

Defining Lean Engineering

3-D | 2:30 - 3:15 pm

Instructor: Andy Pattantys

Lean Engineering is about eliminating the wasteful habits and practices that cause workflow to stop. Keeping design work flowing requires subdividing the work, getting started with incomplete information, managing queue time and eliminating the causes of lost time. In engineering and design, it is the overall timeline that has the most value. This is because most other items in the Value Stream, such as ordering parts or designing the production line, cannot be completed until the design is done. Organizing the workflow is a “systems engineering” task. In other words, the “design factory” itself must be designed to create a system for efficient workflow. The major elements of Lean Engineering are:

1. Define Value
2. Define Requirements
3. Establish a System Architecture
4. Subdivide the Work
5. Learn to Work with Incomplete Info
6. Focus on the Flow to make it Lean
7. Provide a Supportive Environment
8. Eliminate Waste

Define Value

In the Lean world, it is the customer who defines value. Everything else that is not directly in service of customer value is waste. In engineering and design, the timeline is the factor with the most value, often in the tens of thousands of dollars per day. Clarity about value to the customer and the value of the timeline informs all other decisions during the design process.

Define Requirements

The requirements are a formal interpretation of what the customer wants. Functional requirements guide all design efforts, but are often not very accessible, buried in hundreds of pages of documents, with uncertain dependencies. A disciplined approach to organizing the requirements, using the right tools, can yield the architecture of the product and the organization of the project, even before design begins.

Establish a System Architecture

Many complex products have a system architect who defines the system architecture, but many more products do not have a formal architecture. Even a relatively simple product, like a bicycle, can benefit from system architecture, because it is architecture that enables the proper division of a product into its logical modules. System architecture is what unleashes the value and hidden power of modularity.

Subdivide the Work

In most markets, there is a tremendous pressure to do the engineering and design in a reasonable time. Faster is better, provided the designers get it right. For big systems and complex products, the only feasible approach is a massively parallel design effort, where the work is logically subdivided. The trick is

to subdivide the work in a manner that is minimally coupled, to minimize the amount of communicating that each person must do. To divide the work, assumptions must be made, adding risk to the project. The assumptions must be tracked so they don't become liabilities during system integration.

Learn to Work with Incomplete Information

All engineers and designers naturally work with incomplete information, because there is no other choice given the timeline pressure. Designers will make assumptions as necessary to keep moving forward. These assumptions are not usually captured formally and cataloged. Over time, assumptions and knowledge gaps are either forgotten, or become "fact" through usage. If not resolved, these assumptions and undefined parameters inevitably become future liabilities, manifesting as "surprises" late in the project, usually during system integration. To avoid integration risk, all assumptions and unknowns must be actively managed and resolved in a timely fashion.

Focus on the Flow to make it Lean

Anything that is anti-flow is anti-lean. When flow stops, the time that accumulates is Non-Value Added (NVA). For any element of the product or system, most of the lead time is NVA, usually by a factor of 10 to 1 or more. By now, computers and CAD have completely replaced the drafting board, but the lead time gains are much less than were originally expected. The difficulty with managing the design timeline is that the queues are "invisible" and thus are difficult to see well enough to manage. A Lean enterprise makes its queues visible, to enable effective management the queue backlog and waiting time.

Provide a Supportive Environment

An environment that supports the engineering staff reduces the amount of time spent in meetings to a bare minimum. Libraries of parts and standard designs, as well as BOM generation tools, minimize all the small reasons for lost time. CAD standards, enforced through templates, enable designers to focus on the design, rather than the minutia of title blocks, text size and style, arrowheads, and significant figures.

Eliminate Waste

In engineering and design, waste is lost time. Time is lost two ways: 1) inefficient processes that don't manage queue time, and 2) rework. Inefficient processes waste time in many small increments, in a manner that is invisible. Rework results from false assumptions and overlooked parameters, and tend to be huge whoppers; the budget and schedule killers that manifest during systems integration or production, when all the pieces must come together and function harmoniously.

The Lean enterprise understands what the customer values and then focuses on the flow to deliver that value most efficiently. Waste is identified and eliminated by first focusing the work to deliver only what the customer values, and then by systematically eliminating the factors that cause work flow to stop. Engineering is a "Design Factory", and like any factory, it can benefit from system engineering, where the factory is specifically designed to keep the work flowing efficiently.

Andy Pattantysus is President of Strategic Modularity Inc., a consulting firm specializing in Lean Manufacturing and Systems Engineering. Go to www.strategicmodularity.com to find information about Lean Manufacturing. Contact Andy at andyp@strategicmodularity.com or 661-312-5898. Strategic Modularity Inc. is a proud member of The ACA Group, a consulting alliance that specializes in all aspects of Operations Management, including production, inventory, and supply chain. www.theacagroup.com