The evolution of “waste” in lean thinking and its application to the service sector

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ABSTRACT

This paper reviews the complexity of translating the seven wastes associated with lean practices from manufacturing settings to the service sector. I emphasize the view of waste from manufacturing, address the potential hesitation and resistance to the liberal adaptation of their meaning into service industries type-by-type, and point out how these forms of waste shape lean projects to create smoother more efficient business models.

Keywords- lean, muda, waste, service sector, kaizen, kaizen event, lean house, JIT, JIDOKA

I. Introduction

The idea of lean was born in the wake of the Industrial Revolution. Edward Demming was an American thinker who had many ideas and theories on how to both improve and standardize processes in manufacturing. While spending a portion of his career in Japan working as a consultant for Toyota Motor Manufacturing, he created his 14 points, as well as other publications that stressed the elimination of waste in every process to promote the most controlled and profitable industrial processes [1]. Lean is a branch of these ideas focusing on eliminating “muda” which is a Japanese word for waste. At its origin, lean focused on only seven types of waste, which will be covered in the following review [2]. Lean has proven to be very impactful to the industrial world. There is a movement to apply these very same concepts to the service industry [3] in places like hospitals, office buildings, and even grocery stores [4].

As stated, the fundamental principle behind lean is the elimination of waste from a process to promote using the least amount of capital and/or other investments to produce the most amount of gain. The application of this concept is simple in an academic; however, its implementation in the service sector leaves room for debate. Lean requires a controlled process. The tricky part is to bring control to a seemingly more arbitrary industry as service.

This paper reviews the complexity of translating the seven wastes associated with lean practices as they are taken from manufacturing settings and imposed upon the service sector. I emphasize the view of waste from the manufacturing sector and service sector pointing out how these forms of waste shape lean projects and their ultimate success in "leaning out" practices to make smoother more efficient business models.

II. Muda: Types of waste

There are several different kinds of waste that are looked for by lean professionals. Modern lean manufacturing facilities have based their methods on Toyota's production model. This model, shown in figure one, illustrates how these lean tools form the foundation for any efficient production system.

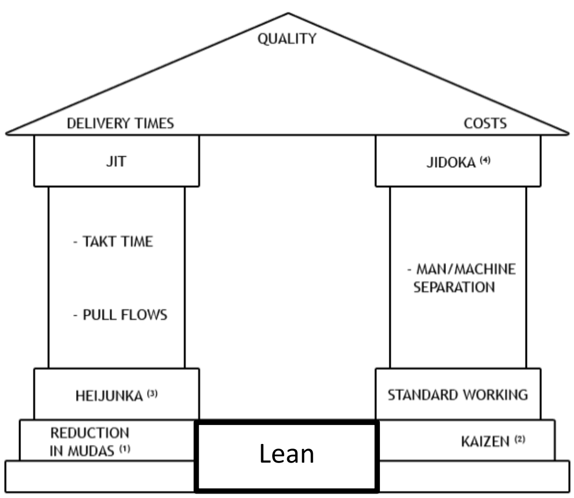

Figure 1: Image adapted from the Pawley Lean Institute at Oakland University. [5]

These "lean houses" are the cornerstone to manufacturing culture for representing how any particular company operates. Lean is the foundation that allows for the rest of the company to operate smoothly. Concepts like "Just in Time" and "JIDOKA" are what usually compose the pillars of the house, yet for the sake of this report we will focus on the base, the tools, and wastes that build the foundation of a lean house. These wastes are:

- Overproduction
- Inventory
- Time/Waiting
- Transportation
- Processing
- Motion
- Defects

The following sections will bullet each of the original seven types of waste from their manufacturing origin to how each of these types of waste can be applicable to the service sector [6].

1. Overproduction:

Producing more than the customer desires or producing product before the customer asks for a given product is common with the traditional view of manufacturing. This excess or proactive production in today's market typically leads to wasted product or unwanted goods. Since Toyota introduced lean in the late 1930's, it has shaped a new standard for efficiency in the goods market. "Kaizen events" or projects to lean out a system take place around the globe on a daily basis. On the manufacturing floor a Kaizen event is relatively simple. A problem is systematically identified, a root cause analyzed, studied, and an improvement plan is created and implemented. This should be a simple concept to translate into any field, however, in the service industry there may be a multitude of problems, with a root cause that is more difficult to identify. A particular service industry case study conducted by the Washington State Department of Ecology, a non-production based entity, devised an event to cut the cost of Laso Bathware's hazardous waste and toxic removal program. The cost savings found by the case study are presented in Figure 2.

Reductions	Source of Savings	Annual Cost Savings	Annual Time, Material, & Environmental Savings
Labor	Event 1 - Productivity improvements	$22,640	1,420 hours
	Event 1 – Reduced repair of units from poor unit spacing on conveyor	Not quantified	Not quantified
	Event 3 - Layout (excludes shim and taping time reduction)	$7,800	490 hours
	Event 3 - Prototype lift installed to reduce shimming and mold adjustment. (Savings reflect future when all four lifts are installed).	$2,100	130 hours
	Event 3 – New foil heat distributor sheet system	$2,000	130 hours
Disposal	Event 2 – More spray-on product, thus less disposal[1]	$1,400	29,000 pounds
Energy	Event 3 – Reduced use of forklift	Not quantified	Not quantified
	Pre-Event 1 – Eliminate shrink oven	$99,290	12,600 MCF of natural gas[2]
Total Quantified Cost Savings		$ 135,230	

[1] This is the potential savings quantified for one model only assuming operators maintain transfer efficiency measured at the time of the kaizen event. Potential for solid waste and cost savings are significantly greater if spray variability is reduced for all models.
[2] One MCF of natural gas = 1,000 cubic feet.

Figure 2 adapted from Washington State Department of Ecology Case Study **[7]**

These savings outlined in the study were derived from the simple reorganization of materials to prevent overproduction because of the lack of flow in the process. In the service sector, businesses often anticipate events and lead to acts of haste to fill "ghost" orders, or orders that are not yet real, but expected. With simple studies, this waste due to overproduction can be realized and remedied to show significant cost savings to the overall organization.

2. Inventory:

The old theory of manufacturing is the larger the batch size the larger the profits that could be made. Don Mitchell, CEO of FSI international, a water and filtration system manufacturer, warns industries of the theory, "If we make it people will buy it" [8]. In the modern sense this philosophy has become antiquated as manufacturing companies no longer set product's prices nor stir demand as they used to [4]. In the current market it is the customers that decide prices and ultimately determine production schedules.

Gina Melendez, a lean production leader at Parker Aerospace recently gave a lecture on the difficulties she has faced attempting to implement lean in the service side of the manufacturing plant (sales, marketing, and management). Although the definition of inventory is fairly straight forward in manufacturing; the number of products waiting to be sold, this concept can in fact be taken more liberally when applied to service. Customers are not willing to pay for what they are not receiving in the form of service. Let us take the simple case of excess paper in a service provider's office.

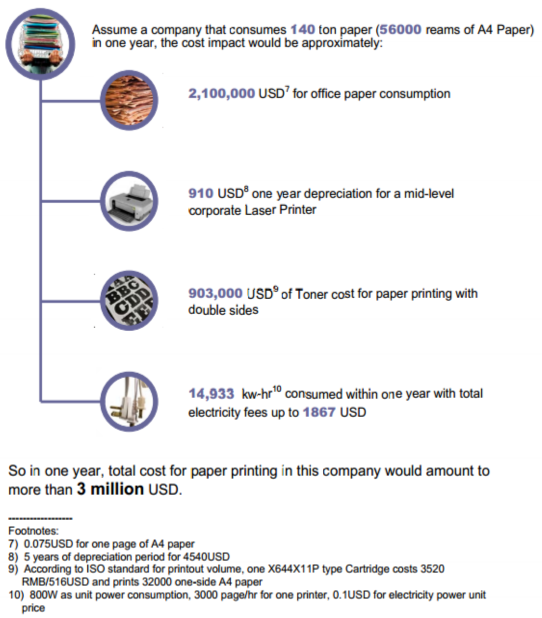

Figure 3 The image above is adapted from Standard Chartered report on Reducing and Eliminating Paper Consumption [9]

Figure 3 illustrates how even a simple reduction in paper use can lead to significant cost savings in any corporate or industrial environment. This particular example relates to a savings of over three million dollars annually.

3. Time/Waiting:

On the manufacturing floor, every minute spent not working is money that is not being used to its full potential. Downtime is costly and therefore an identifiable form of waste. I will present the following example. Take a simple flow line production system when a product is ordered and is started at station one and finishes at station four. That worker at the first station takes three minutes to finish his portion of the part, worker two takes four minutes, worker three takes ten minutes and the final worker takes only three minutes to produce the final product. In this line example, stations one and two have to wait for station three to finish before they can begin working on the next piece. That waiting time related to seven minutes of downtime per the first two stations. Seven minutes at a rate of $15/hr an hour over the course of one eight hour day of production can cost a company over $84 per worker per day. Using a 365 workday operation this equates to $30,660 wasted per worker annually. It was argued by the management team for United Technologies in Connecticut, USA that this is the incorrect way to approach downtime. It was proposed that instead of accounting for downtime on a process as a whole, those individual work efforts should be accounted for. This allows for each station to be analyzed and adjusted optimizing the system as a whole, rather than simply keeping a plant working just for the sake of working [4] If we look at downtime in this way it becomes easier to apply the concept of time waiting to the service sector.

In the service industry downtime can be in the form of waiting by either the customer to receive services or by the service provider in the form of waiting for results. This can be just as costly, if not more so, than in manufacturing. As technology improves and consumers have faster and faster access to information and resources, they expect all things to be done faster and better than yesterday. When customers have to wait in the service industry, it can cost a company a customer. A restaurant is a great example of waiting times and how lean can be used to alleviate excess waiting times. A study conducted at Boston University shows how a restaurant can be transformed into a lean manufacturing facility. This transformation is represented in Figure 4.

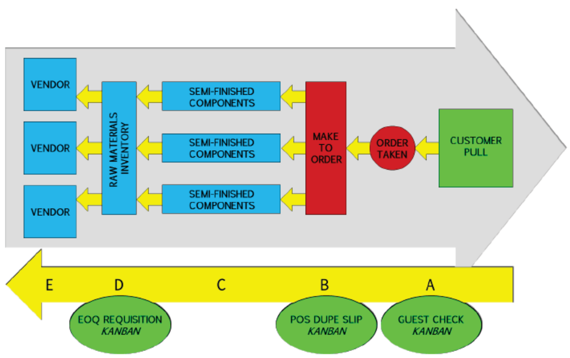

Figure 4 image is taken from Boston Hospitality Review Fall 2012 [10]

Figure 4 represents how a kitchen end of the restaurant is transformed to produce food in a similar way as products are produced on an assembly line. In doing so, waiting times for customers' orders can be reduced, and in addition, the quality of food leaving the kitchen can be monitored and controlled to ensure only the best dishes reach the customers [10].

4. Transportation:

This involves unnecessary movement from one place to another. On the production line the more hands that touch a product the more potential for the product to become defective. Not only is there the potential for damage there is the time associated with the transfer that, as stated in the previous form of waste, can be costly. This was a topic brought up by representatives of FedEx at the Northeast Regional Institute of Industrial Engineering Conference held at WPI in Worcester, MA [11]. Customers for any service provider feel the strain of unnecessary transportation in the form of what some call "the run around," forcing customers to either go from place to place, be it a web site, several forms or to speak with different people to get the desired service. This is costly in the form of time and additionally causes frustration. A study conducted by David. L. Hallowell, a founding partner of Six Sigma Advantage Inc. [12] looks into the common call center and explains how even these centers can be optimized for customer satisfaction. One of the many factors analyzed was transfer and waiting time and their effect on new account growth.

Predictor	Coefficient	SE Coefficient	T	P
Constant	6.1222	0.1927	31.76	0.000
Transfer	-0.01193	0.02974	-0.40	0.691
Wait Time	-0.07830	0.01085	-7.21	0.000
Service	-0.06921	0.02324	-2.98	0.006

New Account B-Best = 6.12 - 0.0119 Transfers B-Best - 0.0783 Wait Time B-Best - 0.0692 Service Time B-Best

S = 0.05848 R-Sq = 62.1% R-Sq (adjusted) = 58.6%

Figure 5 [6]

These coefficient factors are less than typical for a standard manufacturing project to be conducted; yet this shows that in the service industry there is more variability inherent with processes relying on human interaction. The results were staggering. By implementing lean and quantifiably justifying the hiring of additional workers, there was an initial decrease in wait time by 10%. This lean project ultimately lead to an increase in caller satisfaction by over 3% from 70 to 73.4%.

5. Processing:

The more work that a worker is expected to perform, the greater the chance that those actions will become what was described as “non-value added” processes or steps. These actions that do not directly add value to the finished product are waste and through the lean process can be driven out [4].

The service sector is littered with this type of processing waste with forms, data entry for these forms, data processing of the forms that were formatted in the computer, then checked again for mistakes and finally submitted to another department for more processing, to ultimately end up in a database to not be moved again. This waste is costly to both the service provider and the customer, as the cost of these redundancies is often passed on to the customers. It also affects process capabilities in both scenarios. If too much time is spent with non-value added activities, there is a need for more workers, or if that is not an option the service provider will have to accept less customers [13]. Looking back at the restaurant example cited previously, in order to create a lean system, the entire restaurant was mapped from process to process in order to determine which were necessary to the final product and which were simply a waste. This process is called “value stream mapping” and is common practice in the field of lean. These maps can be adapted to any process in any industry. An example of a value stream map is shown in figure 6.

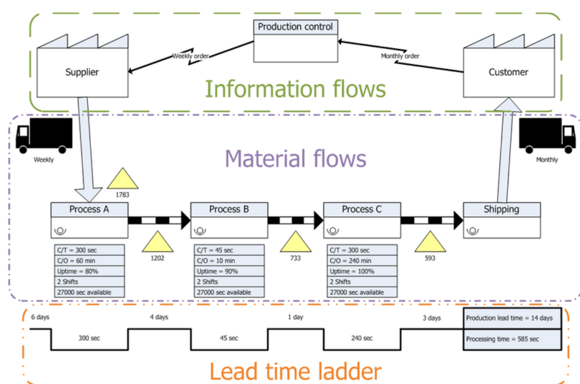

Figure 6 [14]

6. Motion:

Unnecessary motion such as searching for tools can prove just as costly as wasting time. A key tool used by industrial engineers is right hand left hand charts. These charts are designed to study the motions of operators tracking how far they move to conduct their work, by which hand and how long it takes to complete each task at their particular station. The common practice on the manufacturing floor is to “5s” the workstations, allowing for all the necessary materials to perform that given job are placed right at that work station. The 5s are separate, straighten, scrub, standardize, and systematize [15].

This could involve unnecessary searching for necessary data to provide the services demanded of the service provider, such as medical record in a doctor’s office, or cleaning tools for hotel housekeeping staff, or a variety of other locations [16]. Just like with the other forms of waste stated above, the key of lean is to eliminate all waste from a process, and unnecessary motion, be it mental or physical is costly to an efficient process.

7. Defects:

The more defects in the finished manufactured products, the more it will cost for either re-work or discard of a defective product. For large scale high volume manufacturing a single defect in every million parts is not so much of a factor. However, if a defect becomes repetitious, or the process being improved is much smaller and more costly, say, a jet engine, then the concept of defect prevention becomes more evident and necessary [15].

In the service sector, there are many forms of defects that can be identified depending on the company and the particular services that the company provides. Healthcare is a major sector that IE’s have recently become involved with. In this field, mistakes can mean lives. If a surgeon makes a mistake because a tool he or she needed was not available, that person receiving the surgeon’s service could have a longer recovery time, additional complications, or even decease. In a financial office where advisors deal with customers life savings, one mistake could cost a family their entire portfolio of wealth. Lean principles are designed to ensure that defects are at the very least diminished, but ultimately eliminated through the culture of continuous improvement [17].

III. Conclusion

In conclusion this paper has reviewed the seven types of waste and provided examples as to how each are identified in manufacturing settings as well as service industries. The examples presented in this review show that in order to apply lean into service, the idea of waste needs to be taken more liberally. It is only when the concepts are taken out of their manufacturing context that they can be adapted to other industries. In the introduction, the concept of the lean house was introduced in figure one, yet the focus of this paper was on the tools forming the foundation. The pillars “JIT” and “JIDOKA” are systems designed to provide a customer with exactly what they ask for only when they ask for it. Yet, without first eliminating the waste in a process and establishing an efficient base, these other concepts will fail. Lean is about optimization through the elimination of waste and control through the efficiencies of the process creating a culture of continuous improvement. Currently in the service sector, many companies are just starting to realize the potential of lean and its application to service based industries. But as time goes on and the need to generate more and more revenues with less resources increases, lean will become a standard for any business. The word “muda” and the wastes that it encompasses will be common vernacular.

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