

Improving the delivery process for engineered-to-order products – Lessons learned from power distribution equipment

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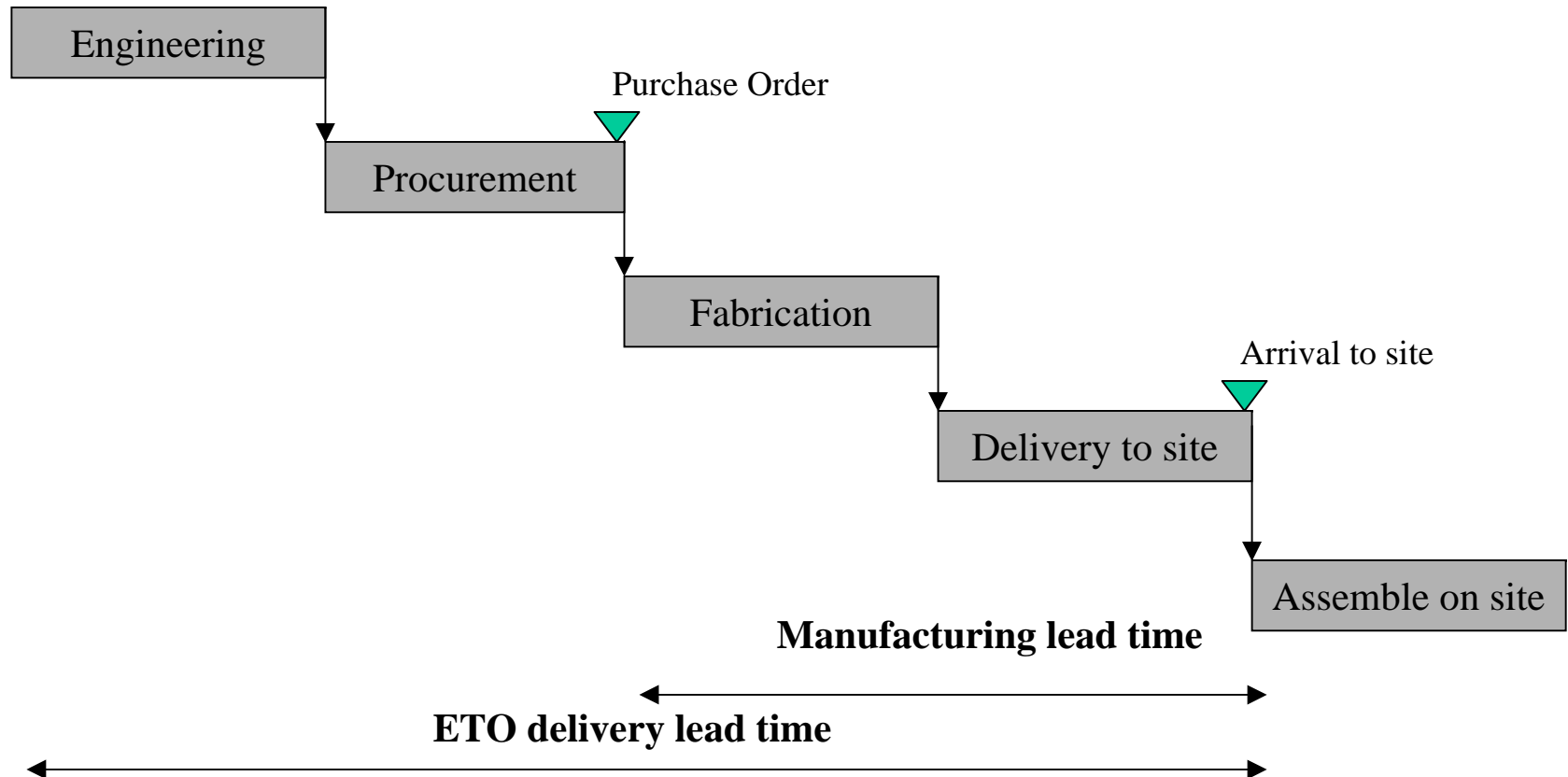
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Overview of research

- Concluding report of a 4-year-study on construction supply chains
- Research question: *“How can the performance of the supply chain of ETO products be improved?”*
- **Research methodology:**
 - **inductive research method** (case studies in Finland and the US)
 - **interpretive research approach** (data collection and analysis interwoven and repeated)
 - **case study-experiment enquiry strategy** (3 sites, 40 companies, 115 interviews, 6 workshops, 408 pieces of power distribution equipment, ...)
 - **data analysis** with help of mapping, performance measures, simulation (Sigma, event scheduling), TFV theory
- **Earlier reports:**
 - IGLC-10 (Literature review/ theory on ETO supply chains & lead time)
 - IGLC-11 (Comparison of cases)
 - WSC03 (Simulated procurement behavior)
 - 3 Technical reports (1 for each case study)
 - 3 journal papers in review
 - Doctoral thesis
- **Today:** Lessons learned

Definitions

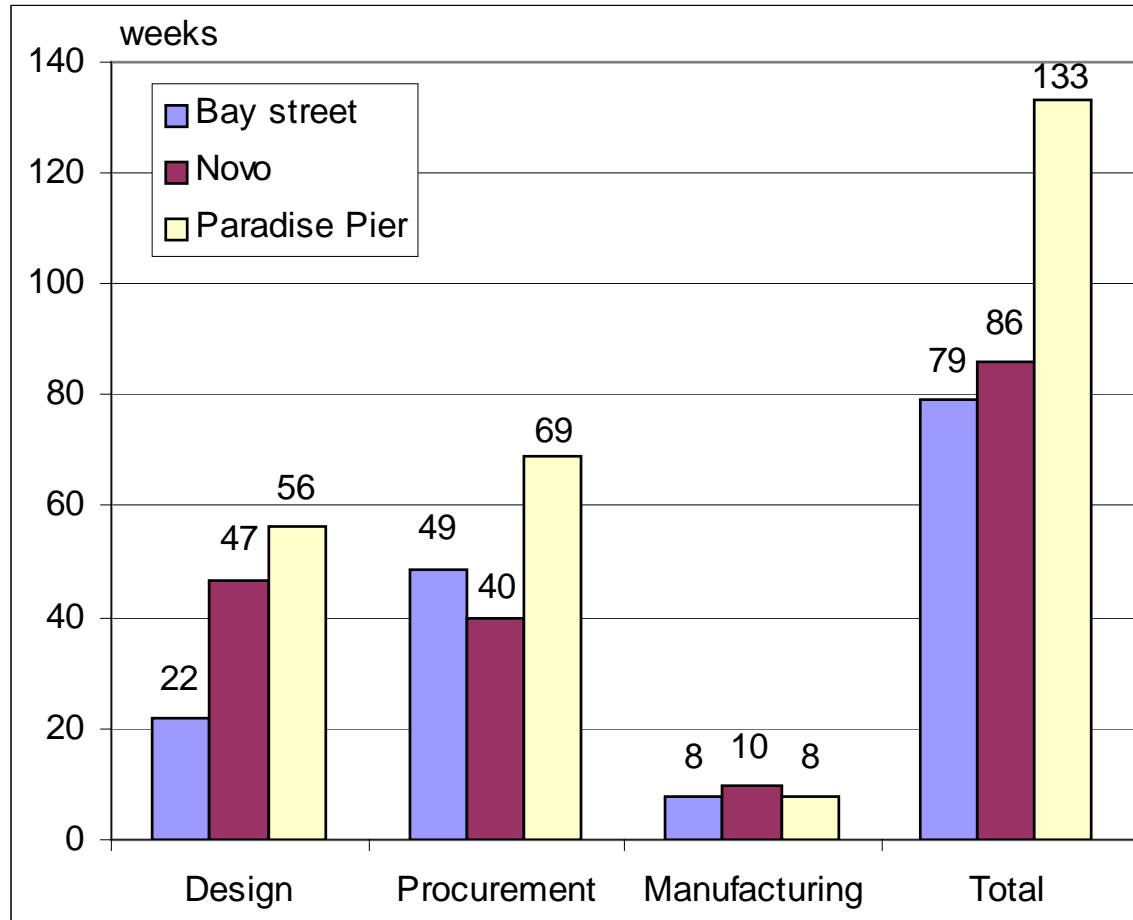


Definitions

Power distribution equipment:

Equipment that distribute electrical power and control the supply of power, e.g., switchboards, panelboards, motor control centers, transformers, switchgear .

Overview of lead times



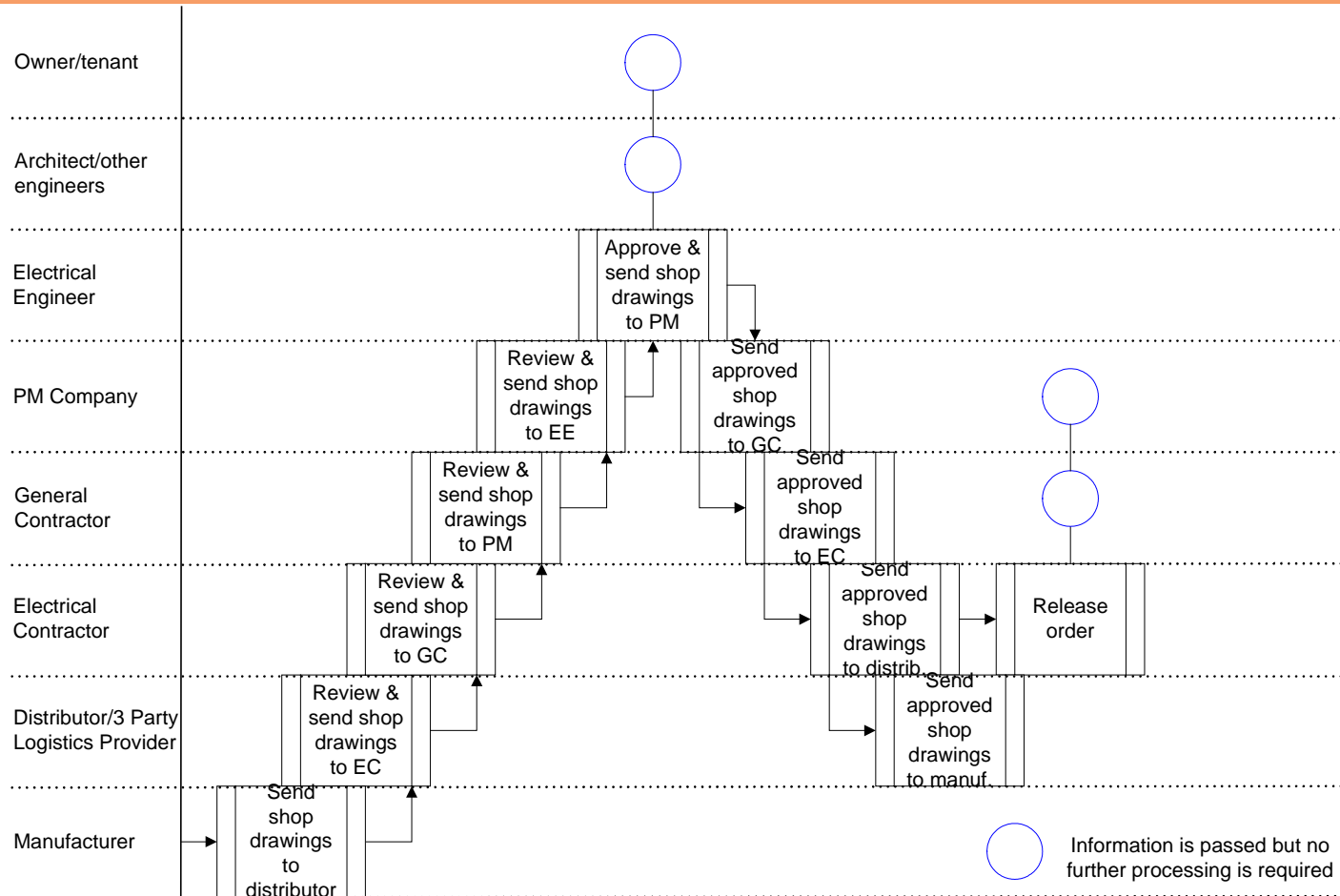
Causes of long lead time

- **Changes** due to early commitment and lack of knowledge
- Changes due to design errors
- Coupling PDE design to other systems design
- Long waiting for local approvals and permits
- Owner(s) and tenant(s) delayed design input
- Low level of design standardization
- Tedious collection of design input (and **poor reliability of input**)
- Non-sequenced “push” driven design
- Complexity-Large number of specialists
- Serial **competitive bidding**
- Exclusion of product flexibility
- **Large document batches**
- Improper document sequence
- Commercial relationships
- Sequential and hierarchical document flow
- Gaming
- Misunderstandings in scope of task
- Cumbersome and tedious shop drawing approval process
- Component lead time
- Limited manufacturing capacity
- Equipment assembly method
- Data entry into various software
- Non-sequenced equipment delivery

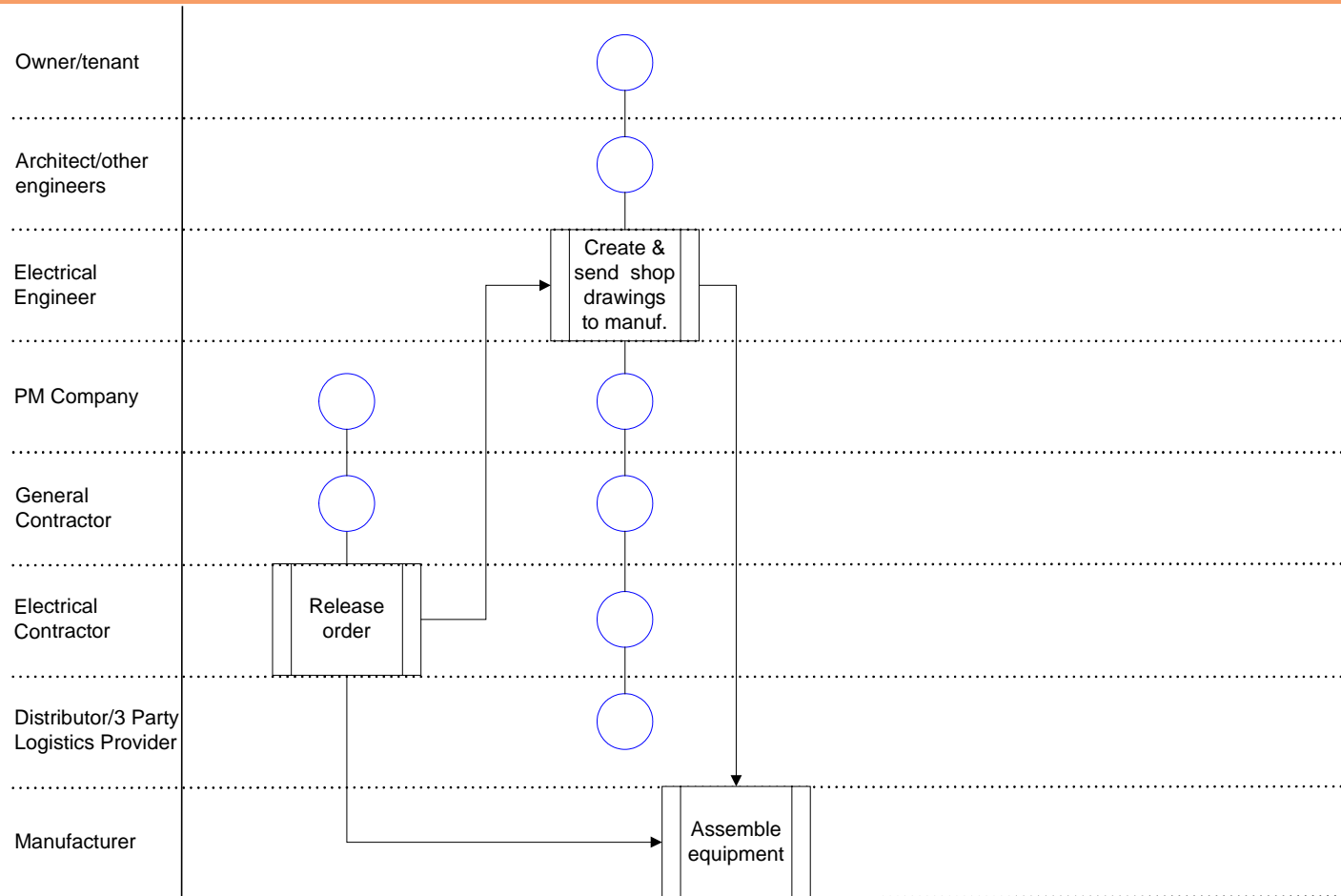
Improvement suggestions

- Reduce document batch
- Standardization of detailed engineering
- Pulled-based design
- Application of manufacturer's configuration software
- Downstream players in upstream decisions
- Postponement of detailed engineering
- Alternative procurement methods to competitive bidding based on complete drawings & specs
- Re-structuring organizational relations
- Changes in manufacturing logic
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Current state map - Procurement



Future state map - Procurement



Conclusions

- Understanding why the process behaves in a certain way is as important as identifying problems and solutions e.g., competitive bidding based on complete specification and current organizational structures were major hindrances to apply lean methods
- 50% of delivery lead time and 30% of labor hours can be saved without any significant investment just with help of TFV and lean methods
- **Future studies**
 - Change order cost (direct and indirect)
 - Process cost of various procurement methods
 - Simulation of construction supply chains
 - What kinds of methods are needed to implement future state maps in a cross-organizational environment?