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Applying Lean Six Sigma: Personnel Reliability Program

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Abstract: The Personnel Reliability Program (PRP) monitors over 400 employees who handle controlled chemical or biological agents for the U.S. Army Combat Capabilities Development Command Chemical Biological Center (CCDC-CBC). The program requires an annual recertification consisting of a medical evaluation, safety training requirements, both in-person and online, and security clearance updates. The annual recertification process begins when a program administrator notifies a PRP enrolled employee to complete their recertification. The process is complete when administrators document the employee's completion of all recertification requirements. Initial surveys revealed over 20% of employees were dissatisfied with the annual recertification process and over 30% of employees were dissatisfied with the instructions provided to complete the recertification requirements. A Lean Six Sigma study was performed to improve the recertification process and increase employee satisfaction. A secondary goal for the study was to decrease the average cost, per employee, of completing the annual recertification process.

Keywords: Lean Six Sigma, Process Improvement, Employee Recertification Program

1. Introduction

The U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center (CBC) provides chemical and biological defense research and product development for warfighters. CBC engineers, scientists, technicians, and specialists are stationed at four locations within the United States: Aberdeen Proving Ground, Maryland; Pine Bluff, Arkansas, Rock Island, Illinois; and Dugway Proving Ground, Utah. Many CBC employees are charged with the responsibility of working with hazardous materials. As a result, the CBC Risk Management Office enrolls selected employees in the Personnel Reliability Program (PRP) to provide protection to workers and the environment by ensuring operations are conducted safely, that materials are secure, and that personnel meet the highest standards of reliability. Employees enrolled in the PRP must complete an annual recertification that requires a medical evaluation, the completion of safety training classes, and an update to their security clearance every six years. This study applied the Lean Six Sigma methodology, specifically the Define, Measure, Analyze, Improve, and Control (DMAIC) phases, to improve the recertification process at Aberdeen Proving Ground. The DMAIC methodology implements creative solutions that specifically address root causes of a process while developing control measures to maintain improvements for the future. The researchers analyzed the PRP recertification process to increase employee satisfaction and reduce recertification cost.

2. DMAIC Process

The purpose of the Define Phase is to determine the project scope, goals, and performance targets (George, Maxey, Price & Rowlands, 2005). During the definition phase, the project sponsor, stakeholders, and the project team draft a project charter covering the problem statement, business impact, goals, scope, and timeline (George et al., 2005). At the completion of the Define Phase, the project team, sponsor, and stakeholders validate the project scope, process, problems statement, goals, and plan to include the initial schedule, budget, and milestones.

The Measure Phase begins once the project is properly defined including a problem statement, scope, and validated process map. The Measure Phase can be conducted through a multitude of strategies but, regardless of methodology, the ultimate goal is to gain a thorough understanding of the process's current state and to collect reliable data on process speed, quality, and costs (George et al., 2005). Assessing the current state of a project helps provide insight into the root causes of

waste and it also serves as a benchmark for the future (Conner, 2009). It is essential to determine key metrics and gather enough data that allows for a thorough analysis and the ability to understand the current process (Montgomery & Woodall, 2008).

The purpose of the Analyze Phase is to pinpoint and verify causes affecting the key input and output variables tied to project goals (George et al., 2005). This is done by determining critical inputs, performing data analysis, performing process analysis, determining root causes, prioritizing root causes, and finally delivering the Analyze tollgate review. Using data collected from the Measure Phase, data and process analysis must be performed to identify the constraints in the system that prevent the personnel reliability program's annual recertification process from meeting their requirements.

The Improve Phase takes all the information collected and proposed system improvements and uses various statistical tools and mathematical calculations to determine which improvements should be implemented. This phase focuses on sorting through the proposed system improvements and narrowing them down into process improvements that are both feasible and effective. The Improve Phase consists of five key steps: develop potential solutions, evaluate/select and optimize the best solutions, develop a "To Be" value stream map, implement pilot solution, confirm attainment of project goals, and finally develop and execute a full-scale implementation plan (George et al., 2005).

The purpose of the Control Phase is to complete the project and hand off the improved model to the process owner, with specific procedures for maintaining the gains realized through the Improve phase (George et al., 2005). This final phase implements performance measures and perfects the process for continued use in the future. According to *The Lean Six Sigma Pocket Toolbook*, there are eight key steps in the Control Phase: developing supporting methods and documentation, launch implementation, lock in performance gains, monitor implementation, develop process control plans and hand off control to process owner, audit the results, finalize project, and validate performance and financial results (George et al., 2005).

3. Applications of DMAIC Process

3.1 Defining the PRP Annual Recertification Process

The problem statement for this research was the CBC employees in the PRP were dissatisfied with the timing of the recertification process, timing of the initial notification, clarity of instructions, and transparency about the employee's status in the process. The goal of this project was to increase the percentage of PRP employees satisfied with the annual recertification process and decrease the average cost per PRP employee. The scope-in for this project, which defines the start and end focus points, was the initial recertification notification and the last step was the documentation of all recertification requirements. The initial PRP enrollment process and the security clearance recertification were outside the scope of this project.

In the Define Phase, a SIPOC (Suppliers, Inputs, Process, Outputs, Customers) Map clearly defines the suppliers, inputs, process, outputs, and customers in addition to the voice of the customer (VOC), voice of the business (VOB), process metrics, and output metrics. The SIPOC Map serves as a process overview to capture all pertinent information critical to the process that is being analyzed. The suppliers in this project were the PRP monitors, medical providers, security personnel, and trainers. The inputs included the PRP customers, medical forms, annual trainings, and customer requirements. The PRP process included the customer notification of recertification, the customer completed the trainings and medical screening, and the screening of documents for potential rework issues before being recertified. The outputs in this process were the recertified PRP personnel and updated annual personnel records. Finally, the customers were identified as the PRP personnel and CBC directorates.

3.2 Measuring the PRP Annual Recertification Process

The Measure Phase for this project focused on developing a clear understanding of the annual PRP recertification process and collecting data to measure the status of the recertification process. Within this phase the team used the information collected in the Define Phase to create swim lane flowcharts of each PRP recertification process to identify personnel and tasks involved. Through communication with the project sponsor and stakeholders, the team verified that the swim lane flowcharts accurately demonstrated the current annual PRP recertification process. The team then created a value stream map of the PRP medical recertification process and identified what data needed to be collected to properly measure the system process (see Figure 1). The value stream map helped identify the data gaps within the PRP medical recertification process. Green steps require direct employee action whereas yellow steps require PRP monitor action. The areas of concern are shown in red in Figure 1 and are identified as process steps that do not provide any added value to the process. As a result, the team created a data collection plan to measure each stage of the PRP medical recertification process.

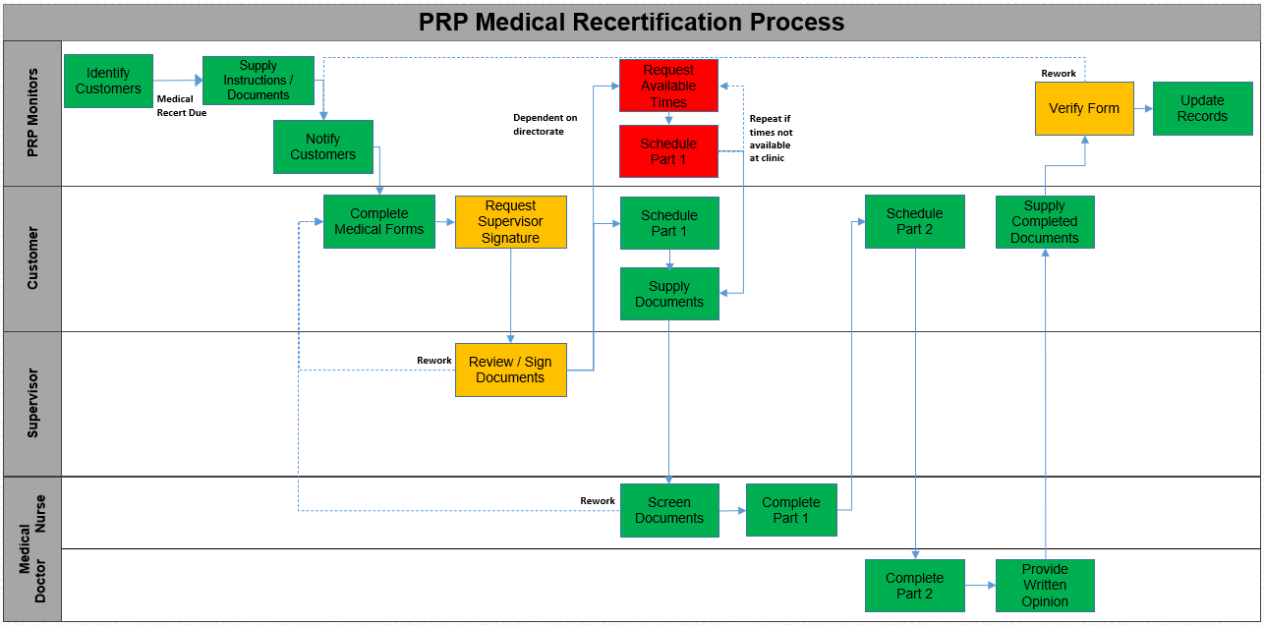

Figure 1. Medical Recertification Value Stream Map with Non-Value Add Analysis

One of the challenges that the team faced with the Measure Phase for this project was the lack of existing data on the current system process. The team created a survey to measure the baseline statistical benchmark for the PRP medical recertification process. This survey utilized a Likert Scale from 1-6 to measure satisfaction where: *1 – Extremely Dissatisfied*, *2 – Dissatisfied*, *3 – Somewhat Dissatisfied*, *4 – Somewhat Satisfied*, *5 – Satisfied*, *6 – Extremely Satisfied*. After a few weeks of data collection, the team utilized Minitab to summarize the overall employee satisfaction with the PRP medical recertification process. The quantitative analysis provided the team with the needed information to readjust the project goals.

The initial survey yielded 68 unique responses via SurveyMonkey.com. Responses were representative of all PRP employees with 50% of responses from the Research and Technology Directorate, 18% Engineering Directorate, and 32% Operational Applications Directorate. Additionally, 76% of responses were from the Chemical PRP, 9% Biological PRP, and 15% were from both Chemical and Biological PRP. The survey responses also represented the full spectrum of employee longevity within the program represented by enrollment duration of 1-3 years, 12%, 4-6 years, 7%, 7-9 years, 6%, 10-14 years, 40%, and 15 or more years, 35%.

Survey results suggested the majority of PRP employees were satisfied with the overall recertification process indicated by a mean level of satisfaction of 4.38, *Somewhat Satisfied* (*SD*=1.1685) (Figure 2a). However, 20.6% of employees enrolled in PRP reported to be somewhat to extremely dissatisfied with the overall PRP recertification process. Similarly, satisfaction with instructions provided for medical surveillance yielded a mean level of satisfaction of 4.45, *Somewhat Satisfied* (*SD*=1.13) (Figure 2b) and satisfaction with instructions for annual training presented a mean level of satisfaction of 4.03, *Somewhat Satisfied* (*SD*=1.27) (Figure 2c). Yet, 22.7% of PRP employees indicated they were dissatisfied with the instructions provided to complete the medical recertification process and 32.3% reported they were dissatisfied with the instructions provided to complete the annual training modules. These survey findings confirmed the administrator suspicions that recertification process improvements were necessary for the Personnel Reliability Program.

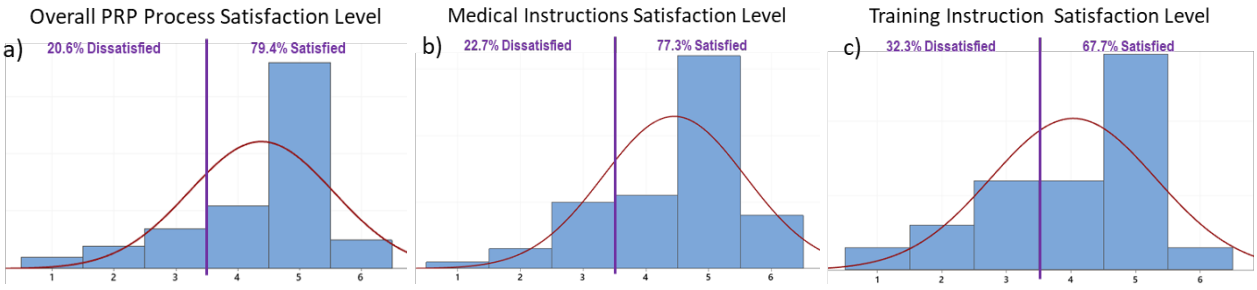

Figure 2. PRP Employee Level of Satisfaction a) Overall Process, b) Medical Instructions, c) Training Instructions

Prior to collecting the process baseline statistics, the team did not have an accurate impression on potential process improvement. One of the challenges of improving a service-related process compared to a manufacturing process, is classifying, and measuring seemingly intangible factors, such as, employee satisfaction. After collecting survey responses, the team had acquired enough data to finalize the process baseline statistics and move on to the analyze phase.

3.3 Analyzing the PRP Annual Recertification Process

With the Measure Phase capturing the current state of the annual PRP recertification process, the team analyzed the data collected and determined what the critical inputs (X's), or significant independent variables, and root causes were for the overall dissatisfaction level with the annual PRP recertification process. The team wanted to begin the Analyze Phase with a quick win based off some of the survey comments indicating employees' desires to have the medical documents necessary for the medical recertification in fillable PDF form. This quick win was also recognized by PRP administrators and the fillable PDF forms were immediately made available to employees via a SharePoint website. Improving the access and ability to fill out forms should reduce the time needed to complete the medical forms and potentially increase satisfaction levels.

Next, the team conducted root cause analysis to identify the critical inputs (X's) that were affecting the employee dissatisfaction. The first step was to determine which sub-satisfaction levels had the biggest effect on overall satisfaction levels. To do this, a Spearman Correlation was calculated between the various sub-satisfaction levels and the overall satisfaction level. Spearman Correlations are used to determine the relationship strength between independent and dependent variables, where a r_s value closer to –1 or 1 has a strong relationship while a value near 0 has a weak or no relationship. The Spearman Correlation resulted in the top four highest correlation levels of medical lead time satisfaction with a correlation value of $r_s(65)=0.429$, $\rho<.001$, medical instructions satisfaction with a correlation value of $r_s(65)=0.420$, $\rho<.001$, training lead time satisfaction with a correlation value of $r_s(65)=0.401$, $\rho<.001$, and training instructions satisfaction with a correlation value of $r_s(65)=0.392$, $\rho=.001$. These four sub-satisfaction levels were the critical inputs (X's) for the critical output (Y) of overall satisfaction level for the annual PRP recertification process.

Once the critical inputs were determined, further analysis was conducted to determine the root causes of these critical X's. Due to the lack of data for the system, the team relied on survey data collected in the Measure Phase. To get a better understanding and further explore the critical X's, Pareto charts were used to look at different subgroups that could potentially make up those who were dissatisfied with the specific areas in the survey. This included what directorate the dissatisfied employees were a part of, how long the dissatisfied employees were enrolled within the PRP, and what PRP program the dissatisfied employees were a part of. This provided insights into whether something such as lack of experience with the PRP annual recertification program, or specific program, or directorate standard operating procedures were leading to dissatisfaction in the annual PRP recertification process. Figure 3 displays the Pareto charts for the number of PRP employees dissatisfied with medical lead time by directorate (a) and by the number of years enrolled in the PRP (b).

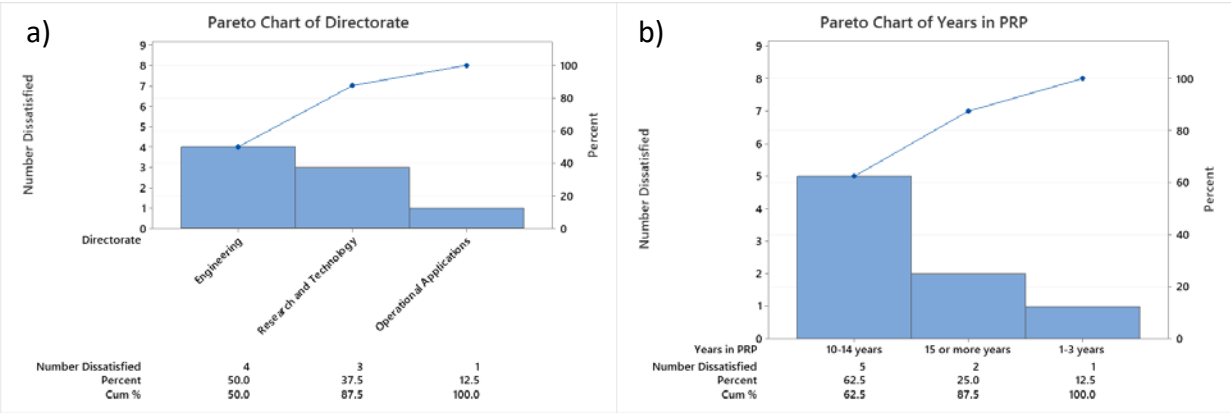

Figure 3. Number of PRP employees dissatisfied by a) Directorate b) Years in PRP

Pareto charts, like the ones seen in the Figure 3 above, allowed the research team to look at different characteristics for the employees who were dissatisfied with the sub-areas of the entire PRP annual recertification process. For all four of the critical inputs that the research team looked at, experience in the PRP was not a factor that led to higher satisfaction. This indicated that dissatisfaction with certain areas of the annual PRP recertification was not due to a lack of experience. The number of people in each PRP category, chemical or biological, did not offer much insight since most personnel are a part of the chemical PRP program, which continuously had more dissatisfied employees than the biological PRP program due to its size. However, the Pareto charts by directorate provided some interesting insights. The percent of dissatisfied employees by directorate were at times greatly different and communicated to the research team that differences in how each directorate conducted their operations may be a potential root cause and was a cause for further investigation. This led to conducting a five why's analysis, an iterative interrogation technique to better understand the effects of root causes, to identify what would cause higher dissatisfaction in the overall PRP annual recertification process.

The Pareto charts and five why's analysis for the critical inputs identified three prioritized root causes for overall dissatisfaction: the use of mass monthly emails to the whole directorate notifying employees about their medical and training lead time status, confusion on location and access of up-to-date medical forms, and the lack of a standard operating procedure on how the directorates send out due dates for training all contributed to overall customer dissatisfaction.

3.4 Improving the PRP Annual Recertification Process

The Improve Phase consists of key steps to develop potential solutions, evaluate/select and optimize the best solutions, develop a "To Be" value stream map, implement pilot solution, confirm attainment of project goals, and finally develop and execute a full-scale implementation plan (George et al., 2005). Applying these steps to the PRP recertification process, the team used the analysis performed in the Analyze Phase as the driving factor to develop system improvements, optimize them, and develop a plan to implement the most promising system improvements. First, the researchers identified the development of medical forms as fillable PDF files would increase process efficiency. After analyzing survey responses from PRP personnel, the researchers generated the potential solution of fillable PDF medical forms since it would decrease the amount of time spent on medical form rework. Additionally, researchers suggested combining the scheduling for Part 1 and Part 2 of the medical appointments to reduce the overall duration of the medical recertification process. Finally, the researchers generated the potential solution to place all medical forms in an organized manner in one location on SharePoint. These quick wins should reduce overall process time by decreasing time spent on completing medical forms. This solution also simplifies the process for PRP personnel by eliminating confusion on required documents to complete and the location of documents for the medical recertification phase. Consolidating the medical forms and providing the forms in a more user-friendly medium should reduce the 22.7% of PRP employees who expressed their dissatisfaction with instructions to complete the medical surveillance process.

The researchers implemented a pilot plan to remove non-value add steps to the medical recertification process and improve employee instructions for both the medical and training requirements. A standardized operating procedure for all directorates was recommended to limit mass email notifications and automate an individualized notification system to better inform employees of recertification status. This should increase employee engagement in the medical recertification process by addressing the root cause of mass notification. Avoiding mass notification emails will improve the timeliness of the employees' request for appointments and increase their awareness of the need to schedule the appointment. The emails will include links to fillable PDF forms and an ordered checklist of the steps that the employee needs to complete. The purpose of this is to increase process efficiency by providing employees with specific forms that are applicable to their current stage in the recertification process. Additionally, standardizing the process in which employees receive and conduct their medical training will decrease future rework. The goal of these recommendations is to reduce employee dissatisfaction by at least 5% and decrease the total time to complete the medical recertification from a mean of 90.6 days to a target of 60 days.

3.5 Controlling the PRP Annual Recertification Process

The eight key steps in the Control Phase as identified in *The Lean Six Sigma Pocket Toolbook* are developing supporting methods and documentation, launch implementation, lock in performance gains, monitor implementation, develop process control plans and hand off control to process owner, audit the results, finalize project, and validate performance and financial results (George et al., 2005). Applying these steps to the PRP recertification process, the researchers documented metrics before and after the new system implementation to compare results to determine its effectiveness. This project compared survey results measuring customer satisfaction before and after new process implementations to compare process results and calculate overall improvement. Additionally, an easy-to-follow Standard Operating Procedures (SOP) for process owner utilization was developed to maintain process improvements. The process customers, monitors, and supervisors were provided step-by-step instructions on how to complete the recertification process while simultaneously reducing waste.

4. Conclusion and Future Work

Prior to this study, there was no data on or understanding of how long employees were spending completing the medical and training recertification processes and only anecdotal evidence to suggest low employee satisfaction in the recertification process. Based on surveys, focus groups, and time studies, this project enabled the PRP monitors and certifying officials to gain a better understanding of the inefficiencies within the recertification process to include ambiguous instructions, lack of transparency in the scheduling process, and limited access to the required forms. The study also helped define the time standards for each step in the recertification process. The quick-win digital access to medical forms implemented has already demonstrated improvements in the reduction of rework on medical forms due to outdated or incorrect forms. The medical recertification pilot plan will soon be evaluated by a sample of PRP employees. The researchers believe the increased access to current medical forms, improved instructions, and standardized procedures will reduce the number of hours employees spend completing paperwork and scheduling appointments leading to an increase in employee satisfaction. In addition, recommended improvements in the scheduling process to eliminate non-value add steps should improve transparency within the medical appointment process and provide more flexibility to the PRP employees resulting in improved satisfaction levels and allow PRP employees to spend more time on their primary responsibilities.

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