Safety Management

You Cannot Get Lean Without Safety

Understanding the common goals

By Bruce Main, Michael Taubitz and Willard Wood

IN TODAY'S ULTRACOMPETITIVE business environment, lean manufacturing concepts offer an opportunity to gain a competitive edge in production, services and other applications. In one company, a lean team set about changing its work area to eliminate the sources of waste and improve productivity. Machines were moved, the 5S process (a lean tool discussed later in this article) was worked and the resulting work cell demonstrated a significant improvement in cycle time and reduced waste.

However, in their zeal to "lean out" the system, the team also "leaned out" safety. Guarding for the point of operation was removed to speed cycle times. When the safety director viewed the result, a culture clash ensued. Although the guarding was reinstalled, the safety director was forced into the role of the bad guy. Several weeks after the clash, the guards were found to be removed again. Worse, safety was leaned out of the lean process—safety personnel were perceived as inhibiting process improvements and safety personnel began to be excluded from lean projects. Unfortunately, this is not a unique scenario.

Bruce Main, P.E., CSP, *is president of design safety engineering inc., chair of the ANSI B11 TR7 Committee and the ASSE representative to the B11 Accredited Standards Committee. He is a professional member of ASSE's Greater Detroit Chapter and a member of the Society's Engineering Practice Specialty.*

Michael Taubitz *is the General Motors Corp. representative to the Automotive Industry Action Group and to the B11 Accredited Standards Committee. He is a professional member of ASSE's Lansing Chapter.*

Willard Wood, ARM, *is a safety administrator and acting safety and health manager for The Boeing Co.'s Auburn, WA, facility. He represents the Aerospace Industries Association on the B11 Accredited Standards Committee. Wood is a professional member of the Society's Puget Sound Chapter.*

Research of the technical literature reveals ample information on lean manufacturing concepts. Similarly, the literature on safety is rich in depth and breadth. Yet, a search that addresses both safety and lean concepts yields little information. Lean and safety occupy different spaces in the technical literature.

Persons formally trained in lean concepts will respond that safety is an integral part of the 5S process and that to exclude safety concerns is inconsistent with lean concepts. The same can be said about those formally trained in safety—their solutions to minimizing risk will appropriately address productivity concerns. But as lean gains momentum, those less well trained in lean and/or safety will attempt projects and the results can be less than ideal.

ANSI B11 TR7: Addressing the Problem

To address this problem, a task group was formed in the machine tool community with the support of the B11 Accredited Standards Committee. The task group studied this problem and developed a technical report based on materials provided by Boeing Co., Deere & Co., General Motors Corp., Liberty Mutual Group and design safety engineering inc. *ANSI B11 Technical Report 7: Designing for Safety and Lean Manufacturing* (TR7) has been released by Association for Manufacturing Technology (AMT), the B11 secretariat.

Although written by and primarily for the machine tool industry, the content can be applied to many other industries. The abstract to TR7 states:

> Lean manufacturing includes a variety of initiatives, technologies and methods used to improve productivity (better and faster throughput) by reducing waste, costs and complexity from manufacturing processes. However, the effort to get lean has too frequently led to the misapplication of lean manufacturing principles in ways that result in significant risks to worker safety and to the goal of lean manufacturing. Safety is a critical element in the lean manufacturing effort to yield processes that are better, faster, less wasteful and safer. This document provides guidance for persons responsible for integrating safety into lean manufacturing efforts. This integration is only possible if lean manufactur-

ing concepts and safety concerns of machinery are addressed concurrently. . . . This document also provides design guidelines on how to meet lean objectives without compromising safety (AMT, 2007).

The table of contents of TR7 is shown in the sidebar below.

A central premise to lean concepts is to minimize or eliminate waste from production systems, service operations or other business processes. The term lean refers to cutting the "fat" out of production processes. The Production System Design Laboratory at Massachusetts Institute of Technology states that:

> Lean production is aimed at the elimination of waste in every area of production including customer relations, product design, supplier networks and factory management. Its goal is to incorporate less human effort, less inventory, less time to develop products, and less space to become highly responsive to customer demand while producing top-quality products in the most efficient and economical manner possible (MIT).

Safety must not be viewed as a separate activity that is a non-value-added effort with objectives contrary to lean concepts. Elimination of waste can also be interpreted as the elimination or minimization of risk that adversely affects wasted human resources and lost time from injuries. Lean imperatives of faster, better and cheaper must encompass the concept of running safer as well.

Lean focuses on minimizing waste in a system. Safety focuses on minimizing risk in a system. Optimizing for one or the other can lead to a suboptimal solution for the overall system—lowest waste but with increased risk, or lowest risk with increased waste. Examples of each are common—guards removed during operations (low waste, high risk) or excessive procedural safety check offs (high waste, low risk). Most experienced safety practitioners have seen machinery with guards that prevent necessary work from being done and that are subsequently defeated (a high-waste, low-risk situation that becomes high risk, low waste after the guard is removed).

The focus of TR7 is to obtain an overall system optimum of lowest waste at lowest risk. B11 TR7 presents a process flowchart of how safety and lean manufacturing concepts can be addressed concurrently. The process is shown in Figure 1 (p. 40) and discussed in detail in B11 TR7.

TR7 includes several real-world examples of situations in which safety and lean have been successfully implemented, and others in which they have not. These examples demonstrate why safety and lean concepts need to be addressed concurrently rather than sequentially. The examples do not simply argue that safety needs to be considered and included; rather, they present lean arguments why failure to include safety actually introduces waste into the system—contrary to the central tenet of lean manufacturing. For example, having to retrofit or add a guard removed during a kaizen workshop introduces the wastes of correction, waiting, excess motion and possibly more of the seven forms of waste. The results demonstrate non-value-added cost and wasted time.

Although safety professionals and engineers are becoming familiar with risk assessment, many struggle to explain the actual tools or methods for achieving lean—particularly in the design stage of a project. Part of the reason is the complexity of "getting lean" coupled with the myriad of choices to approach the subject. An understanding of waste will provide a cornerstone to those who are challenged with integrating safety and lean in the design process.

Understanding Waste

The acknowledged global benchmark for lean production is Toyota. In 2005, Fujio Cho, then president of Toyota Motor Co., commented:

> Some people think that if they just implement our techniques, they can be as successful as we are. But those that try often fail. That's because no mere process can turn a poor performer into a star. Rather, you have to address employees' fundamental way of thinking. *At Toyota, we start with two questions: "Where are we wasting resources like time, people or material?" and "How can we be less wasteful?"* (Cho, 2005, emphasis added).

Identifying waste begins with understanding the different forms of waste. It took Toyota close to 30 years to develop all aspects of its renowned Toyota Production System. The foundation for the system is understanding the seven forms of waste, first introduced by Taiichi Ohno (1988):

1) overproduction;
2) waiting;

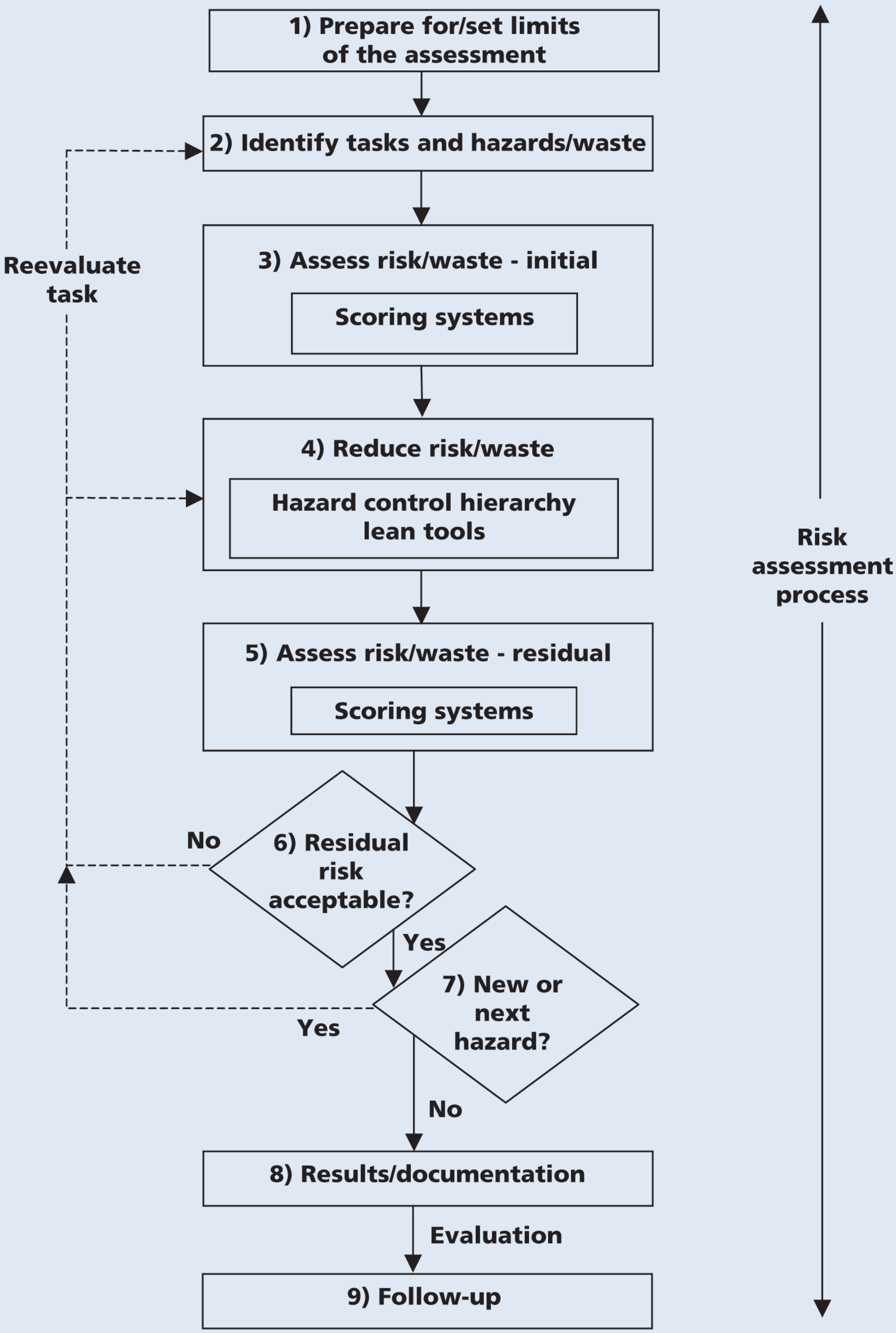
TR7 Table of Contents

Introduction
1: Scope
2: References
3: Definitions
4: Overview of Lean Concepts
5: Challenges and Examples
6: Safety and Lean Solutions
7: Overview of the Risk Assessment Process
8: Examples of Safety and Lean Successes
9: Guidelines for Safety and Lean Design
10: Summary
Annex A: Detailed Risk Assessment of Deburring Process
Annex B: Guidelines for Planning
Annex C: Guidelines for Process Design
Annex D: Guidelines for Planning the Layout
Annex E: Guidelines for Tool and Equipment Design
Annex F: Guidelines for Workplace Handling Equipment

Abstract: *Lean manufacturing processes reduce waste and give companies a competitive edge. But what happens to safety when lean processes are not applied properly? This article provides a brief overview of lean concepts and discusses the importance of implementing lean and safety concurrently.*

Figure 1

Safety & Lean Process Flowchart



Note. From ANSI B11 Technical Report 7-2007: Designing for Safety and Lean Manufacturing, *by The Association for Manufacturing Technology (AMT), 2007, McLean, VA: Author. Copyright 2007 by AMT. Adapted with permission.*

3) transporting;
4) overprocessing;
5) inventories;
6) moving;
7) defective parts.

An alternate presentation of these seven forms of waste is commonly referred to by the acronym COMMWIP, which stems from the first letters of each source (an acrostic):

1) correction;
2) overproduction;
3) motion;
4) material movement;
5) waiting;
6) inventory;
7) process.

After identifying any of the seven forms a waste, it is necessary to have a repeatable method for eliminating waste. That process is known as 5S.

The 5S Method

5S refers to the first letters of five phrases that describe repeatable processes used to identify and eliminate all forms of waste. The five *S*s are Japanese terms, loosely translated as follows:

1) Sort: Remove unneeded materials from the workplace, eliminate distractions and confusion.

2) Set-in-order (straighten): Make it easy to visually find things that are needed including parts, tools, information, etc.

3) Shine: Introduce a regular system for cleaning the work area, also focusing on inspecting the workplace for equipment needing preventive maintenance.

4) Standardize: Establish methods to maintain cleanliness.

5) Sustain (self-discipline): Implement methods to sustain the process, including continuous improvements.

Some 5S programs add safety as a separate *S* and make it 6S. Others consider safety to be an integral part of the 5S process. This seems to be largely a matter of personal preference rather than substance. As long as safety concerns are addressed, there is little difference as to which *S* they fall under.

One key point to clarify is the real purpose of 5S. Many consider 5S as the method to obtain neat, clean, well-organized workplaces. The real value of 5S as taught in kaizen workshops is the participant's hands-on learning. While an organized, visually attractive workplace is a typical result, the real purpose of 5S is to inject a fundamental understanding of how to identify and eliminate waste.

Other Lean Tools & Methods

More and more companies of all kinds and sizes have introduced lean manufacturing into their operations using processes such as 5S, kanban, kaizen and value stream mapping (VSM). While the primary goals may be to decrease waste, increase quality and reduce costs, the companies, their management and their employees also find benefits from improved safety.

Along the journey, a company will also decide whether it needs a powerful quality tool such as six sigma. For those who need statistical control of a product or business system, this widely recognized process is the path to world-class performance. Six sigma is powerful, but demands significant resources. Many smaller organizations and those that do not require statistical control use 5S and VSM as the means to reach the low-hanging fruit.

5S & VSM as Foundations

5S integrated with VSM provides the core tools to unlock muda (waste) in business systems. 5S comes first because it teaches how to identify and eliminate waste. VSM is next in line because this tool forces hidden waste into the open where it becomes visible.

The most important VSM task is to map *actual* steps taken to accomplish the work. This will visibly display the hidden waste causing delays. It will also reveal that most time is not spent in actual work, but in waiting. This is particularly true with business systems.

The big challenge with business system waste is making it visible. System waste is often hard to detect, unlike an overstocked supply room where the waste of excess inventory is readily visible. Many business processes are hidden; they either do not formally exist or they are so incredibly complex (maybe even bizarre) that no one has taken time to map how things happen in the real world.

Lean & Safety

Lean manufacturing has exhibited significant successes in improving manufacturing efficiencies and productivity. Yet as lean concepts have gained attention in manufacturing, there have also been reports of these concepts being misapplied and creating significant problems, particularly concerning safety. Safety and lean manufacturing should not be viewed as having conflicting goals. In fact, they share a common goal of maximizing manufacturing throughput at the lowest risk and waste.

Lean and safety must be considered concurrently rather than separately. In many cases a common optimum can be developed. The challenge to management is to foster a work environment in which safety and lean are addressed concurrently to yield the best throughput with the lowest risk and waste.

Photo 1. Poor design: Top of a storage tank approximately 8 m above the ground. Sensor at apex of tank requires periodic maintenance, yet no hand rail, catwalk, tie-off point or other fall protection means is provided.

Photo 2. Poor execution: Fencing (highlighted by caution tape) does not prevent a person from walking into the hazardous area or reduce risk.

Photo 3. Inadequate access: An impellor installed at the top of an 8 m open tank. There is no method to access this area, and no gate, catwalk, tie-off point or other means of fall protection exist.

For example, assume that a traditional risk assessment determines that an interlocked gate is sufficient as part of overall safeguarding to obtain acceptable risk for an integrated manufacturing system or cell. However, a concurrent analysis for lean may identify the waste of motion for employees to perform specific tasks at the far end of the cell. This analysis may show that the extra capital cost of an added interlocked gate provides better productivity and less waste—both lean and safety.

For the interested reader, B11 TR7 presents a process through which safety and lean concepts can be addressed concurrently. Without this type of process, safety concerns can be omitted by some lean teams. If safety is perceived to be a detriment to the lean effort, it is likely that the safety practitioner will not be invited to participate. B11 TR7 presents a process where manufacturers can achieve an optimum of the lowest waste at the lowest risk. This con-

B11 TR7

B11 TR7, a newly created/approved technical report on lean safety, is a guide on integrating safety and lean manufacturing principles in the use of machinery. The report provides guidance on the practical application of safety and lean manufacturing principles to machines and manufacturing systems for improving performance, safety and quality by reducing injury and waste. The guidance in this technical report assists machine tool suppliers and users in minimizing waste and risk associated with machines and manufacturing systems, including individual and integrated machine tools and auxiliary components.

For information on the report, visit the Mechanical Safety Standards area of Association for Manufacturing Technology's website, www.amtonline.org or call (703) 893-2900.

trasts with approaches that can optimize waste or risk to the detriment of the other, yielding a suboptimal result.

Example: Poor Design

Photo 1 (p. 41) shows the top of a storage tank that is approximately 8 m above the ground. On the left is an access port where chemicals can be added. There is a fixed ladder to access that port. The task of adding chemicals to the tank can be performed safely and effectively, yet another task occurs in this area.

As shown in the photo, at the very apex of the tank is a sensor. That sensor needs to be periodically adjusted or replaced. Although not visible in the photograph, there are footprints leading up to and from the sensor. There is no place to tie off for fall protection. There is no hand rail, no catwalk, nothing to prevent a fall or injury from a fall.

Yet the task needs to be completed and someone must do the work. The additional cost to extend a walkway during the construction and erection of the ladder would have been trivial. The rework to provide safe access to this area now is not trivial and is waste. The time to perform the task with a catwalk in place is small. The additional time and increased risk of falling by walking out onto the tank are waste. As this example shows, you cannot get lean without safety.

Example: Poor Execution

Photo 2 (p. 41) illustrates situations where safety methods represent waste due to poor execution. As highlighted by the caution tape, the fencing shown in the photo does not prevent a person from walking into the hazardous area. The cost to purchase and install that portion of the fencing is waste of material, motion and waiting. This portion of the fencing is not reducing risk nor is it useful.

In certain respects, it could be argued that this poor execution is creating risk and waste to the company. For example, assume a person were injured in the hazardous area behind this fencing and that s/he had gained access to the area by walking through this setup. The fact that the fencing was installed could demonstrate that the company was aware of the hazard and that it must prevent workers from accessing the area. It might also be argued that the poor installation of the fencing failed to prevent such access and perhaps invited access.

This installation creates waste due to poor execution. It also potentially exposes workers to safety risks and, by virtue of the poor installation, may create additional liability risks to the company. Correcting the poor execution creates further waste.

Example: Inadequate Access

Photo 3 (p. 41) highlights an example where risk has been designed into the system, resulting in waste. The photo shows an impellor installed at the top of an 8 m open tank. The impellor motor and/or blades periodically will need servicing. As installed, there is no method to access this area, nothing to tie fall protection to, no gate and no catwalk. Performing the work will require creating a makeshift work platform and climbing over the existing hand rail. Considerable waste exists in terms of motion, material movement and waiting. Considerable risk is also present.

Conclusion

To be on the forefront of machine safeguarding and to help U.S. manufacturers avoid risk and reduce the cost of risk, manufacturers need to recognize the degree to which lean methodologies are driving change. Change can have the net effect of increasing risk or reducing risk. Seldom does change on the plant floor—or even in a service industry—have zero net effect on risk.

The policy and intent of most lean programs is that lean efforts will include and support strong safety performance. But it would be a mistake for any company to fail to recognize that its lean efforts can and will at times be implemented in ways which fail to adequately consider safety.

The concepts of lean manufacturing are very powerful. Properly applied, companies can obtain great improvements in the way they do business from lean manufacturing. Yet misapplied, safety concerns can be ignored or overlooked, resulting in suboptimal performance or results and considerably increased risks to personnel and the organization.

Efforts to become lean by eliminating waste can be derailed if safety is not properly considered. If not handled properly, waste can be inadvertently introduced into systems when unacceptable risks must be corrected. You just cannot get lean without safety. ■

References

The Association for Manufacturing Technology (AMT). (2007). *ANSI B11 Technical Report 7-2007: Designing for Safety and Lean Manufacturing.* McLean, VA: Author.

Cho, Fujio. (Jan. 2005). "5. Act. Improve. Repeat." *Business 2.0, 6*(1).

Ohno, T. (1988). *Toyota production system: Beyond large-scale production.* New York: Productivity Press.

Main, B.W. (2004). *Risk Assessment: Basics and Benchmarks.* Ann Arbor, MI: design safety engineering inc.

Massachusetts Institute of Technology (MIT). As quoted in "Lean Manufacturing." *i Six Sigma.* Retrieved Dec. 8, 2007, from http://www.isixsigma.com/dictionary/Lean_Manufacturing-116.htm.