Projects: Temporary Production Systems

Dr. Glenn Ballard
University of California, Berkeley
Lean Construction Institute

Views of Production

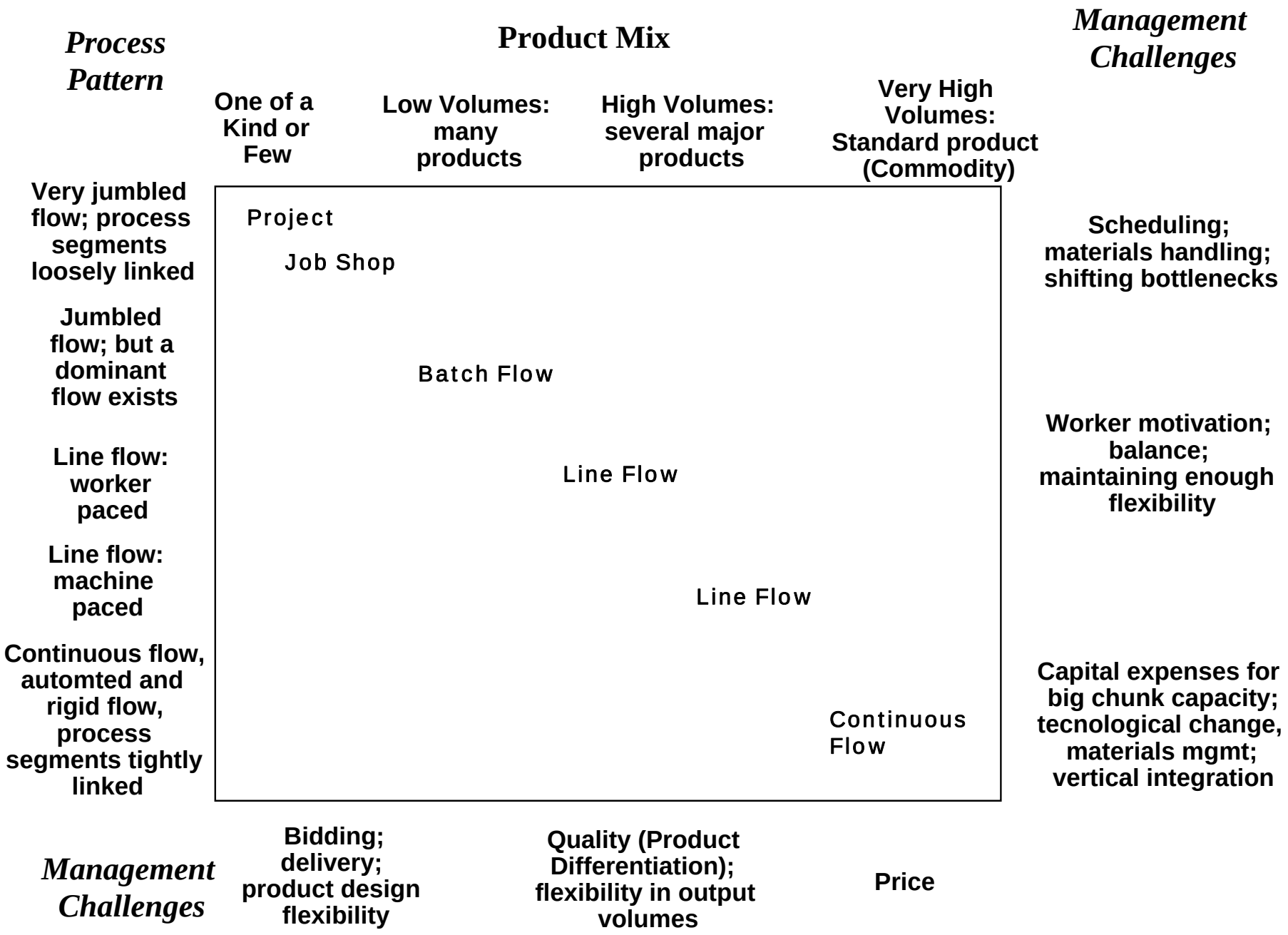
	Transforma-tion View	Flow View	Value View
Concept of production	As a transformation of inputs into outputs	As a flow of info. & material, made up of moving, transformation, inspection, and waiting	As an act of creation
Main principles	Hierarchical decomposition	Elimination of waste; time reduction; variability reduction	Satisfaction of purpose

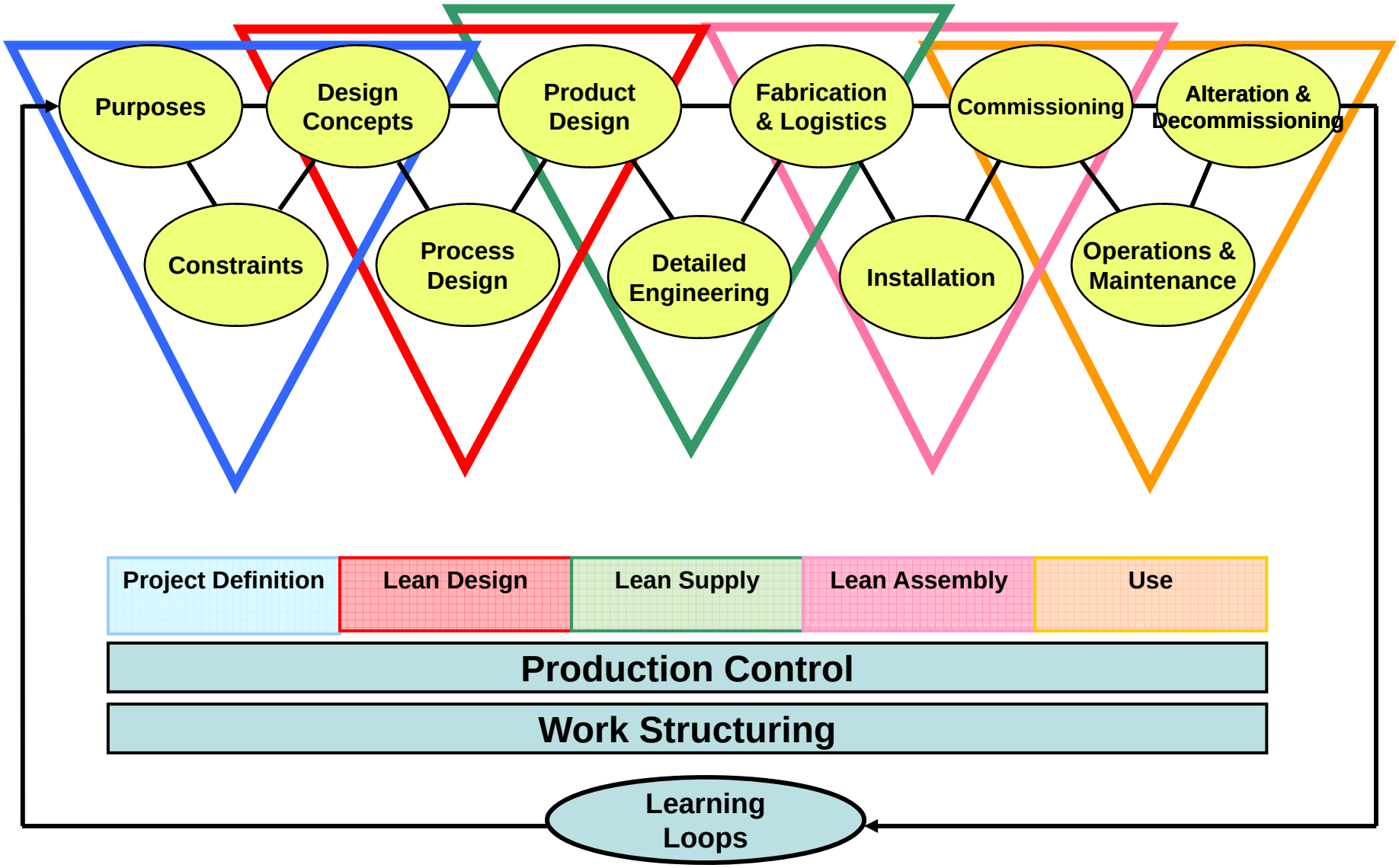
Views of Production

	Transforma-tion View	Flow View	Value View
Methods and practices	Work breakdown structure, MRP, organizational responsibility chart	Continuous flow, pull, continuous improvement	Testing purpose against constraints, translating from VOC, inspecting vs purpose
Practical contribution	Taking care of what has to be done	Taking care that what is unnecessary is done as little as possible	Taking care that the product allows customers to accomplish their purposes

Definition

- To produce is to design and make

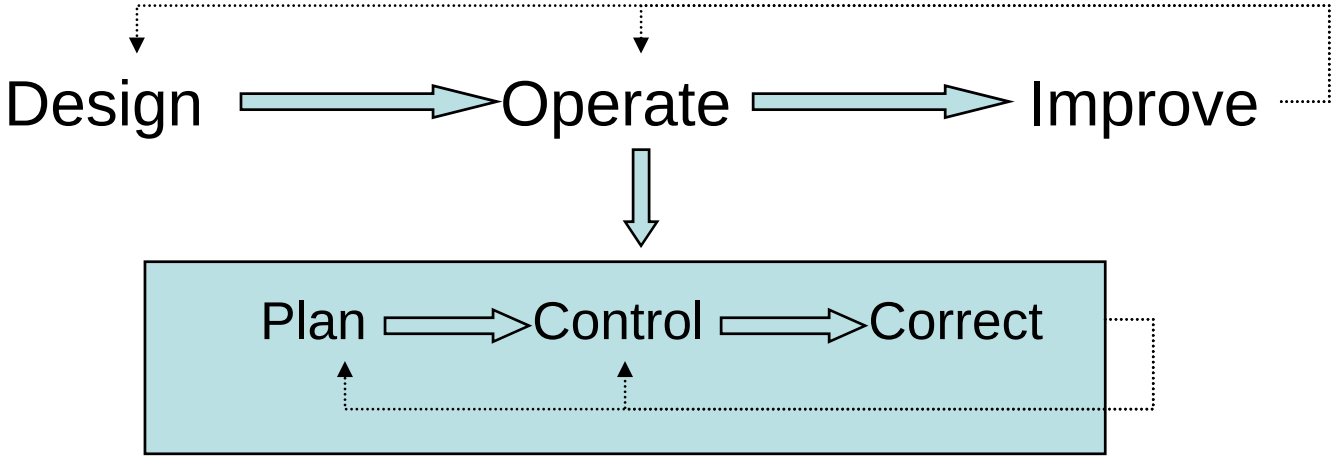

Process Pattern
Product Mix
Management Challenges
One of a Kind or Few
Low Volumes: many products
High Volumes: several major products
Very High Volumes: Standard product (Commodity)
Very jumbled flow; process segments loosely linked
Jumbled flow; but a dominant flow exists
Line flow: worker paced
Line flow: machine paced
Continuous flow, automted and rigid flow, process segments tightly linked
Project
Job Shop
Batch Flow
Line Flow
Line Flow
Continuous Flow
Scheduling; materials handling; shifting bottlenecks
Worker motivation; balance; maintaining enough flexibility
Capital expenses for big chunk capacity; tecnological change, materials mgmt; vertical integration
Management Challenges
Bidding; delivery; product design flexibility
Quality (Product Differentiation); flexibility in output volumes
Price


Purposes
Design Concepts
Product Design
Fabrication & Logistics
Commissioning
Alteration & Decommissioning
Constraints
Process Design
Detailed Engineering
Installation
Operations & Maintenance
Project Definition
Lean Design
Lean Supply
Lean Assembly
Use
Production Control
Work Structuring
Learning Loops

Key Characteristics of Projects

- Frequent restructuring is needed as work load changes quantitatively and qualitatively through the course of a project
- Value is defined within the delivery process
- Stability is achieved by making work flow reliable
- Collaboration is necessary to coordinate action versus the synchronization that results from structure and adjustment
- System optimization is achieved when money can move across organizational boundaries in search of the best system-level investment
- Relational contracts are needed

Theory of Production System Management



- To the extent that capital projects involve making things, the concepts and methods of the Toyota Production System definitely apply, but for projects as a whole, Toyota's Product Development System is a more appropriate model and inspiration because product development is also a type of project production system.

Toyota Product Development System-Publications

- Womack, Jones & Roos' *The Machine That Changed the World*, 1990
- Clark & Fujimoto's *Product Development Performance*, 1991
- Ward et al's "The Second Toyota Paradox: How Delaying Decisions Can Make Better Cars Faster", 1995
- Womack & Jones' *Lean Thinking*, 1996
- Sobek et al's "Another Look at How Toyota Integrates Product Development", 1998
- Sobek et al's "Toyota's Principles of Set-Based Concurrent Engineering", 1999
- Fujimoto's *The Evolution of a Manufacturing System at Toyota*, 1999
- National Center for Manufacturing Sciences' *Product Development Process-Methodology and Performance Measures,* 2000
- Kennedy's *Product Development for the Lean Enterprise,* 2003
- Liker's *The Toyota Way*, 2004

Toyota Product Development System—according to Sobek et al

- Mutual adjustment as opposed to rigidly preprogrammed processes; facilitated by methodical preparation for meetings and disciplined meeting management
- Mentoring supervisors, not facilitators or coaches, but mentors, who teach both technical and social skills through questioning, not through commanding
- Integrative leaders. This is a return to Clark and Fujimoto's *shusa*, now characterized as the Lead Designer, in line with Womack et al's "supercraftsman", but at odds with the idea of a 'super project manager'.

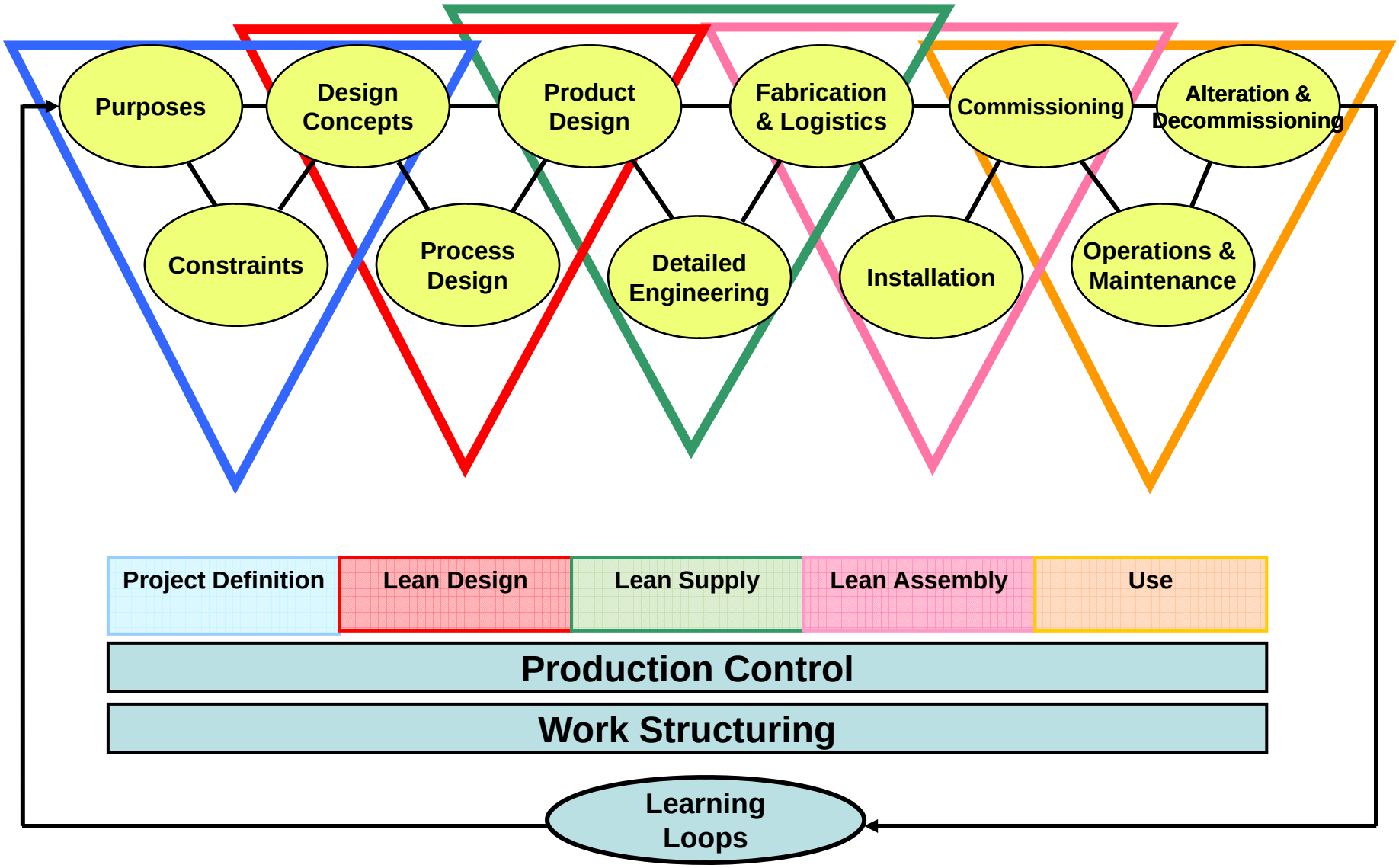
Toyota Product Development System—according to Sobek et al

- Standardization of processes and skills in functional specialties to increase predictability of what will be produced from each specialist—obviously a necessity for set based design. This process involves on the job training, rotation within a functional group until management level (10+ years), then rotation across functional groups to develop a network of mutual obligation—because a highly skilled specialist will not be able to function as a mentoring supervisor in another functional group.

Toyota Product Development System—according to Sobek et al

- Standardization of the product development process—but at the milestone level, with substantial discretion of the project team to shape and modify.
- Standardization of design. Functional groups maintain extensive checklists for evaluating the adequacy of a design option, but those checklists are maintained by each functional department, not by some centralized group of ‘planners’, and are continuously updated to reflect new knowledge and innovations. These design standards are also expressed in terms of sets, ranges of acceptable values or sets of viable solutions, not point values, unlike most design standards.
- The authors conclude by pointing the reader to what they believe is the secret to Toyota’s success in product development; namely, recognition that “…people, not systems, design cars.”

Toyota’s outstanding capability is the capability of reinventing itself, not in response to changes in its environment, but rather in anticipation of changes in its environment, so that it becomes an environmental force itself.


Purposes
Design Concepts
Product Design
Fabrication & Logistics
Commissioning
Alteration & Decommissioning
Constraints
Process Design
Detailed Engineering
Installation
Operations & Maintenance
Project Definition
Lean Design
Lean Supply
Lean Assembly
Use
Production Control
Work Structuring
Learning Loops

Lean is a journey

- Lean is a journey, not a destination. Consequently, the roadmap for implementing lean should be understood as a map for getting you up the ramp and onto the lean highway of continuous improvement and learning. One key milestone along the way is the demonstration project.

To launch your organization on the lean journey, and to take advantage of the lean revolution in project delivery, you should:

1. start in your own house, educate yourself and your people, apply lean principles and tools such as 5S and value stream mapping to processes within your direct control, and prepare your people for the changes to come.

Having begun your own lean journey, you should:

2. start demonstration projects and request that the companies with which you interface also pursue lean goals, act in accordance with lean principles and use lean methods and tools, and help them do so.

The next milestones along the ramp are:

3. deployment of lean principles and practices to all projects and
4. wider integration of the supply chains in which you are a member.

Publications reporting on lean implementations

Petroleos de Venezuela's PARC project

Ballard, Glenn, Gregory Howell, and Michael Casten (1996). "PARC: A Case Study."

Koch Refining's Mid-Plant Project

Howell, Gregory and Glenn Ballard (1994a). "Lean Production Theory: Moving Beyond 'Can-Do'."

Ballard, Glenn and Gregory Howell (1994a). "Implementing Lean Construction: Stabilizing Work Flow."

Howell, Gregory and Glenn Ballard (1994b). "Implementing Lean Construction: Reducing Inflow Variation."

Ballard, Glenn and Gregory Howell (1994b). "Implementing Lean Construction: Improving Performance Behind the Shield."

.

Nokia twin towers

Koskela, Lauri, Glenn Ballard, and Veli-Pekka Tanhuanpaa (1997). "Towards Lean Design Management."

Texas Showplace

Ballard, Glenn (2000). *The Last Planner System of Production Control.* PhD thesis

Malling (precast concrete fabricator)

Ballard, Glenn, Nigel Harper, and Todd Zabelle (2003). "Learning to See Work Flow: Application of Lean Production Concepts to Precast Concrete Fabrication."

Terminal 5, Heathrow Airport

Arbulu, Roberto, Glenn Ballard and Nigel Harper (2003). "Kanban in Construction".

Arbulu, Roberto and Glenn Ballard (2004). "Lean Supply Systems in Construction".

Ballard, Glenn (2006). "Innovations in Lean Design". Presented at the University of Cincinnati, April 26, 2006.

Analytical and Conceptual Models

- Howell & Ballard (1995). *Managing Uncertainty in the Piping Function.* Construction Industry Institute QQ
- Howell & Ballard (1998). “Implementing Lean Construction”. *Proceedings of the 7th annual conference of the International Group for Lean Construction*, Guaruja, Brazil. QQ
- Ballard & Koskela (1998). “On the Agenda of Design Management Research”. *Proceedings of the 7th annual conference of the International Group for Lean Construction*, QQ
- Tommelein & Weissenberger (1999). “Not Just-in-Time: Structural Steel Supply and Construction Processes”. *Proceedings of the 7th annual conference of the International Group for Lean Construction*, QQ
- Ballard (2000). “Positive versus Negative Iteration in Design”. *Proceedings of the 7th annual conference of the International Group for Lean Construction, QQ*
- Kim & Ballard (2000). “Is the Earned Value Method an Enemy of Work Flow?”. *Proceedings of the 7th annual conference of the International Group for Lean Construction,* QQ
- Gil, et al (2001). “Leveraging Specialty Contractor Knowledge in Design”. QQ
- Howell, et al (2001). “Capacity Utilization and Wait Time”. QQ
- Howell, et al (2002). “Working Near the Edge: A New Approach to Construction Safety”. *Proceedings of the 7th annual conference of the International Group for Lean Construction,* QQ
- Elfving, et al (2004). “Improving the delivery process for engineered-to-order products”. *Proceedings of the 7th annual conference of the International Group for Lean Construction,* QQ
- Ballard & Arbulu (2004). “Taking Prefabrication Lean”. *Proceedings of the 7th annual conference of the International Group for Lean Construction,* QQ
- Ballard, et al (2006). “Assignment setup: Building block for agility in project production systems”.