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Savannah River Remediation Liquid Waste Operations Making the Workplace Safer – Lean and Human Performance Improvement Initiatives - 17244

Laurene Rowell, Bob Gray and Patricia Allen, Savannah River Remediation, LLC,
Laurene.Rowell@SRS.gov, Bob. Gray@SRS.gov, Patricia.Allen@SRS.gov
Aiken, South Carolina, 29808

ABSTRACT

The Savannah River Site, a U.S. Department of Energy facility, contracted Savannah River Remediation (SRR) to manage its liquid waste project, which is a unique, high hazard nuclear waste treatment and disposal facility consisting of 51, one million-gallon underground waste tanks, a solvent extraction processing unit, a vitrification facility for the highest radioactive waste, and a grout solifidication and disposal facility for a decontaminated salt solution. Our Project mission is to treat the nuclear waste and close the associated storage and treatment facilities, of which, 8 of the 51 tanks have been closed to date.

Over the past three years, SRR implemented a Lean Business Management System to address site inefficiencies, aging infrastructure concerns and budget constraints. The Lean philosophy started with the work of W. Edwards Deming and his contemporaries. In more recent years the process has matured in the Toyota Production System and migrated into fields as diverse as services industries, healthcare, and now the DOE complex.

Like safety, continuous improvement is a fundamental core business value that starts at the top. The Lean Business System, led by our executive management team, drives quality, production and waste elimination by focusing on PEOPLE using a structured PROCESS that allows the workforce to identify and fix problems in their workplace. Many inefficiencies and quality related issues start with the desire to make systems fail-safe without defining the core requirements for which that process or program was created. This leads to added complexity and latent or inherent human performance issues embedded within our processes. While Lean can't fix all problems, a combination of strong nuclear safety culture, robust conduct of operations, active human performance improvement process, and a business practice of continuously looking for improvements leads to excellence across our industry and creates a culture that is worthy of promoting.

Without strong management, our systems fail because no one sponsors or encourages those attributes we covet. Leadership starts at the top with our customer defining what provides "value" to them, and filters down through to the organization and ultimately the workforce in day to day conduct of operations. It is imperative that our customer drives these desirable ideals through recognition and contractual requirements to encourage and support those behavioral traits that are critical to our ongoing success.

This paper focuses on how the Lean Business Management System supports those attributes that we value: a strong nuclear safety culture; disciplined conduct of operations; and a culture of robust human performance and continuous improvement. These attributes in our daily work environment propel a safer, more consistent, more efficient workplace.

INTRODUCTION

Human performance excellence is a critical aspect of any successful program; a less than adequate level of human performance will adversely impact all aspects of safe operations!

As a high hazard industry, one of the tools we routinely rely on to mitigate vulnerabilities is standard work or procedures to "build safety" into our processes. This standard work technique is consistent with the Lean philosophy to determine the method that reflects the best known way to conduct operations with quality imbedded into the process. However, over time and as the result of process reviews, we have responded to issues by overcompensating within our procedures by adding extra steps/controls and over relying on after-the-fact audits that ultimately impede flow and create additional hazards through bottlenecks, starts and stops, and increased complexity through added steps. This at times, has created "new" human error traps in that these procedures are overly complex, time consuming and cannot be followed as written.

How people perform this standard work is what we consider "conduct of operations" or "disciplined operations". Conduct of operations institutionalizes the pursuit of excellence in the performance of every task and minimizes variations in performance. Conduct of operations applies everywhere workers perform tasks – from the office to the plant floor. It applies every time a worker performs a task throughout the life of a facility or an organization because it is an ongoing commitment to reliable operations. Standard work is analogous to working in "Skill Based" mode, see Figure 1.

Skill-based performance involves highly practiced actions in very familiar situations in which there is little conscious monitoring. Such actions are usually executed from memory without significant conscious thought or attention. When skills are learned to the point of being automatic, the load on working memory typically is reduced by 90 percent. In the skill-based mode, the individual is able to function very effectively by using pre-programmed sequences of behavior that do not require much conscious control. The chance of an error is 1 in 10,000.

People most often possess an accurate understanding of the task and have correct intentions. Roughly 90 percent of a person's daily activities are spent in the skill-based performance mode. Only 25 percent of all errors are attributable to skill-based errors in the nuclear power industry.

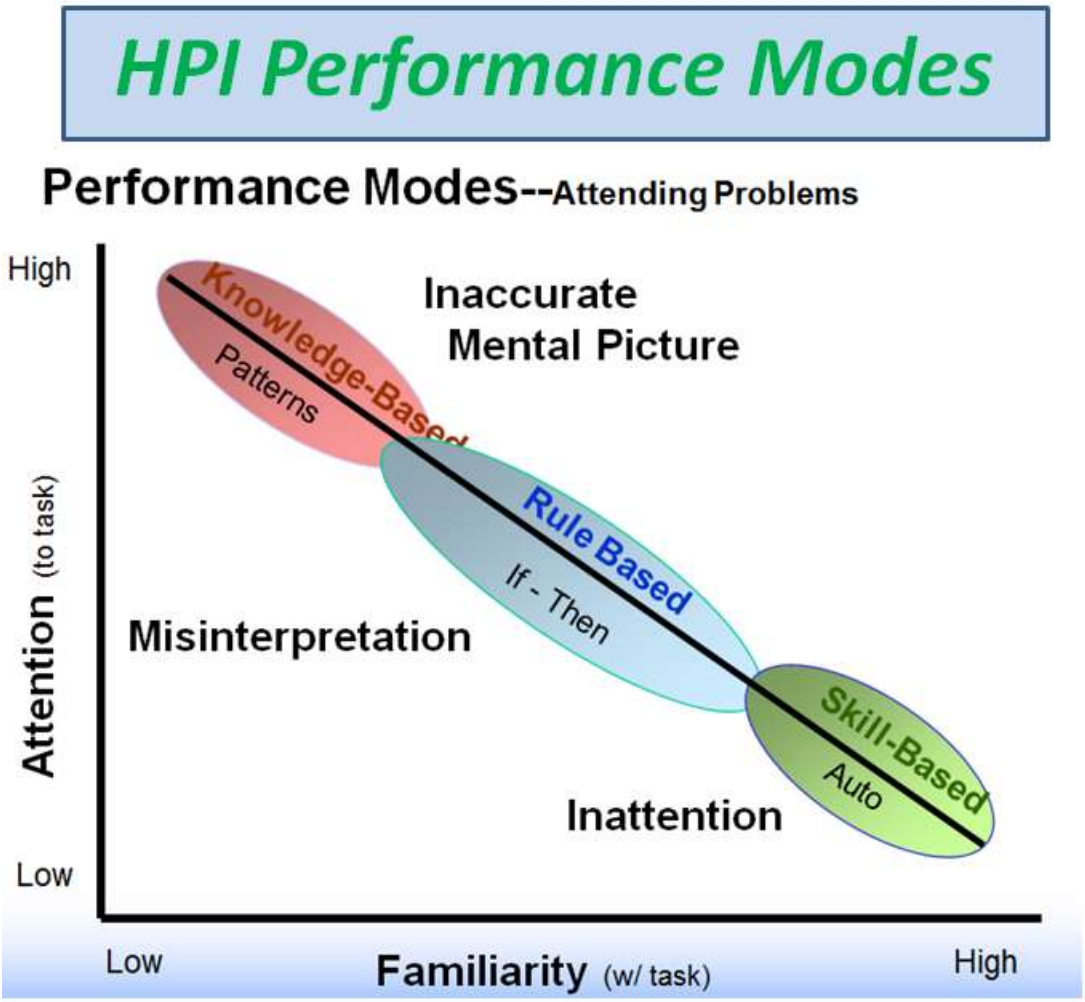

Figure 1: Human Performance Improvement (HPI) Performance Modes

SRR's Lean Business Management System is a continuous improvement program that is built upon a foundation of human performance and disciplined conduct of operations (see Figure 2). Disciplined cconduct of operations institutionalizes the pursuit of excellence in the performance of every task and minimizes variations in performance. In Lean events, we bring the best and brightest of our workforce into a room and develop solutions to problems that we know we have. We test those solutions and tweak them if they are not working. Our management team then monitors the results for a controlled period of time, while guiding and coaching the solution team to ensure we are following through. The true essence of the program is in the monitoring and follow-through.

From a Human Performance perspective, improvements can change the mode of performance. Personnel may now be operating in the "Rule Based" mode versus "Skill Based" mode. People switch to the rule-based performance level when they notice a need to modify their largely pre-programmed behavior because they have to take into account a change (i.e. improvement action). It is called the rule-based level because people apply memorized or written rules. When individuals operate in "Rule Base" it is important to have clear and concise procedures and training is needed, because the chance for an error is 1 in 1,000. Another key factor for successful performance in "Rule-base" is coaching and monitoring to ensure the revisions are understood and the operation is being conducted in a disciplined manner.

Without guiding, coaching and monitoring, it could be like all other improvement initiatives, check the box and move on, and may be not very effective at really making the changes desired. This system when properly implemented provides a systematic approach with huge benefits to the entire workforce.

In 2016, in response to conduct of operations challenges, SRR provided Conduct of Operations and Human Performance refresher training and conducted a number of Lean events that focused on human error reduction and complex procedures. As a result of these initiatives, SRR has seen an improvement in our disciplined operations performance. However, SRR continues to focus on simplification of complex procedures and processes, as well as automation of processes to eliminate potential human error opportunities.

Figure 2: The three pillars of SRR's Business Systems ensure safe and efficient delivery of "value" to our customer.

Our continued drive to improve our processes, simplify complexity and eliminate human error precursors is SRR's next step on our Lean journey. Management support is critical to making this next phase of our continuous improvement journey happen.

SRR has evaluated over 15 different value streams, performed in excess of 100 Lean events and had almost 1/3 of our workforce participate in at least one continuous improvement event. To date we have identified and reported over $1.9B in lifecycle savings for the project. Figure 3 summarizes some of our significant examples of benefits that we have realized since the implementation of the Lean program.

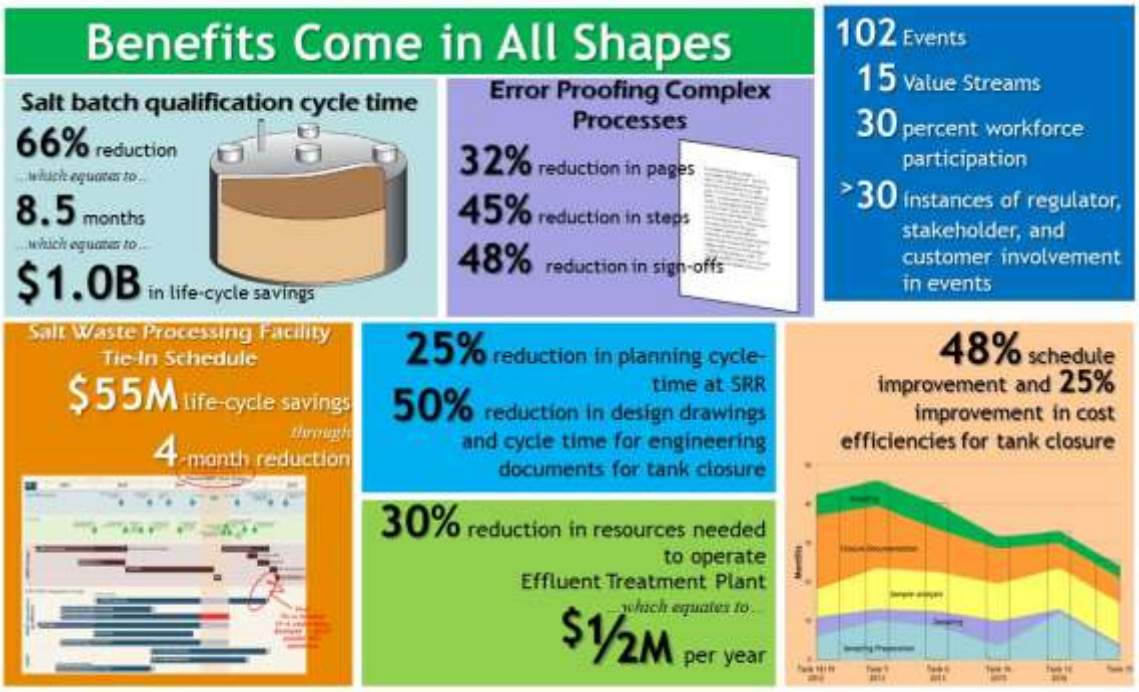

Figure 3: Benefits come in all forms

PROCEDURES

As a Department of Energy nuclear facility, safety is of the utmost importance. Procedures are one of the mechanisms used to address safety in the field. Over the years, the length and complexity of procedures has grown in an effort to remove the potential for human errors, but as procedure steps, requirements, links to alternate procedures, and signoffs have been added, the potential has grown for new and unintended errors to be introduced into the procedures.

A desire to make processes "fail-safe" can create hidden error-likely scenarios, defeating the purpose of providing conservatism in the name of safety. SRR has begun the process of using Lean to find those potential latent errors which have been derived from developing overly robust procedures.

Through fiscal year 2015, SRR facilities noted an increasing trend of transcription, data entry and procedure performance errors. The causes of these errors were attributed to excessive controls within the procedures. The findings showed that our more "complex" procedures had become difficult to follow and time intensive with the length of the procedures and the required signature sign-offs. Personnel had become complacent with signature sign-offs because almost every step had a sign-off within the procedure. Not unlike spurious alarms, personnel began to regard the sign-offs as a necessary burden and not a true validation of the information. SRR decided to conduct Lean Rapid Improvement Events (RIEs) to examine these complex procedures in order to determine the core principles and requirements in order to

eliminate excessive controls which can lead to confusion and errors in data recording, signature sign-offs, and procedure compliance.

SRR identified several complex procedures to investigate for areas of improvement and simplification. RIEs were then conducted with the operators on these procedures. The team reviewed the procedure in its "current state" and reviewed were individuals had identified potential problems and points of confusion. The team focused on the sequence and flow of the procedure while reviewing for the appropriate detail and clarity of the procedure steps. Next, the team reviewed the requirements for the given process and looked to eliminate unnecessary steps and sign-offs. The Lean process was then used to revise the procedures to maintain the core requirements while streamlining the procedure and reducing error-likely scenarios. This was accomplished by: Providing a standardized problem solving process to resolve issues in complex procedures; Creating a common understanding of the current state of a process; Using cross-functional teams to validate requirements; Engaging employees at the working level to provide feedback as the Subject Matter Experts; and Integrating technology where appropriate. Figure 4 shows the current state of one of the complex procedures. The orange, blue, and pink colored stickies show potential problems and areas for improvement.

Figure 4: Current state of a complex procedure with identified potential areas for problems and improvements

As procedures were being streamlined, HPI tools were reinforced to reduce the likelihood of errors. For example, critical steps were identified for the procedures, along with discussing critical steps as part of the pre-job briefing and increasing peer checks. Self checking (Stop, Think, Act, Review – STAR) is another HPI tools utilized to reduce the likelihood of human errors.

The Lean RIEs also identified alternatives to the traditional paper procedures in order to reduce error-likely scenarios. Automation has been identified as a viable solution to reduce procedure compliance and data recording errors. SRR has conducted four different events and developed scopes for seven more events which would utilize automation to reduce potential errors in the procedure process.

In some cases, an entire process has been automated to allow the computer systems to engage motors and manipulate valves as necessary based on process conditions. An automation tool has been developed to standardize procedure architecture and verify requirements have been incorporated. Other forms of automation include performance of complex calculations and interlocks to prevent inadvertent transfers.

The improvements from the Lean events have been immediately noticeable. The employees engaged with the process have provided favorable feedback over the changes made to the procedures. Requirements have been maintained while increasing employee understanding and awareness to those requirements and there

has been a significant reduction in error-likely scenarios. Figure 5 shows the improvements attained from the Lean initiatives performed.

Procedure	Actual Result / Benefit
Transfers: PRFT to SRAT 2.14 and SEFT to SRAT 2.15	32% Reduction number of pages
	45% Reduction of number of steps
	48% Reduction of number of sign offs
CPC Safety Grade Nitrogen Startup: SW4-15.76 Sections: 2.23 & 5.40	40% Reduction of number of pages
	52% Reduction of number of initials required
	98% Reduction of number of acceptance criteria
Melter Maintenance Mode	22% Reduction number of pages
	25% Reduction of number of steps
	18% Reduction of number of sign offs
Tank 40 Slurry to Low Point Pump Pit **Sections: 7.2 & 7.3**	32% Reduction number of pages
	35% Reduction of number of steps
	26% Reduction of number of sign offs

Figure 5: Procedure improvements attained through Lean RIE initiatives

RESULTS AND CONCLUSIONS

SRR has been focusing on complex procedures as one area to tackle coupling our Lean Business Management System and HPI tools. We have tackled some of our most complex written procedures and have demonstrated that we can simplify the process, improve human performance and at the same time still provide, arguably, a safer way to accomplish the work!

In each case, improvements were realized by reducing the length and complexity of the procedures as well as reducing the number of procedure steps and sign-offs. These improvements decreased the potential for mistakes by personnel by making the procedures easier to use and understand. The coupling Lean process and HPI has been very effective at verifying the core requirements while eliminating the unnecessary steps and work which leads to a safe and disciplined operations.