The 8 Sources of Waste and How to Eliminate Them
Improving Performance with Lean Management Techniques

By Shayne Kavanagh and David Krings

Waste makes organizations less able to achieve their objectives; it uses limited resources in ways that do not contribute to the organization's overall goals. Lean is an organizational performance management system characterized by a collaborative approach between employees and managers to identify and minimize or eliminate activities that do not create value for the customers of a business process, or stakeholders. One way Lean organizations strive toward their goal of perfection is by remaining constantly aware of waste so it can be avoided or eliminated. The Lean philosophy identifies eight sources of waste that detract from the value a customer receives from a business process. Educating employees about the eight sources of waste and conducting team-based reviews of business processes to look for and correct them can yield substantial benefits.

The purpose of this article is to describe and illustrate the eight forms of waste as well as the means of eliminating them. A primary example is a recent project undertaken by the City of Bloomington, Illinois, to apply Lean principles to the city's central cash receiving function.

The Eight Sources of Waste and the City of Bloomington
The Lean philosophy holds that there are eight forms of waste that that commonly afflict business processes. The City of Bloomington, Illinois recently undertook a project to apply Lean principles to the central cash receiving function of their City and address sources of waste.

The project started with a half-day team meeting, where Bloomington staff learned about the eight sources of waste and discussed potential waste in the city's cash receipting process, as well as opportunities to eliminate them. The staff built on this discussion by graphically mapping out the current process and further specifying where waste might exist and what the remedies might be. They, then, designed a new process and agreed on the actions they would take to make the new process a reality. This article will focus on the eight sources of waste; including illustrations from Bloomington's experiences and lessons for other public agencies to consider (if you would like to learn more about the Lean approach, please see GFOA and TechSolve's free research report[1]). The eight sources of waste that will be discussed in this article are: defects; rework and correction; inspection and checking; waiting; inventory/backlog; transport; over processing; and underutilizing people's abilities.[2]

> **Technology: The Solution to Waste?**
> Bloomington undertook a Lean process review as it was implementing a new enterprise resource planning (ERP) system. The intent of doing the review and the implementation concurrently was to optimize the use of the new technology by considering it as part of a broader process review. Bloomington was in Phase I of the ERP implementation, so members of the Lean team were reasonably familiar with the technology. Only 20 to 25 percent of the suggestions for improving the process related directly to the new ERP technology, while the rest related to low- or no-tech ideas for improving how employees interacted with each other or with the public. The fact that the majority of ideas for improvement were not related to the new technology is not an indictment of the technology or how well staff understands it; to the contrary, staff saw the new technology as very important, and were enthusiastic about its potential. However, this example illustrates a common result of process improvement projects, which is that technology is not typically the primary concern when it comes to process effectiveness. Technology usually ranks third, after the effective deployment of the people who participate in the process and how the process itself is designed. If technology is applied to a situation that uses people ineffectively or if process design is less than optimal, technology will, at best, help save some time, or, at worst, help the organization do the wrong things faster.

Defects. Ideally, in any process, work is performed correctly the first time. A defect happens when incorrect or incomplete work is sent to the next step in the process or to the customer. Avoiding defects starts with understanding the customer's definition of service quality.

Quality management guru Joseph Juran defined quality as a product or service's fitness for a customer's intended use.[3] Using this assumption, if a government does not have a deep understanding of what a customer wishes to accomplish, then producing a high-quality product with no defects will be impossible. Bloomington identified three types of customers (stakeholders) and their requirements:

- **The Citizen**. The primary customer is the citizen, who wants satisfaction; fair treatment; accuracy; and timeliness.
- **The City Council**. Council members want satisfied citizens and assurance that the process protects against risks from fraud, abuse, and unintentional losses.
- **Other Departments**. Other departments (e.g. water, police) want accurate revenue recognition and meaningful reports.

Once the customer's definition of quality is understood, the process must be controlled to consistently deliver services that are free from defect.

In 1924, physicist Walter Shewhart was working to address the issues of quality and excessive variation, and hence waste, in manufacturing processes.[4] He theorized that any human activity produces variation (since nothing can be done twice with exactly the same effect), but that by understanding variation we can manage it, and thus manage waste. This concept was expounded on by service quality guru W. Edwards Deming, who worked with Shewhart, in Deming's famous management philosophy.

Deming said that "variation is the enemy of quality."[5] Variation can result from inadequate training or work instructions, or simply human error. When used properly, technology eliminates the need for human intervention in the business process, which is the primary source of variation. For example, Bloomington considered scanning checks in order to deposit them electronically, thereby eliminating a great deal of physical handling. The new ERP system was also found to have great potential for electronically storing and transferring records for credit cards, parking fines, and utility payments. Even without new technology, however, there are many ways to reduce variation. Later in this paper is a discussion on eliminating the inspection and checking wastes by increasing consistency through better controls and instruction.

Rework and Correction. The second type of waste, rework and correction, is closely related to defects because a defect often requires correction. Rework also includes repeating a process step unnecessarily – for example, creating multiple copies of the same form or entering the same data into different systems. Bloomington found that its back-office finance staff was recreating the cashiering staff's spreadsheet in order to balance cash with the receipts for each deposit. During the process review, staff concluded that a common spreadsheet with features that would satisfy the needs of both groups could save a lot of effort.

Optimizing the front end of a process is essential to minimizing rework. If the form, application, or other item that initiates a process is flawed, it could affect many later points in the process. Providing customers with very clear and concise instructions can help ensure that the application is filled out correctly in the first place. Technology can also be used to reduce variation in initial intake. For example, payments might be electronically scanned, thereby removing human error from the data entry process.

Inspection and Checking. A process should produce reliable results the first time work is performed. Hence, inspection or double-checking (or triple or quadruple checking) is considered a potential form of a waste. For example, requiring four signatures to approve a routine purchase is likely adding more in cost to the purchasing process than it is creating in value – and might even be destroying value, if the multiple checkers feel that they can relax their diligence, since there are so many other checkers. A good process is designed with controls in place that are judicious and strategic, in addition to avoiding mistakes in the first place.

Bert Teeuwen, author of *Lean for the Public Sector*, advances the concept of the compliance pyramid (see Exhibit 1).[6] It can be used to find ways to help employees stick to performance standards, thereby reducing the need for checks. Process designers can start at the top of the pyramid to see if a "fail-safe" is available for a given point in the process; if not, they move down to the next level of the pyramid, and so on. A fail-safe is the best kind of control because it makes deviation from the standard impossible. For example, Bloomington discussed making the "check number" field in its computerized cash receipting system required; to ensure that appropriate information is entered, the user is not able to proceed without filling in the check number. The city also considered increasing security by placing greater physical restrictions on access to cash.

The next level of the pyramid is visual and audible controls tools, which are intuitive signals given when a deviation occurs. An example is a computerized purchasing system that gives a warning (perhaps a beep, a red flag, or required acknowledgement of the warning) when purchasers are getting close to their budget limits. A low-tech option might be to place a bright green sheet of paper at the bottom of an inbox that holds incoming checks – if processing clerks don't see the eye-catching green, they know they might have a backlog.

The third level on the pyramid is visual aids that offer graphical or pictorial instructions. They provide less immediate feedback but are still more attention grabbing than purely written instructions. A classic example is the safety instructions provided on airplanes. Bloomington discussed creating a scoreboard of key performance indictors in the cashier areas, particularly focusing on overage and underage trends in the cash drawers.

The final level on the pyramid is written procedures, instructions, and manuals. Teeuwen believes that written procedures are the least effective control because, in general, employees are not likely to regularly read and remember them. Written controls can still be useful, however. Pictures, screen shots, or cartoons can be added to written controls to make them more appealing and easier to read, and to help readers comprehend the information. Using more creative writing techniques can improve readability (for example, Google's ethics policy of "don't be evil" draws more attention than most corporate ethics policies). Bloomington discussed developing an easy-to-use, end-of-day activity checklist for cashiers to fill out, and posting an employee and customer code of conduct in large print in a location that would be conspicuous to both employees and customers.

In some cases, none of the levels of the compliance pyramid will be seen as sufficient. Even then, carefully consider the need for a check. Does the check relate to misinterpretation of a law? Did it arise from a highly unusual event that happened long ago? And when checks are necessary, consider how they are performed. For example, can a co-worker perform the check rather than a more highly paid manager? Is self-checking an option?

Inspection Waste versus Strong Internal Controls
Seriously considering the necessity and value of checks and inspections in the context of a Lean team-based review has the potential to improve the control environment. In many cases, it makes checks more meaningful and highlights the importance of the remaining checks. However, applying Lean to a business process could decrease the resiliency of the control environment, if not handled properly.

In Bloomington, the team went through a best business practices checklist for cash receipting before the Lean review began and after the Lean review concluded. This helped the team think about control requirements as they developed the new process. Bloomington found that it was already in compliance with most of the controls and had a few opportunities to improve its control environment, and the city remained compliant

under the proposed new process.

Waiting. Waiting is the idle time created when employees wait for invoices, copiers, parts, materials, machines, information from coworkers, help, etc. Wait time translates into downtime when people and equipment are not creating value. Some of the potential causes of waiting include unbalanced workload among employees, too few office machines, lack of a clear process, quality problems at steps earlier in the process, or waiting for a signature approval. Solutions to excessive wait time depend on the root cause.

Asking the Five Whys to Get to the Root Cause
Parents with small children will have an intuitive understanding of the "Five Whys" technique. When confronted with a problem, like excess wait time , ask why the problem is occurring, and continue to ask "Why?" for each reason given (much like a small child would). Getting to the root cause of the problem typically takes about five iterations.*

* For more information on how many iterations of "why" are needed, see: Tracey Richardson, "How Many Whys Should I Ask?" the A3 Column, October 7, 2011, http://www.lean.org.

To illustrate, Bloomington had a problem with excess wait time for cashiers who needed direction on situations that required an exception to the standard process. One exception is the need for a payment plan. The root problem was that a payment plan, and many other exceptions, required approval from a designated person in a different department and building. The designated approver had many other job responsibilities, which resulted in delays and waiting by the cashiers (and customers). A solution the Bloomington group discussed was to develop clearer written parameters and procedures for these exceptions and empowering the most experienced cashier to handle many of these situations as they occurred.

Inventory/Backlog. In an administrative process, the sum of all tasks waiting to be processed is considered inventory or backlog. One of the primary causes of inventory or backlog is poor balancing of workloads, particularly when work is processed in large batches. When a worker waits for a significant amount of work to pile up before processing it, the process flow grinds to a halt. Other causes include suboptimal housekeeping (for example, poor filing or record keeping, or lost documents) and insufficient communication. Bloomington found a few of instances of backlog and potential solutions:

- **Customer Lines.** A backlog of customers in the cashiering area was causing customer irritation and inconvenience. The staff discussed reconsidering the location of the payment drop-box to make it more visible and accessible, installing an automated payment kiosk, and doing more to encourage online payments, all of which would divert people with ready-to-go payments out of the

line. Staff also discussed installing a "check out" lighting system to indicate to customers which cashier was available and creating an "express" line for customers with cash or checks.

- **Large Check Batches.** An inventory of checks would sometimes build up, creating delays in processing and depositing payments. The staff agreed to experiment with establishing dedicated times during the day when cashiers would focus on processing the receipts so they would not build up to too large a batch, and to look into technology solutions that would automatically post payments upon receipt.
- **Phone Backlogs.** Incoming phone calls were being disproportionally funneled to a single cashier, adversely affecting that person's effectiveness in processing payments. The solution the staff found for this backlog was to adjust the automated rollover call system.

The Value of an Experiment

One way to reduce the risk associated with a new idea is to treat it as an experiment rather than a permanent change. This gives people permission to try new things and, importantly, permission to fail. Generally, people are comfortable participating in experiments because they know that if the experiment does not work, it is perfectly acceptable to try something else or to revert to the old way of dong things. Experiments provide an opportunity for new ideas to be suggested and tested.

Transport. Transporting anything that does not directly add value to a final product or service is another form of waste. This includes not only documents and materials, but also moving customers to different offices and desks to complete a process – a frequent occurrence in government. Bloomington's cashiering staff realized that customers were required to visit the clerk's office to apply for a permit and then visit the cashier (in a separate location) to make payment. Staff agreed to explore the decentralized cashier functioning provided by the new ERP system as a possible solution. The system enables the clerk to accept permit applications as well as payments so customers only need to go to one location to complete the business process.

Suboptimal office layout is another culprit in transport waste. For instance, Bloomington staff realized that cashiers were transporting cash deposits to the finance department, which was in another part of the building, where the deposits were picked up by an armored car service. Staff discussed having the armored car service pick up the deposits directly from the cashier area instead.

Sub-optimal positioning of staff relative to the work to be performed is the final source of transport waste. In Bloomington, staff found that cashiers should be positioned to directly face the customer area, rather than have their backs to the customer area, which required them to turn back and forth from working with customers to working at their terminals. Staff also found that elevating seating for the cashiers to raise them to the standing customer's eye level would reduce excess movement (straining necks, reaching) and make cashiers feel more confident when dealing with belligerent customers.

Over-Processing. Over-processing waste results when a product is made in greater amounts than necessary. The root causes of over-processing include a poor understanding of the customer's true requirements, the failure to communicate customer requirements to workers, or failing to design the products of a process to conform to customer requirements. Common examples of this are over-produced reports (too long, too elaborate), copying more people than necessary on correspondences, distributing information that isn't read, and creating services or rules that aren't needed. Teeuwen cites an infamous example of a European Union rule (later abolished) that imposed constraints on the crookedness of cucumbers.[7] Bloomington didn't find anything as egregious, but it did decide to discontinue some reports that were not being used by their recipients. Another example of over- processed information is the collection of excessive data as part of a process – data that is not later converted into valuable or legally required information.

Underutilizing People's Abilities. This type of waste is the failure to make full use of employees' knowledge, skills, and abilities. The most basic example is using highly trained professionals to perform tasks that could be performed by someone with less training. An example in police departments is having sworn police officers perform administrative tasks that could be performed by civilian personnel.

A less visible and more insidious form of underutilization occurs organizations do not make full use of employee creativity and commitment for the benefit of the customer. Bloomington identified the following opportunities for better utilizing employees:

- Enroll cashiers in the police department's existing training program on dealing with belligerent customers.
- Give cashiers access to online reports so they can search more effectively for misapplied payment errors.
- Include the lead cashier in weekly meetings with the city's utility department to enhance her understanding of salient issues affecting billing and payments.
- Reallocate time saved by eliminating sources of waste, giving staff more time to analyze reports on past-due payments and thereby improve collections.

Making insufficient use of customers' abilities is included in this type of waste. A common example of making use of the customer to successfully complete a process is online self-service. Providing this option allows customers to enter their own data, reducing staff time and errors in data entry. Customers can contribute to the quality of a business process in more creative ways, too. While this was not a problem in Bloomington, one potential form of fraud is "skimming," in which a cashier takes a payment and puts the money in the opened cash drawer, but does not ring up the sale or issue a receipt. The cash drawer is kept open in case a customer should receive change. The cashier is thus able to keep cash from sales that are not rung up and therefore not registered in the cashiering system. One way to help guard against skimming is to give customers an incentive to get their receipts, such as a discount or free products or services if an employee fails to provide a receipt.

CONCLUSIONS

The eight sources of waste reduce the value customers receive from a business processes. Addressing sources of waste, along with other Lean methodologies, helped the City of Bloomington identify ways to reduce processing time for cash receipting by almost two-thirds, while increasing revenues from faster deposit of funds and better collections. Critically, this was done using a team approach that engendered commitment from participants across the process. Clerks began to implement some of the ideas they generated the day after the review. Ultimately, though, Lean should be more than a one-time exercise. Management and staff should always think about the eight sources of waste and strive to eliminate them from public services.

Notes

1 Shayne Kavanagh, *Lean Process Improvement*, Government Finance Officers Association, 2010, http://www.gfoa.org/downloads/GFOAWhitePaper_LeanGovernment.pdf.
2 The sources of waste are adapted from the work of the GFOA and TechSolve, as well as: Bert Teeuwen, *Lean for the Public Sector: The Pursuit of Perfection in Government Services* (New York: Productivity Press, 2011).
3 Terry Schurter and Peter Fingar, *The Insiders' Guide to BPM: 7 Steps to Process Mastery* (Tampa, Florida: Meghan-Kiffer Press, 2009).
4. From a discussion on Shewhart's concept of quality on the Intelligent Management Inc. webside (http://www.intelligentmanagement.ws/organization/quality).
5 From qualitydigest.com.
6 Teeuwen.
7 Teeuwen.

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For more on how Lean techniques can be used to improve processes, read *Less Time, Lower Cost, and Greater Quality: Making Government Work Better with Lean Process Improvement*. This research report, by the GFOA and TechSolve, is available at no cost at www.gfoaconsulting.org/lean.

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The Lean Philosophy
Many people associate Lean with tools for mapping business processes, identifying improvements, and charting progress. However, Lean is an attitude and philosophy about continuous improvement and striving for a state of perfection, where every action creates value for customers and citizens. Perfection is an unobtainable ideal, of course, but the Lean organization is always looking for ways to do things better.

Exhibit 1: The Compliance Pyramid

Fail-safe → Make it the only way – no alternatives

Visual & Audible Control Tools → Warn for variation

Visual Aids → Show the right way

Procedures, Instructions, & Manuals → Reading