

Analysis of Tunnel Jobsite Logistics Processes

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PHASE I: BACKGROUND

COMPANY PROFILE
 Herrenknecht AG develops technical solutions, such as tunnel boring machines (TBM), for the construction of underground tunnels. A TBM excavates earth material in its path and builds rings of concrete linings to create a tunnel.

TBM LOGISTIC SYSTEM
 Comprises of machinery such as gantry cranes, mobile cranes and trains. Responsible for the transportation of materials to and from the TBM.

PLANNING
 At present, the project contractor plans and procures the machinery that comprise the TBM logistic system.

PHASE II: PROBLEMS AND OBJECTIVES

CAUSE

- Current planning for the TBM logistic system is based on rough estimates
- Does not take into account dependencies between resources
- Does not take into account variability in the durations of logistic processes
- Scheduling is on an ad-hoc basis
- Overall impact on TBM efficiency is not considered

EFFECT

- Disruptions due to logistic operations
- Higher costs incurred
- Substantial idle times for the TBM
- Longer project durations

OBJECTIVES

Design a systematic method of planning for the TBM logistic system

- Develop a method of describing a TBM logistic system
- Systematically plan for a tunneling project
- Consider and compare alternative designs
- Recommend improvements to the current system

PHASE III: METHODOLOGY

DESCRIPTION
 'Blueprint': a description of the logistic system

- Component Description
 Lists and describes all resources that comprise the TBM logistic system
- Overall Layout
 Geographically displays the positions of all the resources on a map of the jobsite
- Material Coverage
 Lists all routes of transporting a material
- Dependencies
 Indicates possible conflicts between the resources of the TBM logistic system
- Timing & Scheduling
 Statistical summary of relevant timings and an approximate timeline of activities

SIMULATION MODEL

- Conceptualize an existing jobsite
- Develop a simulation model using data from the blueprint of existing jobsite
- Compare model with the jobsite

ALTERNATIVE DESIGNS

- Explore alternative designs that vary the combination, arrangement and scheduling of resources
- Develop simulation models and compare performance of the alternative systems

COST-BENEFIT ANALYSIS

- Perform cost-benefit analysis to compare the various designs
- Examine the expenditure required to improve the system

RECOMMENDATIONS
 The set of resources that serve to minimize TBM idle time, while taking into consideration total cost, will be recommended.

PHASE IV: IMPLEMENTATION

1. Resource layout and simulation model diagrams.

2. 3D visualization of the TBM logistic system layout.

3. Alternative design layout.

4. TBM Utilization (%) chart comparing Base Case and Alternatives 1, 2, and 3.

Resource Name	Quantity	Acquisition Cost	Operational Cost (per month)	Maintenance Cost (per month)	Total Fixed Cost (per month)	Total Variable Cost (per month, per all quantities)
Gantry Crane	2	100,000	10,000	5,000	105,000	210,000
Mobile Crane	2	150,000	15,000	7,500	167,500	335,000
Excavator	2	200,000	20,000	10,000	220,000	440,000
Train	4	80,000	8,000	4,000	92,000	184,000
Other Resource	2	100,000	10,000	5,000	115,000	230,000
Blank Truck	1	50,000	5,000	2,500	57,500	115,000
Total Fixed Cost (Total available Cost per month)					657,500	

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PHASE V: FUTURE DIRECTION

- Improvements in blueprint template as it is implemented in more tunneling projects to make it more clear and concise
- Simulation software that caters specifically to modeling the TBM Logistic System
- Excel macros that can perform the subsequent Cost-Benefit Analysis
- Explore other approaches that can aid in systematic planning of the TBM Logistic System