LEAN TO THE RESCUE

Combating Safety's Costs With a Lean Solution

By Dan Hannan

The perception that safety costs rather than saves an organization money is still common today. Utilizing lean principles and an engineered safety system can save an organization money while reducing risk.

This article presents an example of a conventional safety system and its associated costs, a case study of a contractor that applied a lean solution to achieve cost savings as well as reduction of injury risk. Conventional guardrail systems on the jobsite are constructed from lumber, can be time-consuming to build, require regular maintenance and are typically discarded as waste at the conclusion of a project. Contractors can significantly underestimate budgeted costs associated with constructing and maintaining this type of guardrail. Wood systems are not sustainable and, when improperly constructed, put workers at risk and do not comply with OSHA guardrail performance standards.

The hierarchy of safety controls places engineered controls before PPE and other risk reduction considerations. This selection preference is demonstrated in many Canadian provincial workplace safety requirements that mandate the use of guardrails for fall protection before alternatives are used. U.S. employers are empowered to choose the method of fall protection with no preference of control. Unfortunately, wood guardrails are not always built according to OSHA guidelines or maintained in a safe condition.

The Business Case

Successful contractors are constantly evaluating how they perform work to identify cost-saving measures. Like many other contractors, M.A. Mortenson in Minneapolis, MN, had been erecting wood guardrail systems to protect unguarded edges and openings. Where feasible, a passive guardrail fall protection system is preferred over personal fall protection (e.g., body harness) as it allows work to be performed more efficiently and with less opportunity for human error. According to Taylor Gunkel, the company's superintendent and design phase manager, "Looking closely at the costs of using wood guardrails, we realized we were off in how they were budgeted. We decided to take a lean approach and reached out to an industry partner to help come up with a solution that would add to, not detract from, the bottom line" (T. Gunkel, personal communication, March 2019).

When preparing project budgets, a cost per linear foot is commonly applied for guardrail needs. However, many costs may not be accounted for and contractors may fail to identify risks. When budgeting a wood guardrail system, a truer calculated cost of $19 per linear foot should be applied when factoring in the following costs incurred over the project life cycle:

- shipping lumber to the jobsite, then moving and handling it to the point of installation;
- inspecting each piece of lumber for condition and defects, then measuring and cutting each piece to length;
- handling four pieces of lumber for each 8-ft section of guardrail (i.e., top rail, mid rail, toe board, corner posts);
- regular maintenance and repair due to damage, weather deterioration or the occasional "borrowing" of lumber from a rail section, as well as conducting more frequent inspections;
- disposal costs of discarded lumber;
- labor associated with sorting and bundling recycled lumber for future projects.

The team proposed that cost containment could be achieved by investing in the development of a sustainable guardrail solution for which the return on investment could be realized in just a few projects.

The Need for an Engineered System

The team completed a cost-benefit assessment and this drove the need to develop an engineered system to eliminate lumber waste and significantly reduce the labor associated with constructing conventional wood guardrails. The solution could be obtained by satisfying three engineering criteria that were not available in a commercially fabricated guardrail: simple, efficient and robust. With a sustainable guardrail system, a sizable impact could be made on reducing lumber and labor waste. Additionally, by applying lean processes, a significant reduction in risk of injury could also be achieved.

The firm leveraged an existing relationship with an industry leader in fall protection to develop such a guardrail system. The partnership identified its sole objective: to meet all of the demands of a project life cycle and end user. With the three engineering criteria established, and 2 years of development and jobsite testing, a simple and efficient construction-grade guardrail system was born. The lean process was applied to address the three engineering criteria: simple, efficient and robust.

Simple

A simple solution would require just two laborers to assemble a single 10-ft section. A penetrating and nonpenetrating base version would offer versatility and allow for applications for concrete construction, leading edges and finished roofs. Expandable guardrail sections could be sized to fit intermediate lengths from 5 to 9 ft.

Efficient

With the lean solution, assembly and disassembly time was greatly reduced, with 120 linear ft being erected within 12 minutes (weighted base version). Wheeled carts were designed to unitize and contain all components. These carts could be moved with a fork truck, crane or pushed by hand to the point of installation. Stackable carts minimize yard storage space and provide more efficient transportation. Moving 70-lb weighted bases was facilitated with a wheeled dolly to reduce strain on workers.

Robust

To combat the strains of construction, scaffold-grade tube steel was used along with a hot-dipped galvanized application inside and out to prevent rusting. Having to replace bent and damaged guardrail sections after being in service for just a few projects detracts from a company's margin. A long product

life cycle was needed to realize the full cost-saving potential.

Risk Reduction

The challenge for all contractors is to maintain a reasonable balance of productivity, quality and safety to ensure an injury-free outcome. When schedule and budget are compressed and greater emphasis is placed on production, injuries are more likely to occur. Applying the lean approach to the design of an engineered guardrail system helps combat injury and reduce risk in several ways:

- Use of lower-consequence power tools in the form of a drill versus a pneumatic nail gun and circular saw to prepare and install components reduces injury risk.
- Unitized delivery and movement via a wheeled cart to the point of installation minimizes lifting and carrying risks.
- No nails or screws are used that present a cut or impalement hazard.
- A manufactured engineered system conforms to the OSHA guardrail performance requirements, which provides safer working conditions and lower risk of violation.
- The application of swing gates provides secured access.
- An integrated toe board provides falling object prevention, and debris netting is easily installed using clips.
- Less time is spent at a leading edge installing an engineered rail versus a wood rail, further reducing risk.

DOWNTIME Process

Lean outcomes subscribe to the elements that are spelled out through the acronym DOWNTIME to reduce waste and increase efficiency. An engineered guardrail system addresses the elements of the lean approach in the following ways:

Defects

Consistent, uniform construction of metal guardrail sections ensures that OSHA height and impact performance requirements are met. Lumber presents a greater risk of defect due to variability in grade quality and deterioration from exposure to the elements. An improperly constructed wood guardrail is considered nonconforming and is subject to OSHA citations.

Overproduction

Expandable guardrail sections from 5.5 to 9 ft minimize overuse and overproduction of guardrail sections.

M.A. MORTENSON

The guardrail system has been deployed on three M.A. Mortenson-partnership projects and has eliminated 80,000 linear ft of wood guardrail and reduced 60% of installation and maintenance labor. No injuries have been reported during installation and handling.

Waiting

Waiting is minimized with the elimination of measuring and cutting lumber to length. Transport carts contain 200 linear ft of guardrail sections and other assembly components. A cart kit eliminates waiting for misplaced hardware, which is common to conventional wood guardrails.

Nonutilized Talent

A metal engineered guardrail is installed by two laborers or even unskilled trade professionals, whereas wood systems require construction by carpenters. Skilled labor can be utilized elsewhere on project sites rather than being dedicated to building and erecting guardrails.

Transportation

Material shipment and handling risks are minimized with the use of guardrail carts that can be hoisted and moved with fork trucks or cranes, or pushed by hand to the point of installation. Carts can be shipped side by side on a trailer and stacked on site to minimize space.

Inventory

A lean system produces no excess material waste, which is common when cutting lumber to length. A guardrail system that is unitized, with uniform components contained on a cart and shipping pallets or racks, can be quickly inspected and inventoried. Stackable carts reduce yard storage space and add to the ease of inventorying.

Motion

Guardrail carts allow sections to be pushed or mobilized to the point of installation, reducing stress on the worker from lifting and moving and increasing productivity. Engineered guardrail sections have a single component, whereas lumber systems have 4 to 8 ft of guardrail. A dolly is used to move weighted base components, which adds to the speed of erecting while minimizing the risk of worker back injury.

Extra Processing

Redoing work due to damage or replacement is infrequent with a construction-grade engineered guardrail system. Add-on features of engineered systems such as debris netting can be efficiently installed using plastic reusable clips, thereby eliminating the dangers of protruding nails and screws.

Project Applications

The product partnership formed with M.A. Mortenson has allowed the engineered guardrail system to be field tested and go through a series of modifications to ensure that it meets the needs of the end user and returns the value demanded by lean principles. To date, the guardrail system has been deployed on three partnership projects including two professional sports stadiums and a 26-story high-rise building. The system has eliminated 80,000 linear ft of wood guardrail, reduced 60% of installation and maintenance labor, and reported no injuries during installation and handling.

Conclusion

Lean processes should be applied to safety challenges. Success is best achieved when solutions are prepared with the needs of the end user in mind. When collaborating with key partners, solutions can be quickly identified and developed. In this case study, a win-win outcome was achieved as the risk of injury was reduced and profitability increased. **PSJ**

Dan Hannan, CSP, is director of EHS at Hilmerson Safety Services (https://hilmersonservices.com/rail-system). He is an OSH professional with 28 years' experience serving the construction, manufacturing, and oil and gas industries. Hannan is a professional member of ASSP's Northwest Chapter.