LEAN SIX SIGMA TO FOR OSH PROFESS

Integrating Safety Into Bus

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OSH PROFESSIONALS ARE REQUIRED TO POSSESS a diverse set of skills and knowledge. Current trends in safety and risk management emphasize proactive approaches and preventive measures (ANSI/ASSP, 2019). Our profession is rapidly changing; to succeed, practitioners must be equipped to integrate safety, risk management, lean six sigma (LSS) and business management methodologies.

LSS has been adopted and proven to work well with OSH management principles, but this prudent and proven approach could elicit some questions (Manuele, 2018).

•Is OSH assigned the same value as product quality and process efficiency?

•Is safety excellence considered a core value in the business environment?

•Is it possible to integrate LSS into OSH management objectives?

This article presents a case study to address these questions, which in many ways determine the trajectory of the OSH systems in place. Since it can be challenging to integrate both of these systems when addressing risks, the case study demonstrates the advantages of using LSS tools within OSH management. Two approaches are used to demonstrate the benefits of this synergy: one originating from OSH, another from LSS.

LSS Methodologies & the OSH Professional

Most OSH professionals are strong in their own discipline but would benefit from the use of LSS tools when communicating to management the organizational improvements and business benefits of a strong OSH program. When risk reduction takes the form of quality and productivity improvements, the OSH message becomes much stronger. One responsibility of an OSH professional is to assist organizations in transformative processes, which move away from reactive responses and toward proactive operational business values. To be successful, practitioners must search for opportunities for integration of LSS into the safety management system so that operational business objectives can be met.

KEY TAKEAWAYS

- **In today's global economy, professionals must learn to reduce risk, increase productivity, improve quality and lower inventories as well as lead time.**
- **OSH management can be integrated into lean six sigma (LSS) to produce improved quality and process efficiency.**
- **Both employers and employees benefit from the power of coupling LSS into OSH management practices.**

The Value of LSS Tools

Due to the competition in today's global economy, professionals must be able to reduce risk, increase productivity, improve quality, decrease inventories and improve lead time simultaneously. To address such challenges, the authors modified a few LSS tools that include these business considerations. Risk assessment was identified as a key component of the entire evaluation process. NIOSH and partnering organizations also built in user-friendly attributes that assess the value of different design alternatives known as prevention through design (PTD). The PTD business case tool integrates hazard identification, risk assessment, financial and nonfinancial benefits of PTD interventions that would present in an attractive manner to business leaders (NIOSH, 2013).

Basic LSS Tools

When a new product or process is designed, the OSH practitioner's main objective is to eliminate or minimize the opportunity for injuries and illnesses. Organizations often begin by forming project teams to accomplish this and other design goals. When such teams are tasked with identifying and implementing product improvements, it is imperative that they have techniques at their disposal. Value stream mapping is one method used to understand and evaluate the current state of a product or process as well as create a single path to a future state. The future state always considers the ideal state of operation. Additionally, this initial mapping process reveals production waste and opportunities for other improvements such as safety. Once opportunities are identified, specific analyses can then take place. For example, productivity gains may be evaluated numerically by utilizing process cycle efficiency (PCE) calculations.

Another lean tool that can be used to compare data is the Pareto chart and the 80/20 analysis. The initial Pareto chart is usually based on previously constructed data tables and communicates a current state. Safety professionals can build a Pareto chart based on organizational results. Liberty Mutual (2019) provides an excellent example of this analysis using the top 10 leading causes for serious injuries and illnesses. In this example (Table 1), we see that approximately 80% of the injuries come

OOLS
SIONALS
siness Objectives

from the first five causes and the first two causes relate to approximately 50% of the direct cost of injuries.

When evaluating losses, a Pareto chart (Figure 1) can help identify the vital few causes. In the example, it is evident that the largest percentage of issues (26.65%) are related to overexertion involving outside sources. The presented Pareto chart helps visualize the 80/20 rule and communicates to management the primary causes that generate most of the direct costs.

Other useful LSS tools include suppliers, inputs, process, outputs and customers (SIPOC), and failure mode and effects analysis (FMEA). SIPOC assists the organization in developing the scope of a project. FMEA, one of the first failure analysis techniques, was formalized by U.S. Department of Defense in 1949. FMEA is also included in U.S. and international standards such as ISO 31000 Risk Management standard and ANSI/ASSP Z590.3-2011. PTD includes FMEA and evaluates risk contributing links in a system. In OSH management, we can utilize PTD combined with LSS to assess risk. The following case study is used to present effective use of such tools.

Case Study

Description of Operation

Quality Auto Parts Corp. (fictional name) assembles aluminum and plastic parts for the automotive industry. A conventional oil-based spray-painting operation is used to coat

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Photos 1 and 2: Example of the type of spray gun used by employees in paint application operation performed at the fictional company in the case study.

TABLE 1

EXAMPLE OF INITIAL DATA INPUT INTO PARETO CHART

Cause	Direct costs ($ billion)	Cumulative %
Overexertion involving outside sources	13.7	26.65
Falls on same level	11.2	48.44
Falls to lower level	5.9	59.92
Struck by object or equipment	5.3	70.23
Other exertions or bodily reactions	4.2	78.40
Roadway incidents involving motorized land vehicle	3.2	84.63
Slip or trip without fall	2.3	89.10
Caught in or compressed by equipment or objects	2.1	93.19
Struck against object or equipment	2	97.08
Repetitive motions involving microtasks	1.5	100

Note. Adapted from "2018 Workplace Safety Index: The Top 10 Causes of Disabling Injuries," by Liberty Mutual Insurance, 2019.

FIGURE 1

PARETO CHART EXAMPLE

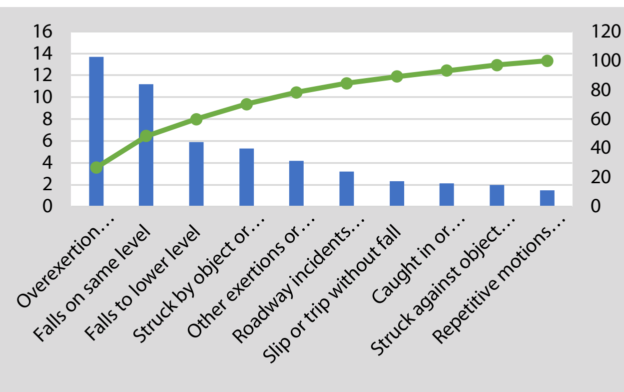


FIGURE 2
MODIFIED FISH-BONE DIAGRAM OF THE PROCESS

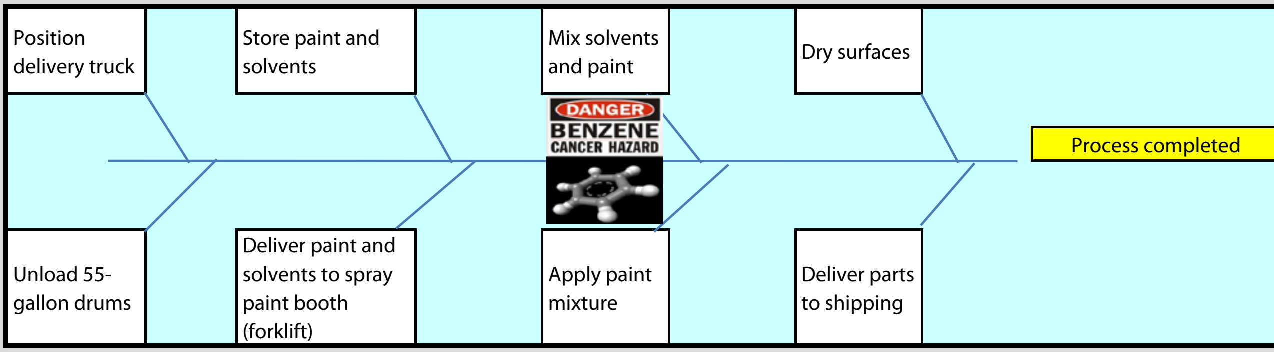


FIGURE 3
DIAGRAM OF THE CURRENT STATE IN MINUTES

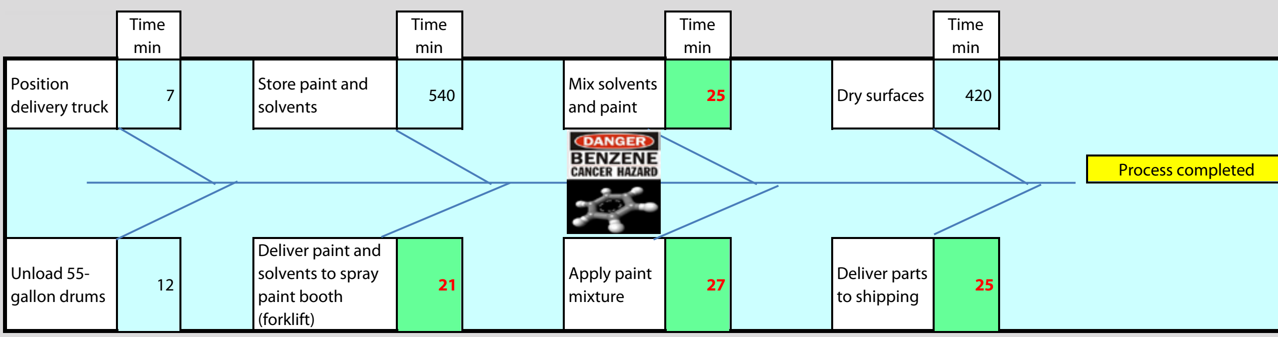
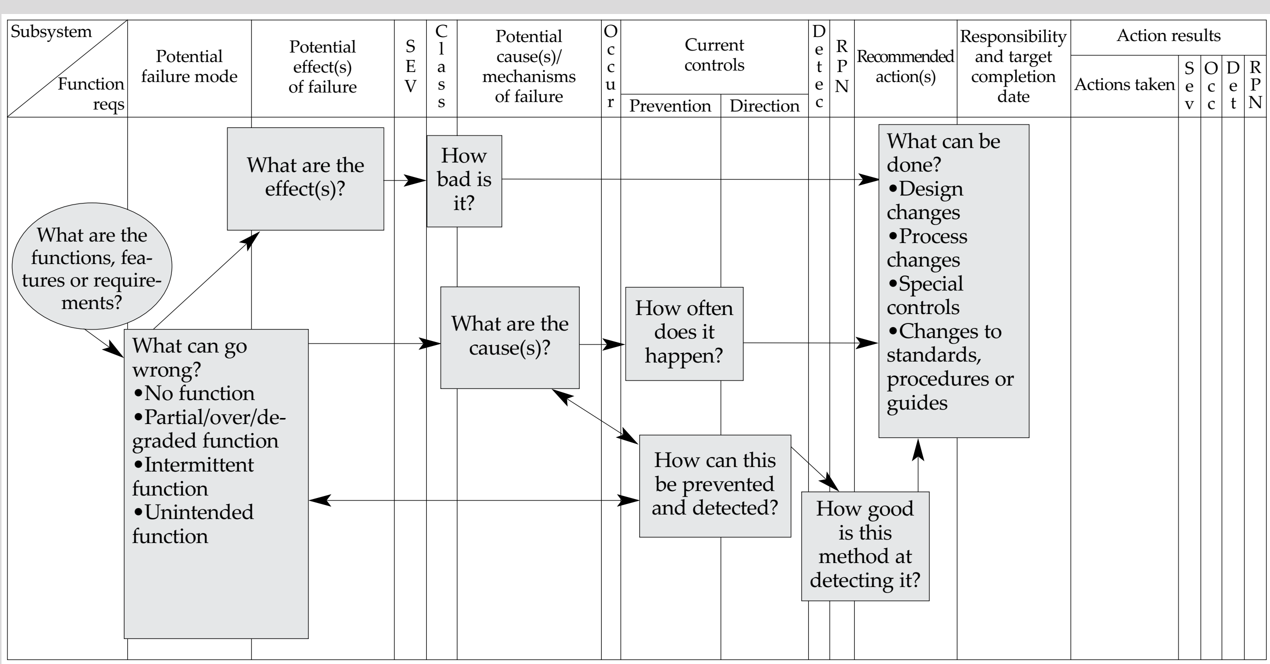


FIGURE 4
SAMPLE FMEA FORM



Note. From *Potential Failure Mode and Effects Analysis* (3rd ed.), by Automotive Industry Action Group (AIAG), 2001, Southfield, MI: Author. Copyright 2001 by AIAG. Reprinted with permission.

FIGURE 5
EXAMPLES OF RISK ASSESSMENT RATING SCALES

Severity	Probability/occurrence	Prevention effectiveness
1) Insignificant	1) Unlikely	1) Avoid, eliminate, substitute
2) Negligible	2) Seldom	2) Engineering control
3) Marginal	3) Occasional	3) Warning
4) Critical	4) Likely	4) Administrative or PPE
5) Catastrophic	5) Frequent	5) None

many different parts. The company stores an oil-based paint in 55-gallon drums in a storage room. Flammable solvents are also stored in the storage room. The solvents contain up to 5% benzene. The paint and the solvent drums are moved from the storage location with a powered industrial truck to a spray booth. Employees use spray guns during the paint application operation. Photos 1 and 2 (p. 33) show the type of spray gun used.

Upon initial evaluation of the operational practices, the process included the use of PPE during paint spraying, the least desirable control method. It was the preferred method by management because it was the least expensive and most convenient option. The operators were using N95 or P100 respirators in combination with safety glasses as PPE for paint spraying. As safety professionals know, P100s control mists and aerosols but do not protect the worker from organic vapors, thus, this is an improper selection for respiratory protection for this operation. Although the strategy was well intended, the quality control/safety manager was not aware that P100 cartridges do not protect against organic vapors. In addition, the safety glasses became coated with paint after 10 minutes of use and the impaired vision of the operators led to a decline in quality and productivity. The quality control manager determined that only 72% of the parts were properly coated. In addition to a 72% defect rate, the workers were not being adequately protected.

Application of LSS & PTD Tools

Another lean tool, a modified fish-bone diagram, can be used in conjunction with a process map to show the current state. Figure 2 shows a process map sequence for simplicity and visualization.

This type of diagram can be used to identify opportunities to eliminate waste in time, products or resources. It can also be used to understand and measure the process cycle time and lead time within the current state (Figure 3).

Lean techniques focus on process cycle efficiency (PCE) as a measure of process time. PCE is a common lean metric that is calculated by dividing the value-added time (VAT) by the total cycle time (TCT) of the process.

$$PCE = \frac{VAT}{TCT}$$

For example, in Figure 3, VATs of the process are highlighted in green and the time in minutes is displayed in red. In the case study, the customer would not be interested in paying for storage. Therefore, it is considered a non-VAT. By adding all the VAT and non-VAT, we arrive at the TCT for the process.

In addition, for the same process we can use FMEA to identify the hazards, perform risk assessments and calculate the risk priority number for all identified hazards. In fact, FMEA is one of the most used system safety tools; an example is shown in Figure 4.

The PTD FMEA example requires entry of severity, occurrence, and detection codes or rankings. Simple multiplication of severity, occurrence and detection codes will produce the risk priority number (RPN). As described by ANSI/ASSP Z590.3, the RPN is a semiquantitative measure of criticality obtained by multiplying numbers from rating scales (usually between 1 and 10) for the consequence of failure, likelihood of failure and ability to detect the problem. A failure is given a higher priority if it is difficult to detect.

Note that the PTD standard describes various severity, probability and detection ranking scales (Figure 5). The authors suggest using the rating scale with numerical grading as the example provided in the PTD standard. The authors adopted the 1-to-5 rating scale provided in *Risk Assessment: A Practical Guide to Assessing Operational Risks* (Popov, Lyon & Hollcroft, 2016). Note the descending numerical order in the prevention scale, which helps in understanding the logic

FIGURE 6
EXAMPLE OF iFMEA WORKSHEET

Conventional oil-based spray painting		
Part or process name:	**Plants affected:**	
Design/manufacturing responsibility:		**Model date:**
Other areas involved:		**Engineering change level:**
Process or function	**Potential failure mode or potential hazards**	**Potential effect(s) of failure/hazard**
Housekeeping and flammable liquid storage	Chemical/physical hazard	Explosion
Oil-based flammable liquid application in the spray booth	Chemical hazard; exposure	Worker overexposure; central nervous system affected due to benzene exposure
Oil-based flammable liquid application in the spray booth	Chemical mixture releases	Environmental release; community overexposure

FIGURE 7
EXAMPLE OF MODIFIED FMEA

Part or process name	Spray painting	Suppliers and deptartments affected				Prepared by		GP	
Design/mfg responsibility	Process engineer	Model date				FMEA date	1	17	16
Other areas involved	LSS	Eng. change level							
Process operation, function or purpose	Potential failure mode	Potential effect(s) of failure	SEV	Potential cause(s) of failure	OCC	Current controls evaluation method	PE	S x O	RPN
Housekeeping and flammable liquid storage	Chemical/physical hazard	Explosion	5	Unsafe flammable liquid storage and moving	3	None	5	15	75
Oil-based flammable liquid application in the spray booth	Chemical hazard; exposure	Central nervous system affected due to benzene exposure	4	Worker overexposure	4	SOPs and PPE	4	16	64
Oil-based flammable liquid application in the spray booth	Chemical mixture releases	Community overexposure	3	Environmental release	4	None	5	12	60

FIGURE 8
SUBSTITUTION PROCESS MAP WITH TIMES IN MINUTES

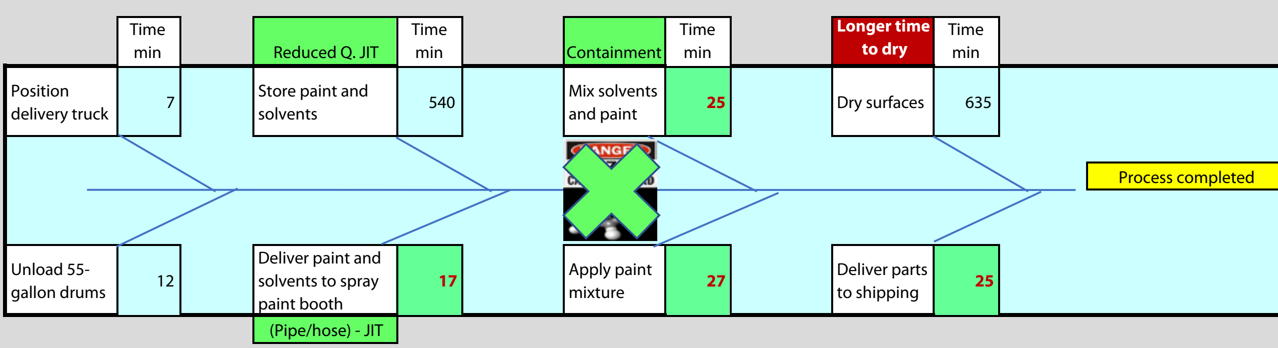


FIGURE 9
PCE COMPARISON: CURRENT STATE VS. SUBSTITUTION WITH LESS TOXIC CHEMICAL

*Compare the amount of value-add time to total lead time

Process cycle efficiency (PCE) = Value-add time (VAT)/total lead time (TLT)

Benzene-containing solvent PCE

VAT **TLT**

PCE = **Value-add time (VAT)** / **Total lead time (TLT)**

VAT = 98
TLT = 1077

PCE = 0.091 9.10%

Time to complete the operation in minutes

*Compare the amount of value-add time to total lead time

Process cycle efficiency (PCE) = Value-add time (VAT)/total lead time (TLT)

Toluene/MEK-based solvent PCE

VAT **TLT**

PCE = **Value-add time (VAT)** / **Total lead time (TLT)**

VAT = 98
TLT = 1288

PCE = 0.0761 7.61%

Time to complete the operation in minutes of the larger total number corresponding to the larger priority number, thus, higher risk.

The authors developed a new PTD LSS model that incorporates risk assessment, hierarchy of controls, productivity and future state projections. The model follows the six sigma define, measure, analyze, improve, control (DMAIC) cycle as a road map for OSH interventions and product/process improvement. Separate tools were developed or adopted for each DMAIC phase. For example, initial FMEA (iFMEA) may be used in the define phase of DMAIC and then the produced RPNs in the measure phase. The iFMEA, as presented in Figure 6 (p. 35), can be used to assist in the identification of hazards and potential failures, and can be described as a preliminary step of an FMEA.

FIGURE 10
ANSI/ASSP Z590.3 PTD RISK REDUCTION HIERARCHY OF CONTROLS MODEL

	Controls
Most preferred	**Risk avoidance:** Prevent entry of hazards into a workplace by selecting and incorporating appropriate technology and work methods criteria during the design processes.
	Eliminate: Eliminate workplace and work methods risks that have been discovered.
	Substitution: Reduce risks by substituting less hazardous methods or materials.
	Engineering controls: Incorporate engineering controls/safety devices.
	Warning: Provide warning systems.
	Administrative controls: Apply administrative controls (e.g., the organization of work, training, scheduling, supervision).
Least preferred	**PPE:** Provide PPE.

Note. Adapted from Prevention Through Design: Guidelines for Addressing Occupational Hazards and Risks in Design and Redesign Processes [ANSI/ASSP Z590.3-2011 (R2016)], by ANSI/ASSP, 2016, Park Ridge, IL: ASSP.

Common hazards in spray painting operations are well described in many OSH publications, which provide the foundation for the ranking system applied. Based on the identified hazards, potential causes of failure and control measures could then be added. In addition, semiquantitative severity, occurrence/probability and prevention effectiveness rankings were added and presented in Figure 7.

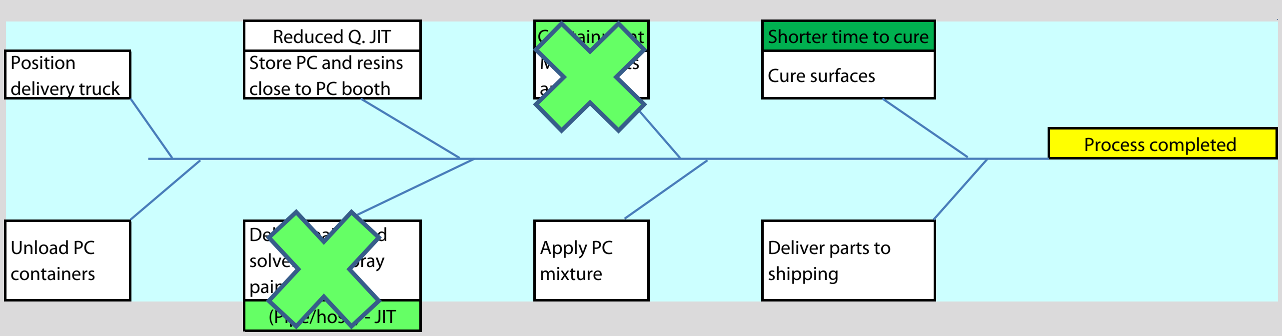
The FMEA tool was used in the presented case to prioritize the hazards and modify the procedure to demonstrate and quantify the risk reduction after the proposed OSH interventions. Based on the FMEA worksheet, OSH professionals can see that the highest RPN is related to potential explosion hazards followed by the coat application operation (Figure 7). Following the DMAIC sequence, the RPNs were used as a measure and the next stage was analysis. It is obvious that the operational risk under the current condition was significant and clearly related to the use of solvents. A careful analysis of the OSH hazards led to the conclusion that significant changes were needed. Different solutions were evaluated and prioritized as the improve phase of DMAIC.

Applying this FMEA tool helped the team to compare alternative options for this coating application operation. A substitution utilizing a less hazardous solvent was considered. Substituting a benzene-containing solvent with a toluene, methyl ethyl ketone blend, the severity and probability of central nervous system depression was effectively reduced. In the FMEA tool, the RPN of chemical exposure is reduced because of the reduced severity number. However, the substitution process with such a mixture will lead to PCE reduction due to longer drying time for the auto parts and was not acceptable from a lean perspective.

The process map is presented in Figure 8 and PCE comparisons are presented in Figure 9. In other words, to complete the DMAIC cycle in the control phase, we can also evaluate the improvements from a business perspective. The drying time specific for the substitution solvent reduces the PCE by almost 2%.

Safety management and risk reduction appear to be in conflict with LSS practices, since the RPN and risk reduction are undermining the PCE. However, these tools can be used to demonstrate how OSH management and LSS can work concurrently to yield excellent results in terms of improved throughput at the lowest risk level and less waste. For example, if the LSS and OSH risk reduction team wants to reduce

FIGURE 11
POWDER COATING PROCESS MAP



the risk even further and increase PCE at the same time, the team must consider even higher levels of PTD hierarchy of controls, presented in Figure 10 (p. 37).

Solvent substitution was not effective to reduce all operations' RPNs and did not allow removing the PPE as a low level of control in the coating operation, which strongly suggests further looking at the next higher level of hazard control. For example, as recommended in the PTD standard, one option might include elimination of solvents in the paint spray operation and the introduction of powder coating. Utilizing the powder coating method will eliminate two steps in the current state production process as demonstrated in the revised process sequence diagram, shown in Figure 11 (p. 37).

Implementation of the powder coating method will require significant investment but will eliminate two steps of the process and considerably improve PCE. That, in turn, will allow the company to reduce manufacturing cost and increase the speed to market or improve lead time. PCE for the powder coating operation is detailed in Figure 12. Projected PCE of 40% is a significant increase compared to solvent paint spray coating. Operation efficiency is significantly improved by eliminating PPE and spending no time donning and doffing PPE. This elimination would also directly affect the quality by reducing the percent of improperly coated parts.

Once the elimination of solvents has been completed, a new risk assessment should be performed, since powder coating operations represent different hazards. For example, combustible dust may present an explosion hazard. Therefore, the severity of a potential incident would be catastrophic. However, the probability of an explosion is considered unlikely. OSH conditions after the improvements were evaluated utilizing the FMEA. The powder coating process versus solvent spray painting is presented in Figure 13.

FIGURE 12
PCE ESTIMATE FOR POWDER COATING OPERATION

*Compare the amount of value-add time to total lead time

Process cycle efficiency (PCE) = Value-add time (VAT)/total lead time (TLT)

VAT **TLT**

$$\textbf{PCE} = \frac{\textbf{Value-add time (VAT)}}{\textbf{Total lead time (TLT)}}$$

VAT = 57

TLT = 140

PCE = 0.4071 40.71%

Time to complete the operation in minutes

Creating the Business Case Using the A3 Tool

In the business case, LSS tools and OSH management were shown to be compatible. To bring the case details into one presentation, an additional tool can then be used. A visual and effective way to communicate OSH opportunities is the A3 problem-solving tool. A3 refers to the metric equivalent of an 11 x 17-in. page. This methodical, organized approach to problem-solving addresses three specific states: the current, target and future states. Using this tool helps the OSH professional support continuous improvement by defining each state and determining an overall plan of action. A3 is not only a project management tool, but also a thought process that can be applied when addressing safety and health challenges. Throughout the A3 process, Deming's (1982) plan-do-check-act (PDCA) methodology is put to work and a process of improvement is made visual (Table 2).

Current State

The current state is simply the documentation of the way the process is currently run. This can be done using the value stream map as in our case, so specific steps can be made visible to the team. Without identifying the individual steps of the process, it is difficult to determine what must change to improve a process. Since many employees or employee groups may be involved in any one process, a multidisciplinary team is desirable when mapping.

This exercise is an opportunity for OSH professionals to identify areas where incidents have occurred and contribute to the identification of loss and other types of waste that may be present. Remember that when work is difficult or safety measures are cumbersome, waste is likely present. This exercise is a chance to demonstrate the many ways safety managers can support the objective of continuous improvement.

Target State

The target state helps bridge the gap between current and future states. This allows the problem solver or team to iden-

FIGURE 13
FMEA CURRENT STATE VS. ELIMINATION OF SOLVENTS FUTURE STATE

Part or process name	Spray painting	Suppliers and deptartments affected				Prepared by		GP		Part or process name	Powder coating					
Design/mfg responsibility	Process engineer	Model date				FMEA date	1	17	16	Design/mfg responsibility	Process engineer					
Other areas involved	LSS	Eng. change level								Other areas involved	LSS					
Process operation, function or purpose	Potential failure mode	Potential effect(s) of failure	S EV	Potential cause(s) of failure	OCC	Current controls evaluation method	PE	S x O	RPN	Recommended action(s)	Area/individual responsible and completion date	Action results actions taken	SEV 2	OCC 2	PE 2	RPN 2
Housekeeping and flammable liquid storage	Chemical/physical hazard	Explosion	5	Unsafe flammable liquid storage and moving	3	None	5	15	75	Elimination of solvents and engineering controls	Management	Reduced explosion hazards	5	1	1	5
Oil-based flammable liquid application in the spray booth	Chemical hazard; exposure	Central nervous system affected due to benzene exposure	4	Worker overexposure	4	SOPs and PPE	4	16	64	Automate	Management	Reduced exposure	3	1	1	3
Oil-based flammable liquid application in the spray booth	Chemical mixture releases	Community overexposure	3	Environmental release	4	None	5	12	60	Eliminate (one operator)	Management	Eliminated exposure	3	1	1	3

tify and establish an organized avenue for arriving at the future state. In OSH management, the professional might apply various controls and establish several short- and long-term goals for arriving at the state of zero-incident excellence. The path to success will be created with several targets that, once achieved, will align the programs for improved overall performance. The process of continuous improvement should eventually lead to an incident-free future state. Identified targets can be specifically related to hazards or tied to operational systems.

The case study demonstrated the targeting of a specific hazard within a process and the risk reduction options explored. If targets are related to the implementation of a specific system, the achievement of various voluntary programs or certifications (e.g., ISO 45001, ISO 14001, VPP, SHARP) might be the emphasis.

Although it is desirable to move from the current state directly to a more desirable future state of operation, the transition from one or the other is a process of intermediate steps with multiple targets, the focus always on continuous improvement. Establishing short- and long-term targets allows for the development of OSH and other programs and sets the pace at which implementation must occur.

Future State

The future state is defined as the way the process or work activity should look in the future in a realistic sense. This state is similar to the current state but with less waste. It is optimal to create a process with only value-added activities and no waste, an ideal state, but the reality for most organizations is that waste, in one form or another, will occur. Some activities are not considered value-added but are still deemed necessary and are difficult to remove without experiencing other negative effects. The work of the OSH professional could arguably be classified as non-value-added. OSH work activities do not typically add value to a process (something the customer is willing to pay for), but removal could cause added waste and become manifest by a loss event.

Using the A3 Tool & Communicating to Management

A3 is a versatile tool that incorporates the use of other LSS tools such as the fish-bone diagram, value stream mapping, FMEA, single-minute exchange of die (SMED), creation of standardized work instructions, completion plans, takt time studies, process mapping, waste walks and many others that can be used to support the process of continuous improvement. Since the work of the professional is ongoing, a completed A3 can be used as a place to begin when attempting to make additional improvements on already established processes.

Kaizen events often are managed using the A3 tool, which not only creates a way of managing the activities of the event, but also provides a storyboard that explains to stakeholders the focus of the group and the tools used to understand and solve the assigned problem. Since a safety incident is a waste to any process, using lean tools to identify hazards and assess risk fits well with OSH management. During the study of a process, OSH professionals can use lean tools to identify loss opportu-

TABLE 2
A3 PROCESS & PDCA METHODOLOGY

A3 steps	PDCA cycle
1) Reason for action	Plan
2) Initial state	
3) Gap analysis	
4) Target	
5) Solution	Do
6) Rapid experiment	
7) Completion plan	
8) Confirmed state	Check
9) Repeat the previous eight steps	Act

FIGURE 14
COMPLETED A3 PROCESS

Title: Quality Auto Parts (QAP) spray painting
Date started: **Revision date:** **Rev:**
Team: Safety Sciences
Resources: QAP example

1) Reason for action

- QAP Corp. is the primary supplier for the automotive industry in the Kansas City area.
- The goal of the project is to improve OSH conditions in the spray painting department.
- The team used Plain View exception to observe and document workers' actions.
- The management was concerned about the spray painters' exposure and environmental releases.

4) Target condition

- Improve financial results.
- Improve productivity and OLE.
- Reduce turnover rate to manageable 5%.
- Reduce OSH risk by 50%.
- Improve process cycle efficiency (PCE).

7) Completion plans

Task description	Who	When
Send RFP for powder coating equipment	Purchasing	3/1/17
Form implementation team (finance, engineering, production, supervisor, employee, OSH)	Multiple	3/15/17
Install powder coating	Contractor	4/1/17
Training employees and supervisors	Contractor	5/1/17
Initial operation testing	Operations	5/15/17

2) Initial state

- We had seven reportable injuries and illnesses last year. Our IIR is significantly higher than our competitors
- EMR approaching 1. Direct and Indirect costs related to the injuries and illnesses were estimated at $357,789
- Environmental emissions violations
- Employee turnover rate: 20.7%.
- Only 72% of the parts are coated properly leading to significant losses. Overall labor efficiency (OLE) is just above 54%.

5) Solution approach

- *Solution 1: Substitute benzene with less toxic toluene. Implement JIT spray paint delivery. Activated charcoal PP equipment.*
- *Solution 2: Powder coating operation*

8) Confirmed state

Metric/action description	Before	Goal/after	Est value/yr
Employee turnover rate	21%	3%	50K
OLE	54%	81%	120K
Injuries and Illnesses cases reduction	357K $	120K $%	237K$
Risk level reduction	12	6	50% Red.
NPV			2.1M$
ROI			155%
Payback period			2.1 years

3) Gap analysis

- Spray painting without proper PPE
- Injuries and illnesses - spray paint operation
- EPA - potential shutdown

No action was taken to correct the conditions so far.
- Exposure to $12,000 or more in fines per instance. The overall liability for the exposure could be much greater.

6) Rapid experiments/improvements

- *Substitution of benzene with toluene leads to longer drying time. PCE reduced.*

Cannot achieve major target condition with Solution 1.

9) Insights

- *Solution 2 - Powder coating was significant investment. However, it was long term investment.*

nities and make necessary adjustments to prevent injuries and illnesses from occurring without burdening an employer with a different or additional system of management.

The A3 shown in Figure 14 (p. 39) is common in format and basic, but useful in explaining the story of process improvement and safety management practices. Although there are many A3 formats to select, the authors encourage OSH professionals to use a model that fits the needs of the organization with a focus on simplicity. If the audience must study the A3 for long periods before understanding the message, the overall value of the tool is diminished.

A3 Thinking

As noted, A3 is not only a tool, but also a thought process that, when applied, helps the OSH professional perform the work of risk reduction and incident prevention. When evaluating risk, it is understood that designing a system with no risk is not always feasible. When applying the A3 approach to managing safety and health, OSH professionals engage in an incremental process of risk reduction. Changing technologies and workloads requires the repetition of this process so that hazards are continually identified, and risk reduction measures applied. The focus of A3 thinking is this process of continuous improvement. Despite continued debate about the concept of zero injury excellence, the effort of continually improving the work environment and reducing the risk of exposure is a reasonable approach to OSH management and the reason that the A3 tool is a great fit for the practitioner.

Using LSS to communicate OSH management practices illuminates a clear path toward a desired future state and addresses not only risk reduction but also waste elimination in general with the result of improving productivity and profitability.

Case Study Conclusions

Different solutions to the paint spraying problem were evaluated and prioritized using OSH and LSS tools and measurables. This synergetic approach of satisfying both OSH and business criteria allowed the team to solve the problem and reach the goals of safety risk reduction, which directly projects to an increase of quality and productivity. The application of LSS helped the team compare different options to improve safety, quality, delivery and cost.

Often business managers prefer to see more than one possible solution to a problem and a comparison of different proposals with corresponding outcomes. The FMEA worksheet helped the team compare the current state to future state, which included RPNs. The PCE calculations, on other hand, revealed the business side of possible solutions. Such a numerical evaluation directly benefits decision-making by clearly showing the scale of improvements when solvents elimination is applied. In the presented case, it is easy to see that typical OSH tools such as FMEA fit well in LSS methods such as DMAIC and A3 by supplying valuable numerical data.

To gain support for OSH improvements, LSS risk reduction teams would also benefit from including a clear cost-benefit analysis. This type of analysis further develops a business case for mitigation of potential hazards and improved efficiency. The methodology of LSS and the tools can be used to support OSH in many ways and help to tell the story of hazard identification, risk reduction and continuous improvement. Using LSS to communicate OSH management practices illuminates a clear path toward a desired future state and addresses not only risk reduction but also waste elimination in general with the result of improving productivity and profitability. Risk reduction is the most important nonfinancial benefit contributing to improving product quality and efficiency, and OSH professionals must take credit for such process improvements. **PSJ**

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