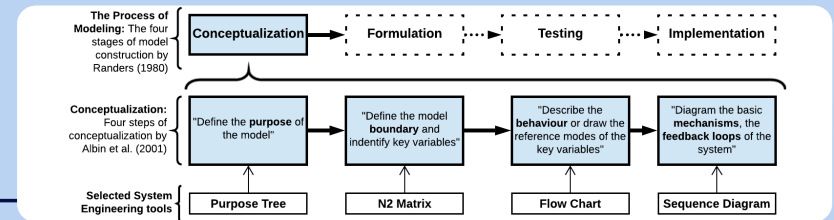
- Flow chart of the patient flow process in SUS' ED.
- It's the most common tool, however, here it functions as a basis for the other steps in the suggested methodology.

Sequence diagram



- Sequence diagram helps showing the patients full sequential pathway throughout the system across time.
- Can also highlight the multitudes of different possibilities of patient flow.

Sequence diagram - Case



- Sequence diagram showing the full pathway of patients in the patient flow process of SUS. Emphasizing the multitude of patient pathways.

Conclusion

- This project exemplifies a rigid use of SE methodology as a basis for making a firm conceptual model for use on patient flow in ED. The results of this project might be adjusted for other applications and thus work as an outlet for other projects.
- We believe that this paper delivers an answer to the question posed by Mass (1986, p. 78): “How does, or should, a model structure evolve through iterative formulation testing, and analysis?”. This proposed methodology yielded a good outset for the formulation step in the case project.