Kenworth Paint Preparation Kaizen

Strategic Objectives and Scope

PACCAR is a global technology leader whose principal businesses include the design, manufacture and distribution of high-quality commercial vehicles. It also provides financial services and information technology and distributes truck parts related to its principal business.

PACCAR and its employees are firmly committed to strong, quality growth and are proud of producing 69 consecutive years of net profit. The embedded principles of integrity, quality and constancy of purpose continue to define the course in PACCAR's operations. Environmental responsibility is one of PACCAR's core values and PACCAR is recognized as a global environmental leader.

PACCAR has made major advances in the reduction of packaging material, such as cardboard and wood, in its manufacturing facilities through the implementation of recyclable, returnable containers. Since 1996, PACCAR has eliminated over 650 pounds of dunnage material for every vehicle it has built in North America by utilizing improved packaging techniques and coordinated logistic programs with suppliers. Recently, all of PACCAR's manufacturing facilities in Europe and North America earned ISO 14001 environmental certification.

In March of 2007, the Kenworth Chillicothe plant was experiencing a 28% rework rate in the paint department. This not only had a negative impact on capacity and the labor efficiency of the plant, but the additional painting resulted in increased greenhouse gas emissions and unnecessary solid wastes disposed in landfills, which is inconsistent with PACCAR's commitment to environmental stewardship.

In order to address the high rework rate and reduce the impact on the environment, a kaizen event focused on the paint preparation area was initiated and a team of process experts was formed to reduce waste. This cross functional team included technicians from Paint Prep, Supplier Quality, and Cab/Sleeper Build areas of the plant in cooperation with plant management and engineers to support the concentrated efforts of the team. The objectives of the project were to identify and improve key process input variables causing the high rate of repainting hoods, cabs, and sleepers in the paint process. The project objectives are outlined below:

- Reduce Main Paint defects 27%.
- Reduce Hood work in process at Paint Prep 68%.
- Reduce hood repaints 42%.
- Reduce conventional cab repaints 24%.
- Reduce sleeper repaints 58%
- Reduce environmental impact.

The project typifies Kenworth Chillicothe's commitment to environmental stewardship and was successful in achieving the objectives. The success of the project has been noted and benchmarked by other PACCAR facilities with similar kaizen events within their respective paint prep areas. Additionally, key information for the improved filtration system in the cab wash process has been

supplied to other PACCAR sites who share similar washer equipment. The ensuing narrative tells the story of how Kenworth Chillicothe's Paint Prep Kaizen Event unfolded and led to the reduction in repaints, which reduced greenhouse gas emissions and waste to landfill.

Project Narrative

Define

The team began the event by mapping the paint prep area processes. At the end of this exercise, 339 process steps were identified and 304 of these steps were marked as non value added. This non-value added activity consumes time that otherwise could be spent focusing on the key tasks that lead to quality output. Cycle time analysis was also conducted during this phase and activity at all stations were measured and compared to the required TAKT time needed for the current build rate.

Measure (efficiency):

After completing cycle time analysis and waste identification, the team began to measure the inefficiencies of each station in the prep process. Spaghetti diagrams were used to measure the effect of the process on operator walking and travel waste. The final analysis of all spaghetti diagrams showed that total operator travel was 0.41 miles per piece or 74.3 miles per day. The average walking distance per day was 1.9 miles per operator.

Measure (DPU Baseline):

The team utilized Pareto charts to determine top causes of defects requiring rework. Through the use of these Pareto charts, it was determined that dirt and contamination were the greatest causes of rework. The highest concentration of this type of defect was found in hoods.

Analyze:

In order to determine key process input variables causing the contamination issues on the hoods, the team employed cause and effect diagrams. Focusing on hood cleanliness, several diagrams were created to identify potential root causes of dirt and contamination contributing to the highest amount of rework. This analysis led the team to focus on two key process variables - incoming hood condition from the supplier and the plant's internal wash process.

1.) Incoming Hood Condition: Kenworth Chillicothe utilizes an offsite supplier to sequence, drill, and deliver hoods to the paint department. Their process was to offload and stage the hood from the supplier's truck until ready for use. The problem with this process was that during the staging of the hood at the supplier location, dust, dirt, and contaminates would collect on the exterior surface of the hood and react during the pre-paint heating cycle causing a defect if not properly cleaned.

The team identified atmospheric contaminate exposure as a process variable and determined that the current storage and delivery process of hoods on Kenworth's property was also a contributor to contamination. A reduction in WIP and a change in the hood storage and delivery process would allow for better process control and reduce exposure to contamination. Prior to the event, the average number of hoods in the on site staging area was 25.

2.) Internal Wash Process: Kenworth Chillicothe utilizes a four stage washer to pressure wash and clean all parts prior to each piece's introduction to the paint spray booth. This particular style of washer is used at most PACCAR paint facilities. Prior to the event, the filtration units in stages one,

two, and three utilized 600 micron filters for removal of contaminates in the process water. When the team sampled the water in each stage of the washer, they found contaminates were being allowed to pass through the filtration units resulting in contamination on each piece as it passed through the washer process. Hoods had the highest risk due to the orientation of the hood as it passed through this process.

Improvement Phase (DPU Reduction):

During the improvement phase, the team developed action plans to address the two key process input variables.

Internal Washer Process: As noted in the analyze phase, the washer stage filters were identified as a potential key process input variable. In order to validate this, cab washer filtration was analyzed using Six Sigma tools to investigate whether filter micron size was a significant contributor to paint rework. The analysis involved three filter micron sizes; 600 microns, 200 microns, and 25 microns.

The data revealed a significant reduction using the 25 micron filters. As a corrective measure, the filters in the washer were changed from a 600 micron filter to a 25 micron filter. The result was a reduction in the number of cabs and sleepers requiring rework.

Incoming Hood Condition: The team attacked incoming hood quality by implementing a new cleaning process at the supplier. This partnership creates an innovative solution to create a paint ready hood surface condition. In the new process, the supplier is responsible for unloading hoods from supply trailers onto hood dollies, where they are drilled according to customer specifications. A washing station was incorporated as the last stop prior to delivery to the Kenworth plant.

The hood delivery process was changed to a “just-in-time” process to eliminate excessive outside exposure after the hood has been cleaned. The reduced amount of WIP allowed the paint department to reduce handling labor and allowed hoods to be brought into the paint area faster, reducing exposure to atmospheric contaminates.

Prior to full implementation, a trial was conducted of the proposed cleaning process and defect data was collected to determine the impact of the trial on hood quality and rework. The data indicated a positive shift in defects per unit (dpu) with a 21% reduction in hoods requiring repaint.

The overall impact on hood rework is documented in the supporting documentation. *(See Addendum E – Improved Rework)*

Control Phase:

In order to sustain the improved processes, the team implemented control measures for all process changes. The new hood wash process was documented and implemented by the supplier. The process is audited by Kenworth’s paint defect analyst periodically and hoods are reviewed daily by Kenworth’s paint prep technician. All procedural changes made to the paint prep stations have been documented in the Kenworth Process documents with critical processes audited per schedule requirements and maintained by the manufacturing engineering group.

Summary of Results

This project exemplifies how process improvement efforts can be multi-faceted and used to effectively meet customer quality expectations, internal efficiency requirements, and environmental stewardship efforts.

Net savings in 2007 were $1.8M. Improvements are summarized as follows:

Environmental Impact

- Reduced Volatile Organic Compound (VOC) Emissions 15 tons
- Reduced waste paint disposal 382 gallon drums/year
- Reduced paint 8400 gallons/year (enough to paint 6000 trucks)
- Reduced solvent 4400 gallons/year

Efficiency Measurements

	Baseline	Goal	Current	Reduction
Main Paint DPU	1.8	1.3	0.9	49%
Hood WIP	25	8	4	84%
Hood Repaints	52%	35%	31%	40%
Cab Repaints	7.9%	6%	5.6%	29%
Sleeper Repaints	21.5%	9%	8.1%	62%

Overall, rework was reduced from 28% to 16%, a 43% reduction in components needing to be repainted. This resulted in a 10 truck per day increase in paint capacity.

In conclusion, this event set the stage for further improvements in the Kenworth Chillicothe paint department to provide greater customer satisfaction in paint quality.