Using Computer Simulation to Plan Construction Projects Accurately

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Introduction

- The three main objectives in construction projects are completing the project on time, within budget, and with good quality
- Construction projects are unpredictable and unique, so it is better to model the project before executing it
- Computer simulation models help to visualize construction projects without the cost and time drawbacks that come with experimenting with the actual system

Problem Statement

- The problem is a steel erection project inspired from a real project in Fort McMurray, Alberta, Canada
- The process involves the delivery of three types of steel materials to the site, moving them by forklift to a crane and erecting them with the crane
- 2 cranes and 2 forklifts are used
- Material 1 uses crane 1, material 2 uses crane 2 and material 3 uses both cranes
- There is a 20% chance deliveries will be delayed one day and a 10% chance they will be delayed two days

Tasks	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Delivery of Material 1 (10 ton/day)										
Erection of Material 1 (10 ton/day)				1	2	3	4	5	6	7
Delivery of Material 2 (12 ton/day)										
Erection of Material 2 (10 ton/day)					2	3	4	5	6	
Delivery of Material 3 (15 ton/day)										
Erection of Material 3 (20 ton/day)						3	4	5	6	

Figure 1: Schedule showing the planned delivery and erection of materials 1, 2, and 3

Model

- The model is a computer simulation created on Simphony.NET
- Materials 1, 2, and 3 are created as entities that travel through different tasks such as "loading onto forklift," in the model to represent the construction process
- At the end of the model a counter records useful information such as the amount of time it took for the project to be completed

Abbreviation	Meaning
M1	Material 1
M2	Material 2
M3	Material 3
C1	Crane 1
C2	Crane 2

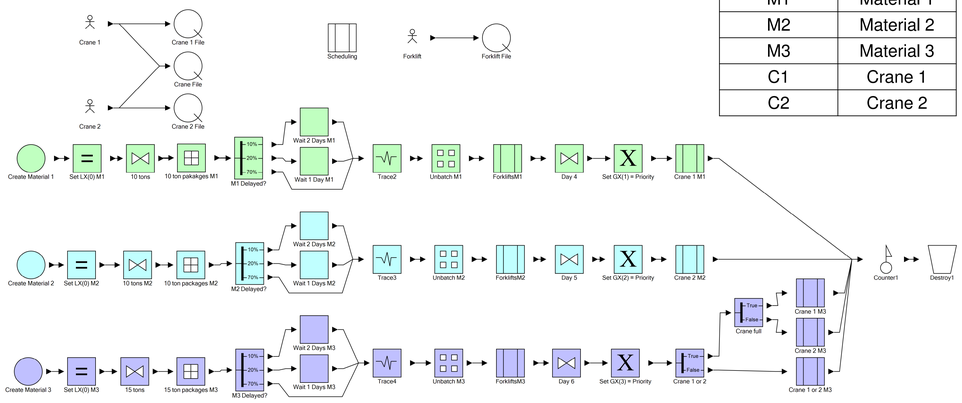

Figure 2: An image of the simulation created on simphony.NET. This model simulates the problem assuming work can commence the entire day (24hrs), that the erection site has unlimited storage, and delaying one delivery will not delay all the deliveries after it.

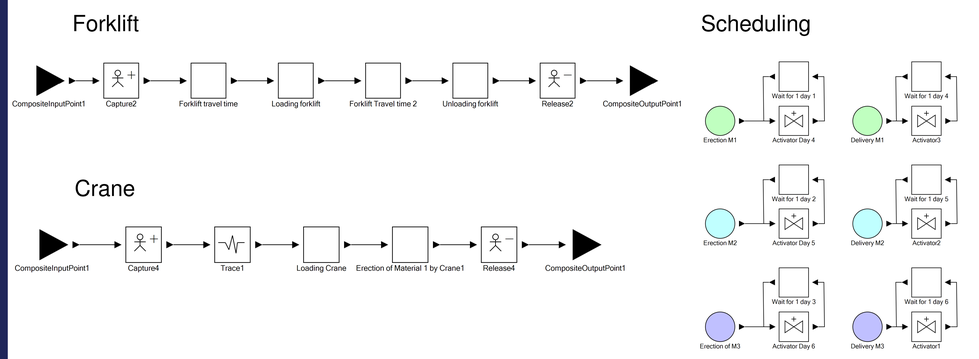

Figure 3: An image of the forklift, crane, and scheduling sub-models in the model. The forklift and crane sub-models are the expanded view of what tasks the materials go through when passing through the tasks ForkliftsM1 and Crane 1 M1 in the model. The scheduling sub-model runs at the same time as the model and makes sure tasks don't get ahead of schedule

Results

- With the results collected from running the simulation, a second schedule was produced
- This schedule shows on which days materials were delivered and blank spaces where nothing was delivered
- Although several deliveries got delayed, none of the erection schedules were delayed because the erection process is fast and due the assumption that unlimited storage is available

Tasks	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Delivery of Material 1 (10 ton/day)			*			*				
Erection of Material 1 (10 ton/day)				1	2	3	4	5	6	7
Delivery of Material 2 (12 ton/day)				*						
Erection of Material 2 (10 ton/day)					2	3	4	5	6	
Delivery of Material 3 (15 ton/day)										
Erection of Material 3 (20 ton/day)						3	4	5	6	

Figure 4: Schedule showing the delivery and erection of materials 1, 2, and 3 according to the simulation. The * shows when two deliveries arrived on the same day

Conclusion

- Computer simulation allows us to better visualize the construction process.
- Uncertainty is easily accounted for in the simulation.
- Results of the simulation can be used for improved planning.

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Literature Cited

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