Lean Aerospace Initiative

Value Creation Through Integration Workshop

Value Stream Analysis and Mapping for PD

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Steps in Lean Thinking
(Womack and Jones)

- Precisely specify value by specific product
- Identify the value stream for each product
- Make value flow without interruptions
- Let the customer pull value from the producer
- Pursue perfection

Want Value Stream techniques for PD

Approach

- Survey use of VSA/VSM tools
- Assess tool capabilities
- Measure effectiveness (lean outcomes)
- Identify best practices
- Synthesize methods into LAI tool

Value Stream Analysis

- **Value Stream Analysis (VSA) is the method by which managers and engineers analyze, plan, and coordinate their company's Product Development efforts.**
  - **These efforts are represented as various steps that add value to a final product, which aggregate to form a stream of value**
  - **VSA is done with an enterprise and overall systems perspective combined with application and process knowledge**
  - **VSA is performed to increase in the understanding of a process**

Value Stream Mapping

- **Value Stream Mapping (VSM) is a method by which the outcomes of Value Stream Analysis are depicted or illustrated.**
  - **May include several types of streams within Product Development (i.e. material, product information, command information, tasks, processes, decisions, inputs/outputs, deliverables, organizations)**
  - **May be used in several phases of VSA (i.e. background research and current, future, and ideal states)**
  - **VSM serves for data collection, communication, and derivation of improvement measures**

Survey Methods

- Research data taken January to August 2000
  - 9 sites, 31 interviews, 48 contributors
  - 1 weeklong Lean PD improvement exercise
  - Semi-structured interview, self-assessment format
- Data Collected
  1. Value Stream Mapping/Process mapping tools used
  2. Lean context
  3. Success of VSA/VSM improvement efforts

Process Mapping Tools

- Six types of tools
  - Gantt Charts
  - Learning To See
  - System Dynamics
  - Ward/LEI
  - Design Structure Matrices (DSMs)
  - Process Flow Maps
- Often several tools used in combination

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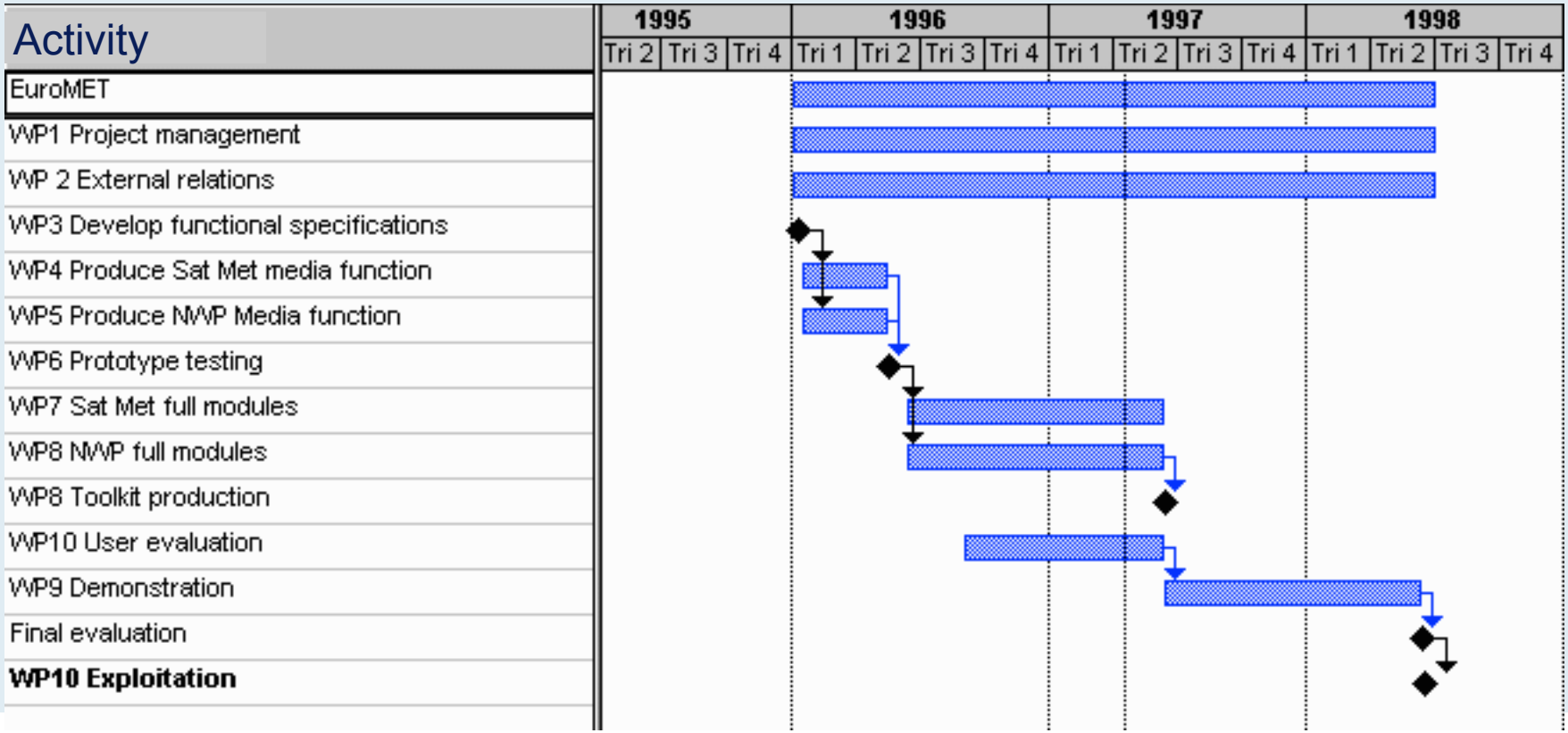
Gantt Chart

- **Scheduling tool highlighting precedence and concurrency**



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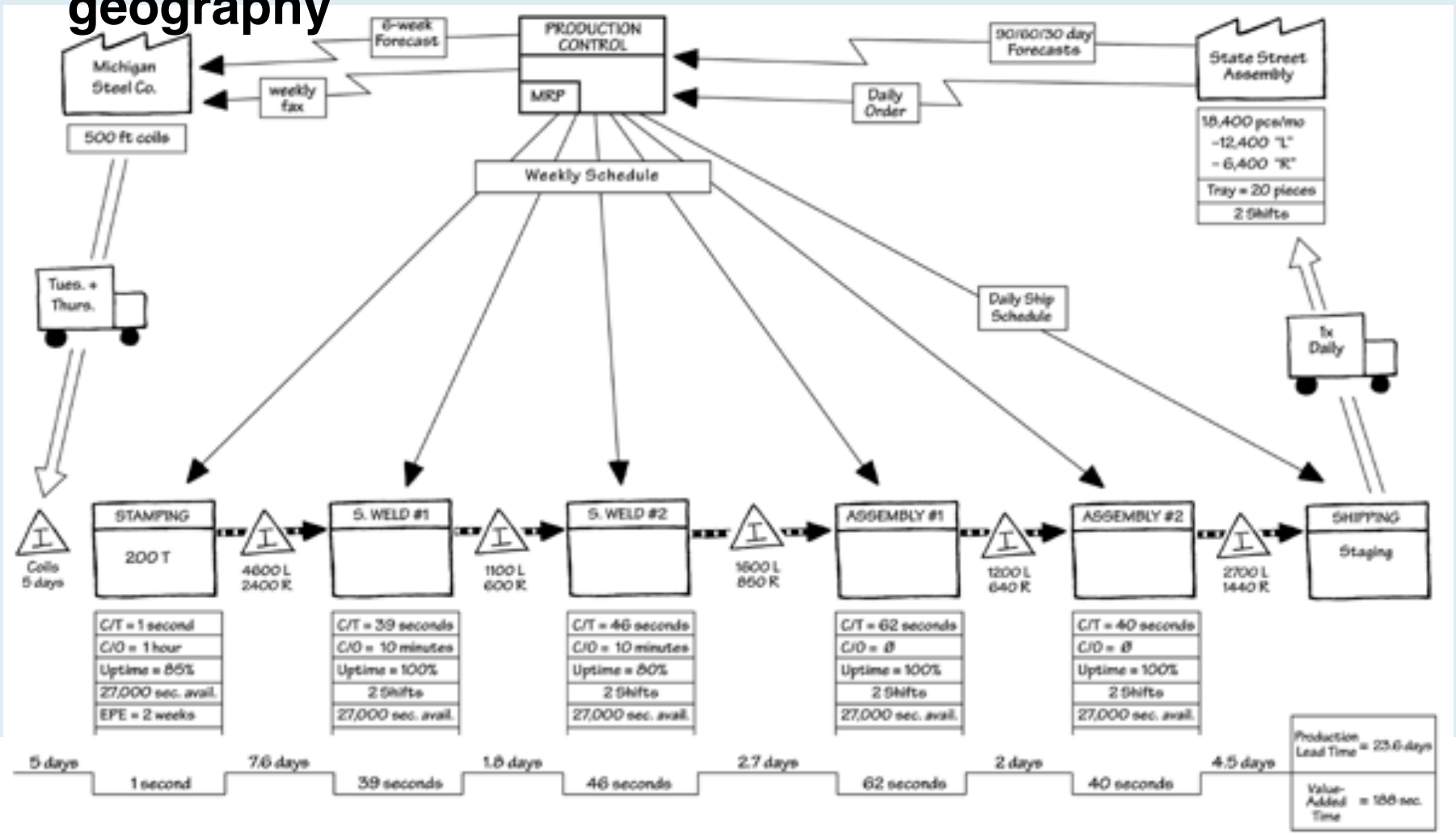
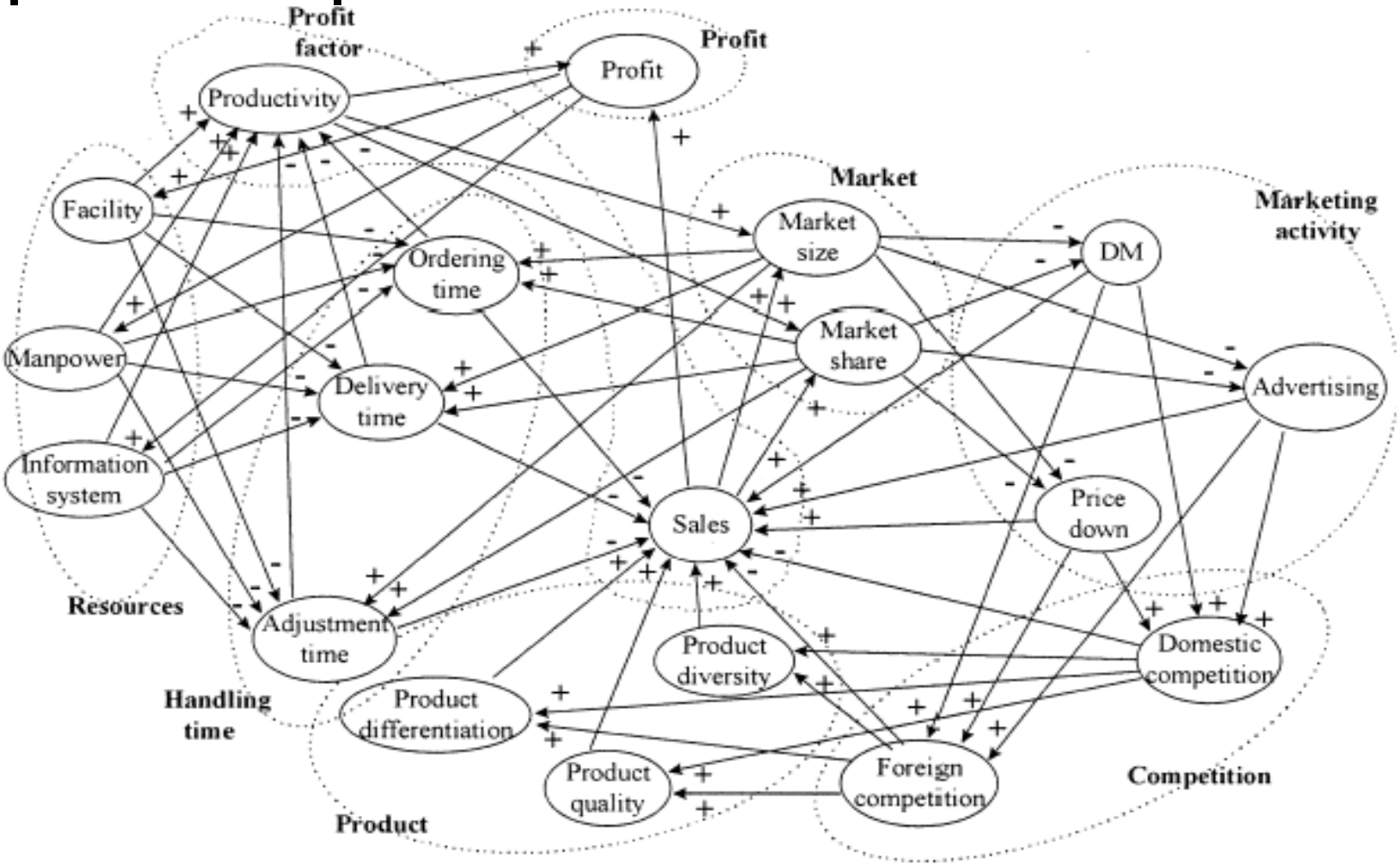
Learning To See

- **Process mapping tool highlighting product flow and geography**

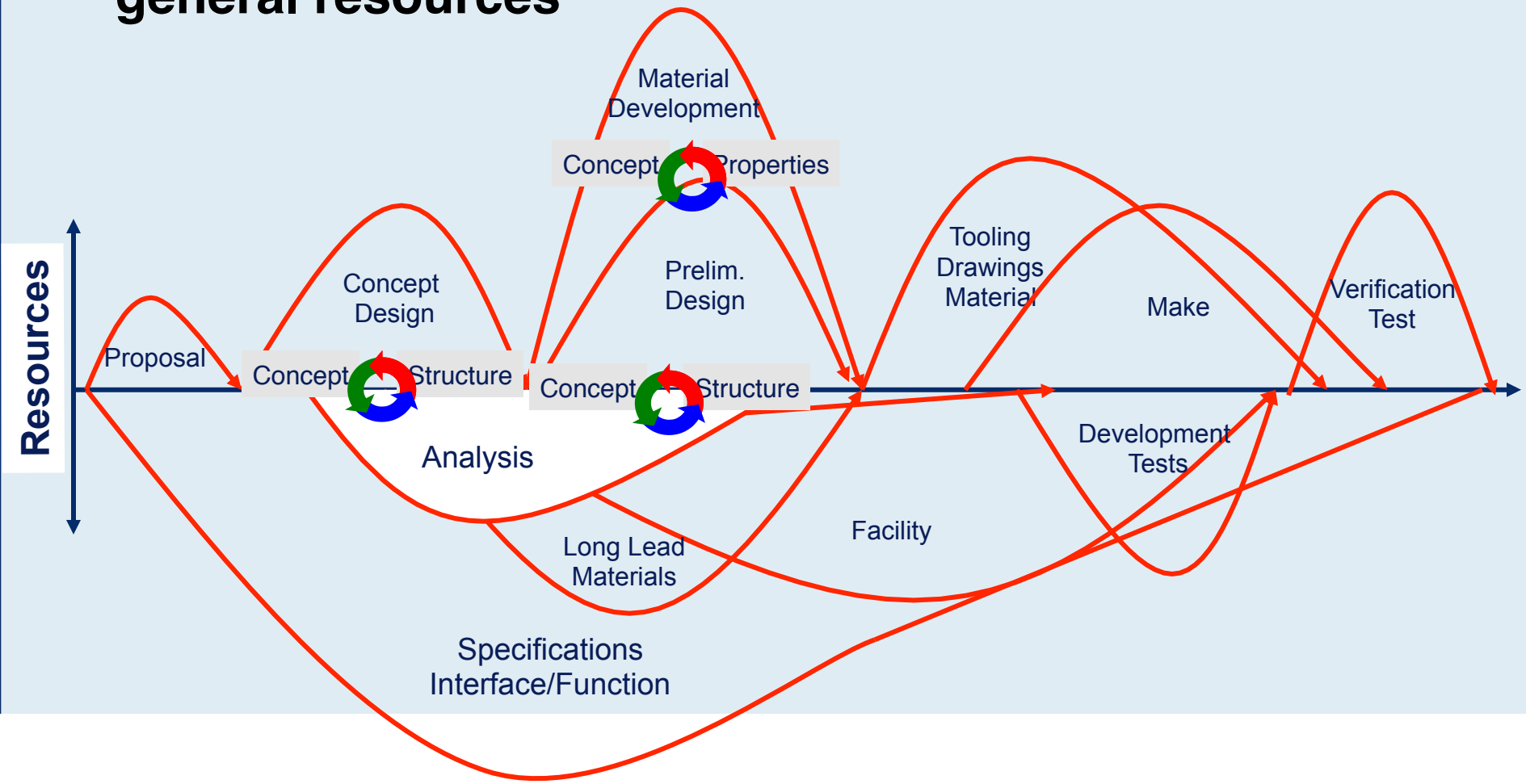


System Dynamics

- **System analysis tool highlighting inputs/outputs and quantified dependencies**



- **System mapping tool highlighting concurrency and general resources**



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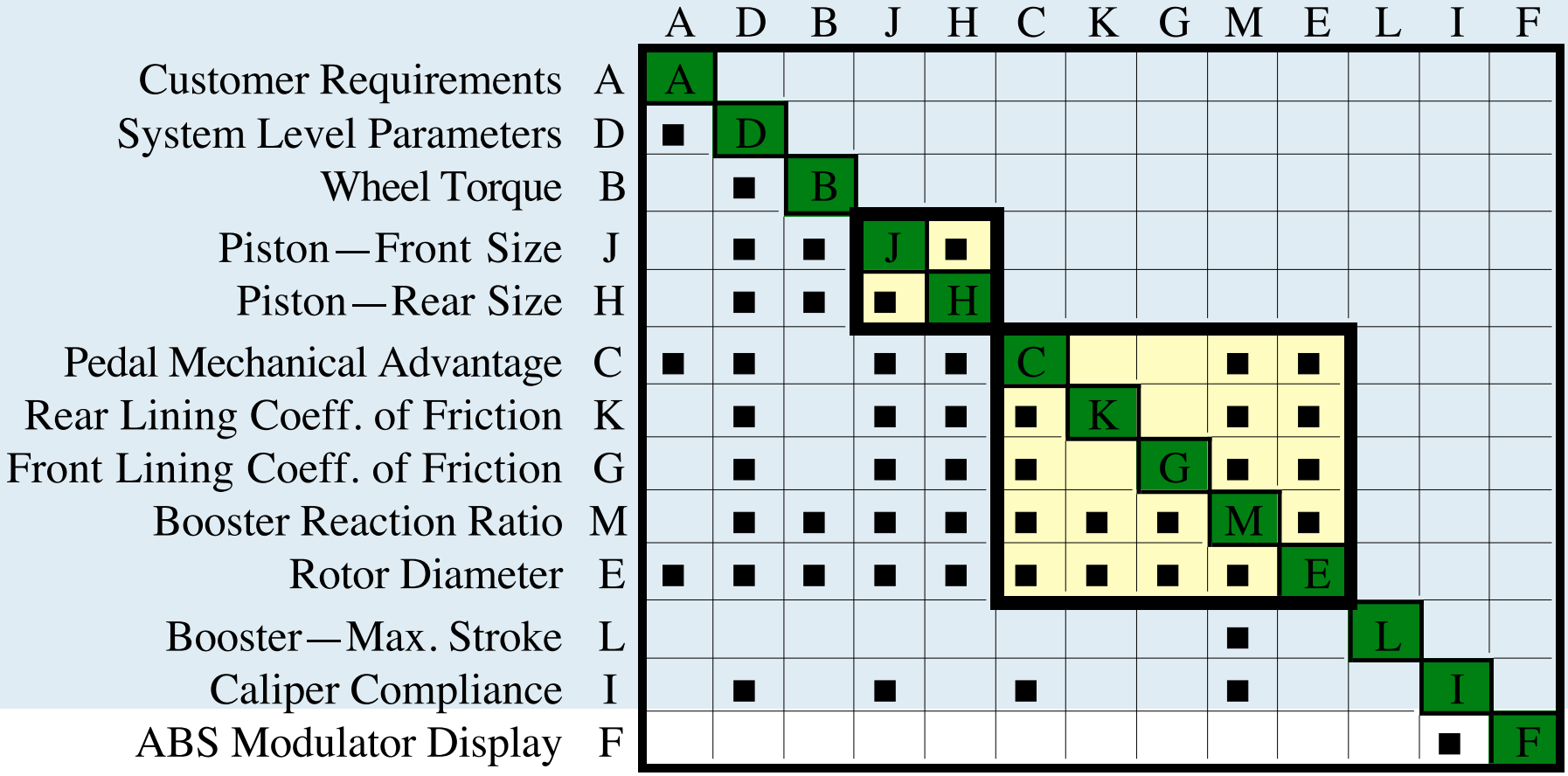
Design Structure Matrix (DSM)

- **Product flow tool highlighting iteration, feedback, and precedence**



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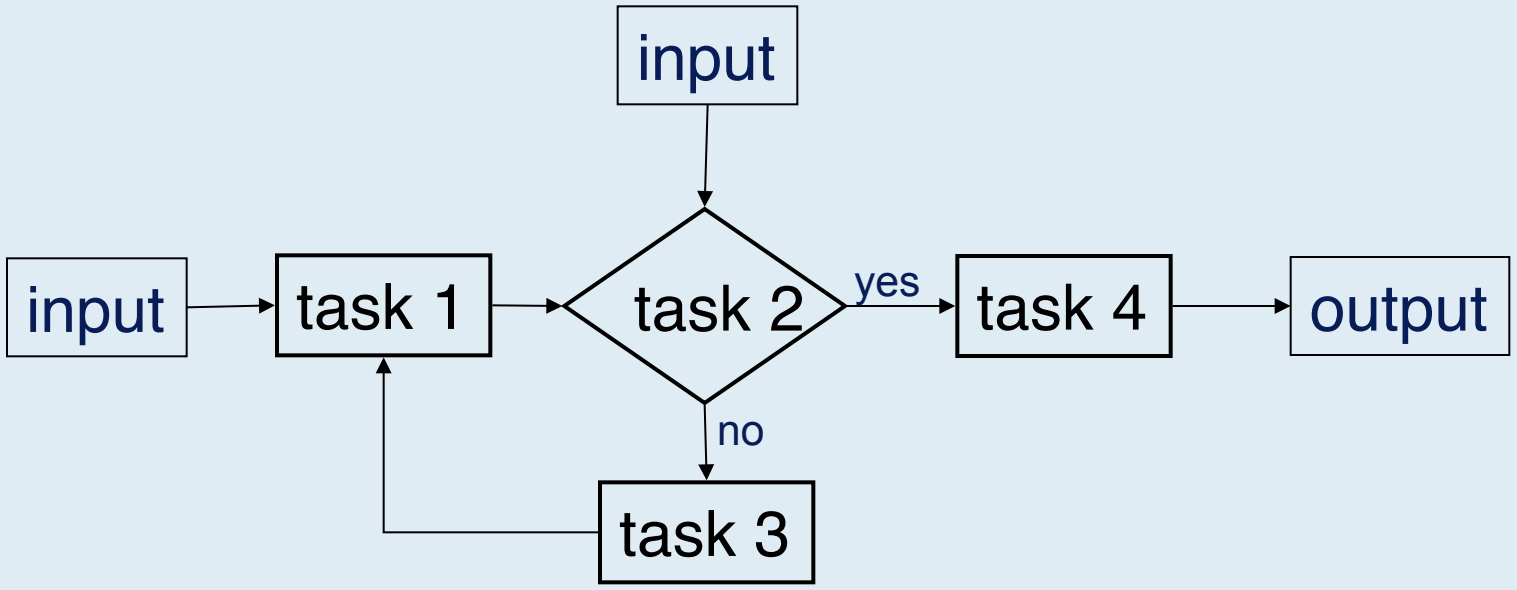
Process Flow Map

- **Process mapping tool highlighting flow, precedence, and metrics**



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VSM Tool Characterization Matrix

Attribute	Gantt	Process Flow	DSM	Learning To See	System Dynamics	Ward/LEI
concurrency	✓		✓		✓	✓
decision branching		✓				
task duration	✓					✓
feed						
flow						
"p						
c						
n						
geography		(✓)		✓		
grouping/teaming			✓			
inputs/outputs		✓		✓	✓	
iteration			✓		✓	✓
generalized						✓
specific	(✓)	(✓)	(✓)	(✓)	(✓)	
start/stop times	✓		(✓)			✓
tasks	✓	✓	✓	✓		✓
value		(✓)		(✓)		(✓)

Various strengths and weaknesses

Different tools good for different uses

Best representation: Ward (1.00), Gantt (.98)

Best analysis: Process Flow (1.00), DSM (0.85)

Lean Context and Success

- **Lean context rated by:**
  1. **Opportunity for Lean education/training**
  2. **General resource allocation**
  3. **Leadership involvement in improvement efforts**
  4. **Organizational Lean integration**
  5. **Lean vision/goal**
- **Self-evaluation of success**

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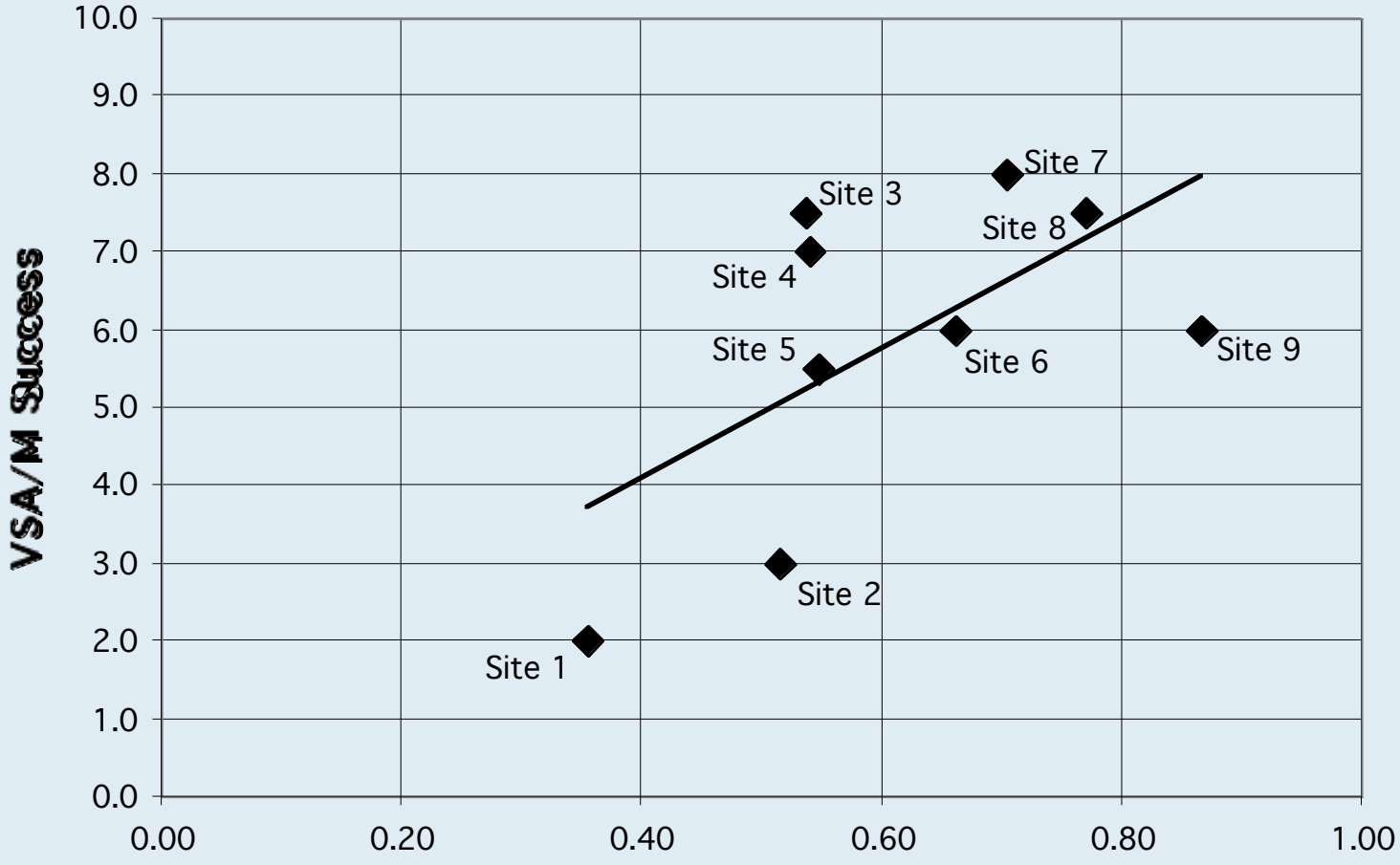
Tool Capability vs. Success



Tool capability key to success?

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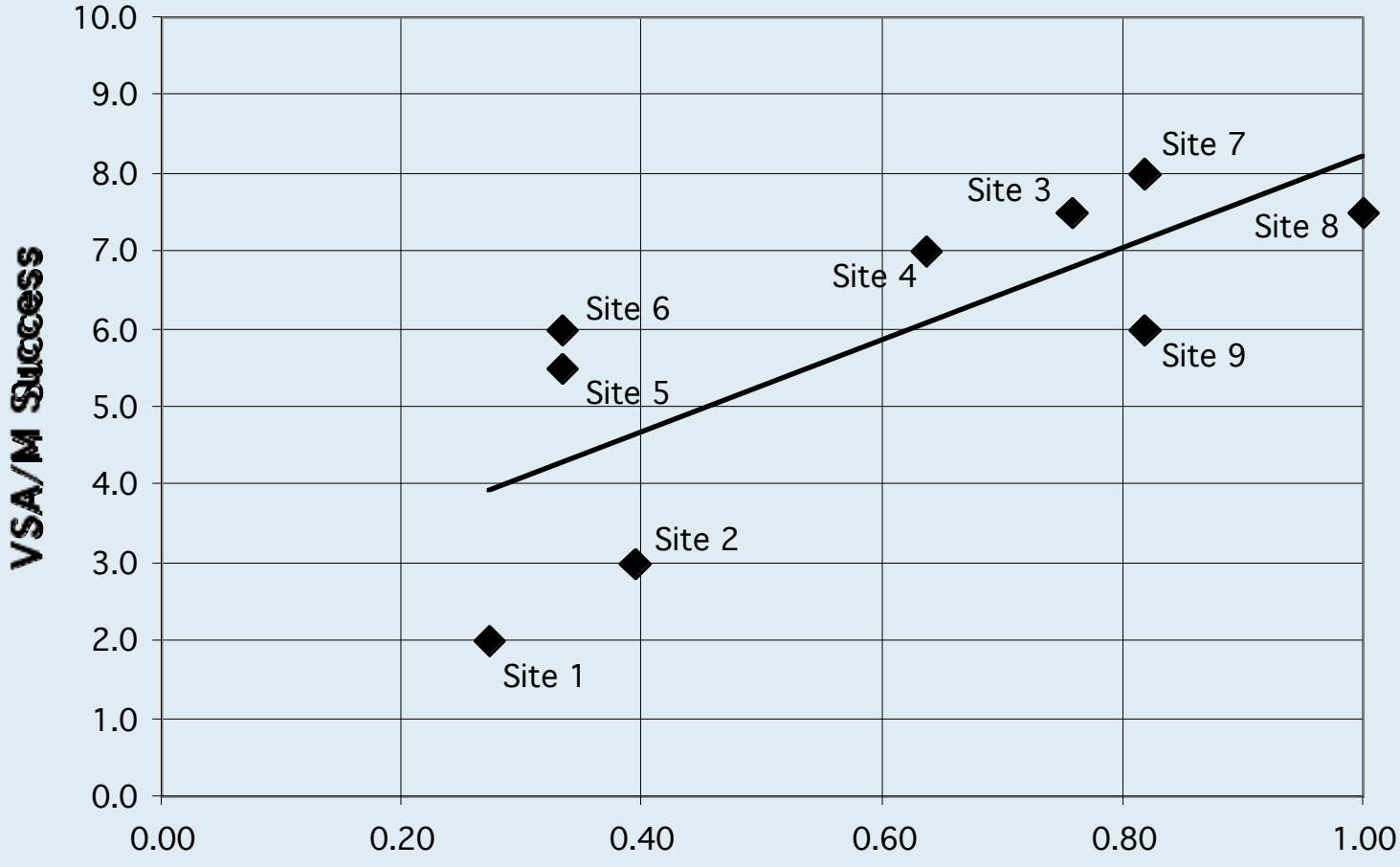
Lean Context vs. Success



Or is it the overall lean environment?

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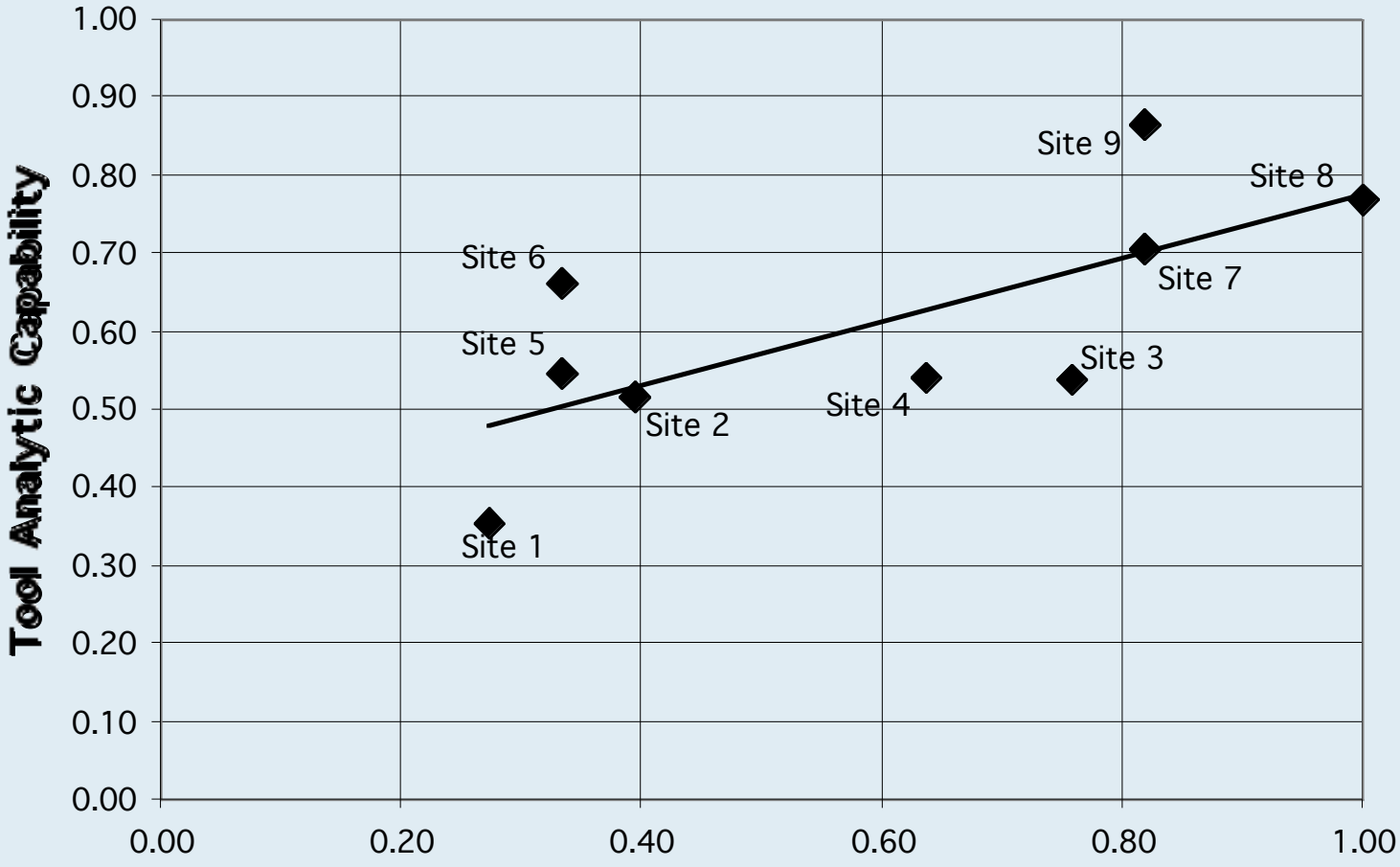
Tool Capability vs. Lean Context



Hard to say…all three correlated

Identify Best Practices

- Not done
- Different tools suitable for different uses
- More capable tools correlate with success
- Cause and effect difficult to establish - more capable tools correlate with overall lean sophistication

Suggestions

High-level representative tool

- Gantt, Ward/LEI
- Definition of Value Stream elements, “big picture”

Detail-level process map

- Determination of value, *what to do* in process
- Using traditional symbols, with appropriate data

Detail-level DSM (Eppinger)

- Optimization, *how to do* process
- Process structure, groupings, concurrency
- Organizational structure, teams
- Product system interactions

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PD Value Stream Data Sheet

General		Resources		
Activity Name	FEM Development	Elapsed Time	4	(days)
Location	Design Station #4	In-process Time	21	(hrs)
Pers./Org. Performing	Fernandez/Chase	Core Task Work Time	19	(hrs)
Completion Criteria	model finished	Activity Based Cost	$1,350	
Success Criteria	analysis with no rework	Special Resources Req.	design station/software	
Other:		Chance of Rework/Time	33 %	5 (hrs)

Input #1		Input #2		Input #3	
Name	Stability & Control	Name	Structural Rqmts.	Name	
Sender	Kirtley	Sender	Uzair/Chambers	Sender	
Transfer	Documentation Report	Transfer	electronic file	Transfer	
Quality	1 2 3 4 5 N/A	Quality	1 2 3 4 5 N/A	Quality	1 2 3 4 5 N/A
Utility	1 2 3 4 5 N/A	Utility	1 2 3 4 5 N/A	Utility	1 2 3 4 5 N/A
Format	1 2 3 4 5 N/A	Format	1 2 3 4 5 N/A	Format	1 2 3 4 5 N/A

Output #1		Output #2		Output #3	
Name	FEM model	Name		Name	
Receiver	Walton	Receiver		Receiver	
Transfer	electronic file	Transfer		Transfer	
Purpose	Allow SS&L Analysis	Purpose		Purpose	

Critical Drivers (metrics/attributes): sensitivity of FEM software: varies based on type of model, and often causes rework

Context (interaction with other VS): must schedule design station and personnel resources

Value

Non-Value-Added 1 - - - - - - - - - 2 - - - - - - - - - 3 - - - - - - - - - 4 - - - - - - - - - 5 Value-Added

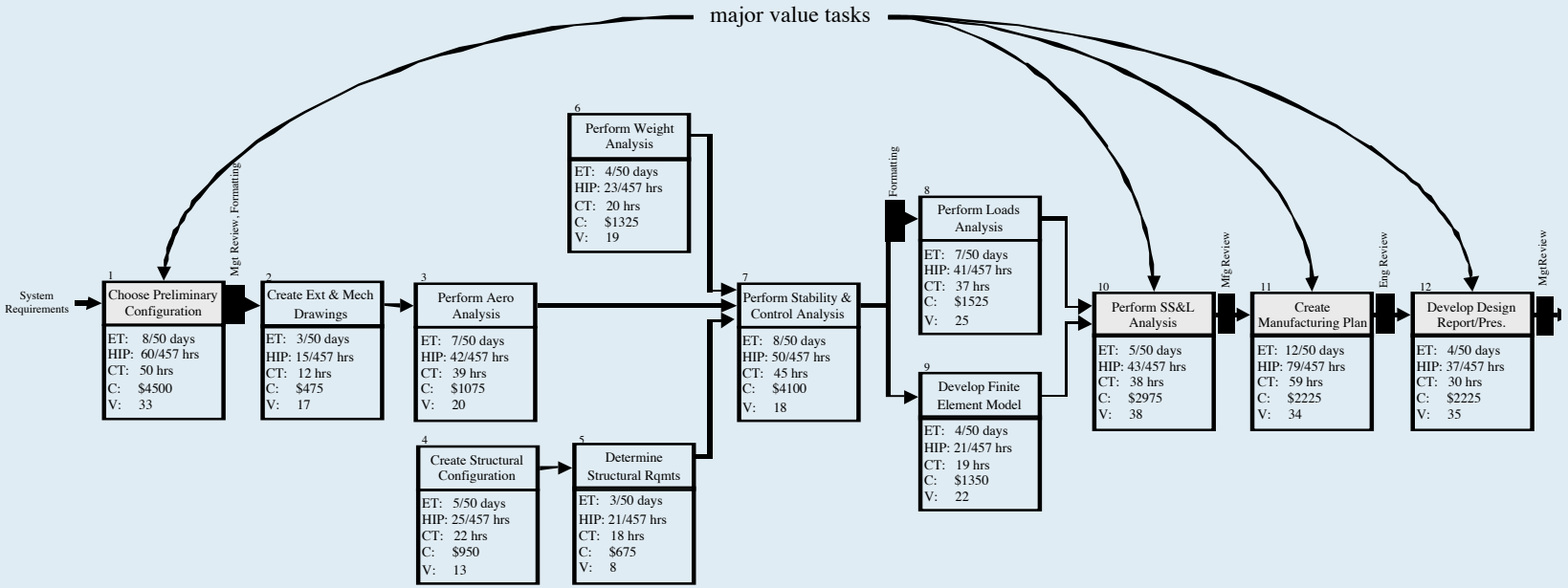
Functional Perform.	1 2 3 4 5 N/A	Enabling Activities	1 2 3 4 5 N/A
Defn. of Processes	1 2 3 4 5 N/A	Cost/Schedule Savings	1 2 3 4 5 N/A
Reduction of Risk	1 2 3 4 5 N/A	Other: employee job sat.	1 2 3 4 5 N/A
Form of Output	1 2 3 4 5 N/A	Other: customer	1 2 3 4 5 N/A

Waste Sources

Waste of Resources	
Waste of Time	waiting for material properties
Waste of Quality	errors in meshing, connectivity
Waste of Opportunity	
Information Waste	
Other:	

Comments/Suggestions (improvement ideas, problems, stress points): over-multitasking of personnel at design station #4 often causes bottlenecks in the process and low flexibility with iteration.

Process Map with Data



Summary

- No simple answer
- Suggest several methods for coarse to fine mapping
- Modified process mapping tool good at detail level
  - Definition of inputs and outputs
  - Right metrics
- Thesis has detailed example

Unlikely to work alone - lean context also important to success

