

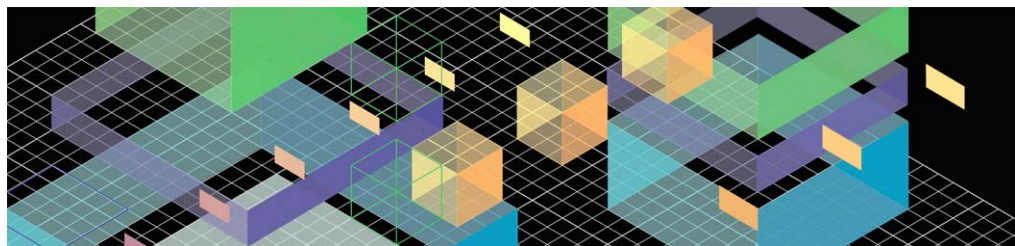


The Eight Wastes: A Lexicon for Lean NPD

The past decade has seen an expansion of Lean principles, tools and methods to the broader Lean Enterprise, extending beyond the factory floor and encompassing the administrative and commercial functions of the business. As product innovation increasingly becomes the key driver of organic growth, companies are seeking enhanced capability in New Product Development (NPD). As such, NPD has emerged as a strategic opportunity area for the application of Lean principles and concepts in reducing speed-to-market and development cost while delivering right-first-time quality and efficient market introduction. At the same time, the body of knowledge relating to the direct and specific application of Lean tools and principles to NPD is relatively sparse.

The introduction of Lean concepts to functional areas of the company outside of factory operations can be a challenge. Even today, the term “Lean” may produce an image of cellular manufacturing supported by kanban/pull, heijunka boards, etc. But Lean is much, much more. Its principles apply to every business process for which there is a customer, an output and an input. Once the translation of Lean principles is communicated and understood by the organization, and once people experience the power and impact of Lean on their key business processes via hands-on application, the game changes and the business benefits.

Product Development is viewed by some as the “Holy Grail” of Lean implementation in that it is one of the more elusive business processes to apply Lean tools and rigor. In truth, there are unique cultural perceptions and barriers that must be overcome in order to win the Lean game in NPD. Since learning to identify waste is an obvious prerequisite for eliminating it, a first step in addressing the Lean NPD opportunity is learning to see the waste.



Debunking the Myths of Lean NPD

As a preparatory step in learning to see waste in the NPD process, it is important to address the common concerns, fears, uncertainties and misconceptions regarding Lean as it applies to NPD. Several of the more common myths:

1. “Lean only applies to the factory. It won’t work in my area.”
2. “We can’t apply Lean to NPD because what we do is not repetitive.”
3. “Product Design is creative, based on discovery and innovation; Lean will remove all creativity by forcing us to work to standards.”
4. “Lean works well only on linear processes. Product Development is project-based and has multiple parallel processes and task dependencies. Lean is simplistic”
5. “Every task is executed differently on every project; you can’t implement standardized work on projects.”
6. “We follow a rigid, documented product development methodology which is already Lean.”
7. “The time and cost of our projects is based on complexity and scope; forcing reductions may compromise the quality of the product.”
8. “We don’t have 100% dedicated resources for projects; we work from shared resource pools.”
9. “There is no ‘Gemba’ (visible production area) in product development because design teams are not co-located and much of the work is subcontracted.”
10. “Customer demand and Takt time are not relevant because there is no customer; we work to the project deadline.”

The foregoing examples of a cultural mindset regarding the application of Lean to NPD are important to understand and manage when removing waste from the NPD process.

Applying the Eight Wastes to NPD

The concept of the Lean Factory and the Lean Enterprise is based on the systematic identification and elimination of waste in every business process in order to drive value to the customer. Taiichi Ohno, founder of the Toyota Production System, coined the term “Seven Wastes” after observing various wasteful activities on the shop floor. In 1996, James Womack, in his book *Lean Thinking*, identified an eighth waste—the waste of underutilized employee intellect. A Lean value stream is one in which waste has been eliminated and where value flows. Generic definitions of the eight wastes follow:

The Eight Wastes

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|--------------------|---|
| 1. Motion | Excessive movement by people or equipment |
| 2. Transportation | Product moving from person to person or between locations |
| 3. Over Production | Producing more product than is required at the current time |

- | | |
|--------------------|---|
| 4. Over Processing | Unnecessary content - beyond what is required to meet customer requirements |
| 5. Waiting | Period of inactivity while waiting for the next process step to commence |
| 6. Inventory | Accumulations of unprocessed, partially processed or finished products |
| 7. Defects | Process steps that result in scrap, rework, or reprocessing |
| 8. Behavioral | Unused creativity and underutilized human capital |

All of these wastes apply to NPD, but it takes some interpretation and skill to learn to identify them. The following guidelines seek to provide a useful lexicon for identifying waste in the NPD process.

Waste #1: Motion

Excessive motion is a waste because it consumes time and resources without producing value. Classically defined, motion waste refers to people moving within and outside of their immediate work area to find tools or materials. In NPD, this same definition applies. A design engineer may frequently go in search of drawings and plots, retrieve project files, and collect work-product from a remotely located shared printer. Whereas, in a factory environment, a worker should ideally be able to perform his/her job without leaving the manufacturing cell and with minimum movement within the cell (i.e., walking, bending, reaching). The same is true of an engineering office!

A more sophisticated example of motion waste regards the requisite number of ‘clicks’ within or between computer applications. Think about how many clicks it takes to navigate from one application to another in a computer-based environment.

Walking around—digitally! Think further about the many transitions between software applications executed per person per day and how many minutes are spent traversing screens. If you were to go to Gemba and observe this for a day with a pad and stopwatch, you would be surprised at waste of productivity.

Seconds and minutes add up quickly over the lifespan of a multi-month development project with dozens or even hundreds of people.

Think about the time spent during the course of a day searching online for files and data. This could add up to hours per day per person consumed looking for the correct files and latest revisions. The reason this escapes scrutiny as motion waste is because when observed, the

Case Study - Motion

During a major software development project, complaints were growing among the project team members (80 in total) about the difficulty of finding correct file revisions, which included design specs and coded objects. Team members would search for minutes and sometimes hours attempting to locate the correct file. Frustrated, they would resort to e-mailing each other or ‘walking the hallways’ in search of the correct file. Aside from this wasteful time spent, the result was often less than 100% evidenced by the use of obsolete files being used—causing defects, rework and waste.

The project had a shared file server that was accessible by all team members and was organized by the eight project sub-teams. After doing some research, it was revealed that the project server contained over 30,000 files and folders. File organization and revision control was spotty—at best. It was unsurprising that productivity and quality were low! The problem was corrected via application of Lean tools; a combination of (digital) 5S for server organization, new documented file management processes and Standardized Work.

individual is stationary; but nevertheless, there is unnecessary, non-value-adding motion in traversing the digital world in searching for the ‘materials’ needed.

Waste #2: Transportation

Transportation waste is distinguished from motion waste in that it occurs when the product itself is moved from one location to another within the process. While the product is moving, no value is added to it. Transportation waste is easy to recognize in the factory because you can readily observe products moving through the process on push carts or forklifts or by crane. In NPD, there may be analogous instances of transportation waste such as the movement of a physical drawing package through the office to be reviewed and approved or to be moved to the next individuals’ desk or work area for processing.

In the more technologically sophisticated NPD environments, there is no paper, no Mylar, no sepias. It is a digital world that is “paperless” and so it is presumed that the transportation waste does not exist or is at least insignificant since electronic conveyance is at the “speed of light.” In fact, we have to think about this waste differently. Just as we counted “clicks” to recognize the waste of motion, here we count hand offs. Every time we hand off the design product to another person, organization, design partner company, etc., we can consider that as transportation waste. Why? The hand off itself adds no value to the product design. In an ideal state, there would be no hand offs at all and the development of the product would be a continuous flow of value-adding tasks performed by each person. This seems unrealistic, of course, but the concept of waste elimination in Lean thinking is to migrate toward the ideal state—perfect-quality products that flow continuously and accumulate no inventory. Hand offs also result in other wastes such as inventory and waiting and should, therefore, be minimized wherever possible. Every juncture in the NPD process where we observe a hand off should be a yellow flag and an invitation to ask the “5 Whys.”

Waste #3: Over Production

Over production is a waste because it produces product that is not currently needed or product that is not needed at all. The three tenets of just-in-time manufacturing in the Toyota Production System are to produce:

- Only the products required
- Only the quantity required
- Only when needed

This is the basis for the Lean philosophies underlying kanban and pull systems on the factory floor to control and regulate Over Production.

One of the classic reasons given for over production in the factory is to keep people and machines busy to maximize their efficiency. This notion of “efficient utilization” is flawed by the offsetting and resultant waste of inventory. In many engineering organizations, direct vs. indirect time charging and the associated metrics often drive work to be started and completed sooner than needed and, at times, to be sequenced sub-optimally in order to keep direct/indirect ratios high. The negative consequences are frequently seen in project cost overruns due to excessive time charging and rework caused by the premature completion of tasks and loss of synchronization to other project tasks and deliverables.

On a larger scale, the timing and execution of the product development portfolio is often unbalanced and not properly level-loaded relative to need. Project starts are not typically aligned with real need dates that are driven by product strategies and business imperatives. Instead, projects are planned to start as soon as they can and their end dates are determined by

their duration and critical path. The result of poor portfolio management is the overlapping of strategic and non-strategic projects that compete for limited resources, driving inefficiencies and overruns of both cost and schedule.

Waste #4: Over Processing

Over processing waste is distinctly different from over production. Over processing is doing more than necessary to generate satisfactory value as defined by the customer. One way to describe the waste of over processing is with the common term “Overkill.”

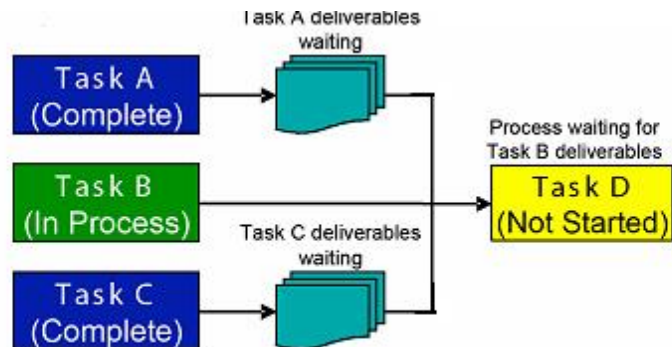
In NPD, there are three forms of this waste:

1. **Within the NPD process itself:** This waste may manifest as unnecessary steps in the design process itself or an excessive number of iterations. An example of this may be the number and duration of tests required to confirm a particular product performance feature during the design validation phase.
2. **Within the resulting designed product:** This waste is seen in products that are over-engineered for their application. Over-engineered products are those that do not deliver incremental customer value that is commensurate with their cost and price.
3. **Within the resulting designed process:** Over-designed, overly-complex processes are of the type that motivates Lean initiatives in the factory and at suppliers’ sites. Examples might be over-curing in an oven or machining to a higher tolerance than necessary. These processes are a direct result of NPD because they are designed along with the products themselves. The best time to address these wastes is during product and process design. Stop the waste before it starts!

Waste #5: Waiting

No value is added while people wait for product to process or product waits for people or machines. The waste of waiting is prevalent in any business process where flow stops and continuation is dependent on another action occurring. In NPD, with the many hand offs between people, functions, and enterprises, most of the end-to-end time is spent waiting. Often this wait time in NPD is driven by the network of task dependencies defining the critical path.

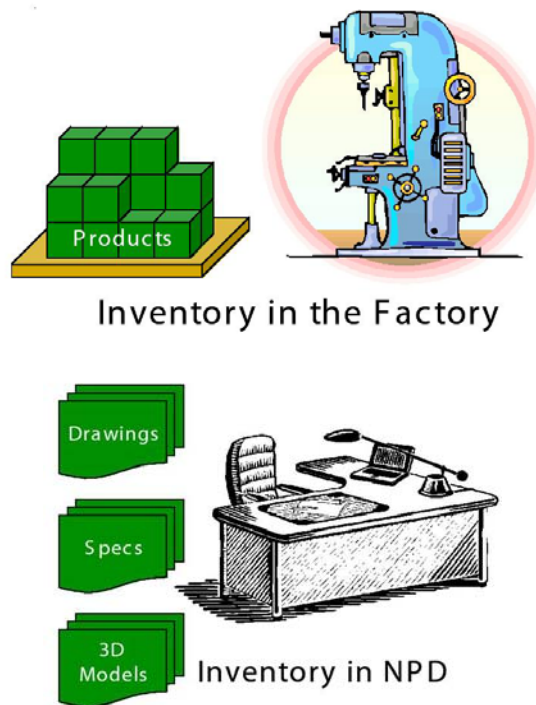
Exhibit 1: Waiting



Waste #6: Inventory

Inventory is well understood in the factory and supply chain because it is tangible, physical and can be observed, counted and measured. In non-factory processes, such as NPD, inventory waste is less obvious. Here we define inventory as being the collection of unprocessed documents, data objects, and transactions that are queued-up between people and processes. Inventory in this context is often dismissed as not a waste because it does not have an obvious financial “carrying cost” as does its physical counterpart. However, the cost associated with this waste is the loss of flow and the extension of process time. In NPD, time to market is a primary performance metric and the accumulation of inventory causes unnecessary waiting (waste) and extends unnecessarily the entire NPD process cycle. Inventory waste is often the result of poorly managed resources creating tasks that wait for people, and inefficient task planning resulting in poorly synchronized processes that cause people to wait for products and transactions to process. So while inventory may seem innocuous at face value, understanding it and minimizing it throughout the NPD process will result in a streamlined process that flows continuously.

Exhibit 2: Inventory in the Factory and in NPD



Waste #7: Defects

Defects are waste because they are the result of executed processes that did not produce value. The consequences of defects are to scrap the product (perform the process over again) or rework the product (perform parts of the process over again). Again this metaphor of scrap and rework has strong factory floor association but in NPD these are often accepted and sometimes even formally documented as part of the process and methodology.

Case Study - Defects

A high-tech industrial products company had an NPD methodology that called for two separate and sequential design-build cycles. Each involved a separate supplier selection, pre-release of drawings and specs, and a proof of concept prototype to be built and tested. It was implied within in the methodology that the design teams would encounter numerous problems and flaws with their product and consequently would need at least two complete iterations before they could get it right. In between iterations they had defined tasks within the methodology to revise drawings and specs and re-release them. They were also unable to commit to final supplier selection during the first design-build cycle and even the secondary supplier selection was not yet a commitment to specific suppliers for subsequent production. Not only did this practice drive excessive cost-to-market, but it also drove excessive time-to-market and the resulting product quality was not assured even by having two design-build cycles. An affront to right-first-time!

In this manner, the company had institutionalized the idea that design work is never right-first-time and that rework scrap is a normal and expected outcome of doing business! This excessive design-build cycle was viewed as progress and not as waste! By ultimately recognizing that these practices were contrary to Lean concepts, the company was able to re-think its entire NPD methodology and substantially improve its cost, schedule and product quality, thus assuring a smooth transition to production and more rapid delivery of a quality product in the marketplace. They moved away from an expectation of failure.

Waste #8: Behavioral Waste

Behavioral Waste is defined simply as the waste of underutilized intelligence and intellect. People are a critical asset to any company, not just because of what they do, but more importantly because of what they know—or can learn to do. From the factory floor to the corporate office, there are countless instances where the true knowledge capital and creativity of people is overlooked and under-leveraged. Human capital is a crucial and differentiating asset because the know-how of running the business—and much of the true intellectual property of the business—lies in the people, not in databases and binders. Underutilizing people’s knowledge and creativity is considered waste because of the potential value that is unrealized. There are many examples of employees that have great ideas—and no means to contribute. Incredibly, they are often never asked. Effective enterprise Lean transformation brings out the best in people by engaging their creativity and innovation to drive improvements to all business processes. From reusing design components to sharing best practices and capturing knowledge, the opportunities to drive value from people are abundant throughout the entire NPD and product life cycle.

Summary

The first step in eliminating waste from NPD, and thus making the process Leaner, is to learn to identify the eight wastes. By closely examining the entire NPD process from the Lean perspective, the opportunities to drive out waste and increase value will become obvious.

Remember that the pursuit of Lean is a relentless journey and requires strong commitment to change and continuous improvement. The payoff however, is a true Lean NPD capability for the enterprise that will drive profitable, sustainable growth and shareholder value creation.

About the Author

Joseph Mele

Joseph Mele has been a practitioner and leader in Lean enterprise transformation since 1992, in both industry and consulting roles. While at Sikorsky Aircraft, a division of United Technologies, Joe learned Lean from the founders of Shingijitsu, experts in the Toyota

Production System. He was one of the UTC leaders that developed the corporate-wide Lean initiative and training program during the 1990s. In addition to his background in Lean, Joe has extensive experience in hands-on manufacturing, product development, supply chain operations, finance and enterprise information systems.

About Lean Horizons Consulting

Lean Horizons Consulting offers integrated competencies for achieving enterprise-wide performance transformation to global firms in the manufacturing, energy, consumer products, financial services, pharmaceutical, bio-technology and healthcare sectors. Lean Horizons further serves investment firms regarding acquisition integration and rapid value creation. Lean Horizons aligns Lean and Six Sigma capabilities with the deployment of enterprise strategy to deliver unique, end-to-end solutions that incorporate the organization's business model, core processes, functions and information systems. Lean Horizons' field force of internationally experienced industry professionals bear direct lineage to the Toyota Production System, lending a unique combination of explicit and tacit knowledge to Lean performance transformations.



Strategically Creating Value through the Elimination of Waste

Lean Horizons Consulting - Americas

P.O. Box 1402
Glastonbury, CT 06033 USA
Phone: Intl +1 (860) 537-6786
Email: getlean.am@leanhorizons.com

Lean Horizons Consulting – Europe, Middle East, Africa

Stratford-upon-Avon
Warwickshire, CV37 8PA UK
Phone: +44 (0) 1789 450484
E-mail: getlean.ec@leanhorizons.com

leanhorizons.com

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