



Lean & Environment Case Study: Canyon Creek Cabinet Company



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Lean and Environment Pilot Project Case Study: Canyon Creek Cabinet Company

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Washington State Department of Ecology, Hazardous Waste and Toxics Reduction
Program (www.ecy.wa.gov/programs/hwtr)

Washington Manufacturing Services (www.wamfg.org)

Pilot Facility Participant:

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Lean & Environment Case Study: Canyon Creek Cabinet Company

The Washington State Department of Ecology’s Hazardous Waste and Toxics Reduction Program (Ecology) and Washington Manufacturing Services (WMS) partnered in a lean and environment pilot project to provide technical assistance to Canyon Creek Cabinet Company (Canyon Creek), a large manufacturer of custom frameless and framed style cabinetry in Monroe, Washington. Ecology provided environmental expertise, while WMS provided lean expertise and management of on-site activities at Canyon Creek from May through August 2006.

The primary objectives of the pilot project were to:

- Evaluate the benefits and synergies of deliberately integrating environmental considerations into on-the-ground lean practices.
- Identify and reduce material wastes, risks, and costs.
- Gain experience to offer and promote lean and environment projects to manufacturers statewide.

Project Activities and Results

Pilot project participants formed teams to address two targeted areas: (1) Canyon Creek’s “Millennia” cabinet line, along with plant-wide milling and cutting operations (addressed by the “Woodchuckers Team”), and (2) the finishing department, where products are stained and coated (addressed by the “Toxics Team”). The teams included cross-functional staff from Canyon Creek and Ecology. Each team used the lean value stream mapping (VSM) method to identify improvement activities, and participated in three, week-long kaizen events to implement lean and environment improvements. During the lean events the teams conducted additional analysis of the sources and costs of environmental wastes.

The collective efforts of Canyon Creek, Ecology, and WMS produced considerable operational, financial, and environmental benefits. Process improvements at Canyon Creek resulted in reductions in lead times, work-in-process (WIP), defects, overproduction, downtime, operator travel time, and material loss and damage. These improvements also reduced the company’s hazardous wastes, solid wastes, wastewater discharges, energy consumption, and volatile organic compound (VOC) emissions. With the decrease in VOCs, Canyon Creek will avoid the need to address additional regulatory requirements.

As a result of the project, Canyon Creek has realized \$1.19 million per year in cost savings through November 2007. The cost, time, material, and environmental savings are shown in Table ES-1.

Table ES - 1 – Annual Cost, Time, Material, and Environmental Savings

Reductions	Woodchuckers Team		Toxics Team	
	Annual Cost Savings	Time, Material, & Environmental Savings	Annual Cost Savings	Time, Material, & Environmental Savings
Raw Material	\$110,000	-1,820 wood sheets		
Hazardous Substance and Use			\$128,450	68,720 pounds
Air Emissions				55,130 pounds (net reduction in VOCs)
Hazardous Waste			\$37,100	84,400 pounds
Energy			\$24,000	20,680 therms
Solid Waste	\$58,000	508,000 pounds		
Rejects			\$208,000	10,400 parts
Labor			\$624,000 ¹	39,000 hours ¹
<i>Cost Savings Sub-Total</i>	<i>\$168,000</i>		<i>\$1,021,550</i>	
Total Cost Savings:	\$1,189,550 per year			

¹ This is a conservative estimate. The additional labor hours were used to fill open positions.

Canyon Creek expects to save an additional \$194,000 in raw material and waste reductions and 2,600 labor hours from the pending investment of three cross-cut saws. The saws are expected to increase the efficiency of wood ripping and reduce the equivalent of up to 37,000 wood sheets per year.

The project also resulted in numerous other benefits, including improvements in product quality, customer service, worker health and safety, and staff morale. Highlights of these benefits include the following:

- Increased production from about 900 cabinets per day on average to about 1,000 cabinets per day.
- Allowed for up to 70 percent additional production capacity before reaching the Clean Air Act Title V permit threshold for VOCs.
- Greatly reduced the number of defective doors that are scrapped and sent for hog fuel.
- Increased the first-pass quality yield rates in two milling departments by 3 and 12 percentage points respectively.
- Reduced lead time in the Millennia product line by 24 percent.
- Reduced floor space needed for work in process in the Millennia line by 590 square feet.
- Improved general workplace organization, ergonomics, and exposure levels.
- Eliminated one shift, reassigning all third shift employees to the first and second shifts.
- Freed first and second shift staff time to assist with other tasks such as continuous improvement activities and equipment audits.

Post-Pilot Project Activities

Canyon Creek successfully sustained the pilot-project results in the year following the pilot project activities. Furthermore, facility management and staff have embraced and supported new lean and environmental continuous improvement activities. These collective improvement activities have improved product quality, increased the production line speed and uptime, and led to cost, time, and material savings.

Conclusions

The close examination of environmental pollution and wastes during lean implementation at Canyon Creek led to the identification of new opportunities to eliminate wastes, improve processes, and reduce costs. WMS and Ecology worked effectively together in providing technical assistance on lean and pollution prevention methods through this pilot project. These combined efforts yielded powerful results for Canyon Creek's bottom line, its environmental performance, and the health and safety of its workers.

This case study summary was prepared for the Washington State Department of Ecology by the Pacific Northwest Pollution Prevention Resource Center and Ross & Associates Environmental Consulting, Ltd. For more information about this pilot project please contact Rob Reuter at rreu461@ecy.wa.gov or 425-649-7086.

Lean and Environment Case Study Canyon Creek Cabinet Company

Introduction

This revised case study describes a lean and environment pilot project conducted in 2006 with Canyon Creek Cabinet Company (Canyon Creek) that integrated lean and environmental methods to improve productivity and reduce waste. In addition, the case study outlines post-pilot project implementation activities that occurred from September 2006 through November 2007.

Canyon Creek, located in Monroe, Washington, manufactures affordable custom frameless and framed style cabinetry for kitchens, baths, home offices, entertainment centers, and other rooms.

This pilot project is part of an overall Lean and Environment Project involving Washington Manufacturing Services (WMS) and the Hazardous Waste and Toxics Reduction Program of the Washington State Department of Ecology (Ecology).¹ The two organizations formed a partnership to jointly deliver technical assistance to improve the operational and environmental performance at several facilities in Washington.

The collective efforts by Canyon Creek, Ecology, and WMS resulted in \$1.19 million per year in cost savings. Environments savings included reductions in VOC emissions, hazardous substance use, energy, and raw materials, and solid and hazardous waste generation.

Pilot Project Objectives

The main objectives for the project were to:

- Develop a collaborative partnership between Ecology and WMS.
- Evaluate the benefits and synergies of deliberately integrating environmental tools into on-the-ground lean practices.
- Gain the expertise to offer and promote future lean and environment projects to manufacturers statewide.

The objectives for Canyon Creek to participate in the pilot project were to:

- Identify and reduce material and resource wastes.
- Identify and reduce risks (including worker safety hazards, spills, and site contamination).
- Identify and implement low-cost, high-impact improvements that reduce these wastes and risks.

This case study introduces the Canyon Creek facility, provides an overview of the project structure and lean and environment integration strategy, and describes the lean and environmental improvement activities conducted during the project. In addition, this case study outlines post-pilot project improvement activities, summarizes the results and costs of the project, and outlines key lessons learned and conclusions from the project.

¹ WMS is a not-for-profit organization that provides assistance to Washington manufacturers; it is an affiliate of the National Institute of Standards and Technology Manufacturing Extension Partnership (for more information, see www.wamfg.org). Ecology managed this pilot project through its Hazardous Waste and Toxics Reduction Program, which works with businesses and citizens to prevent pollution, safely manage wastes, and raise awareness of hazards and safe options (for more information, see www.ecy.wa.gov/programs/hwtr).

About Canyon Creek Cabinet Company

Canyon Creek is a wood cabinet manufacturing company that has created an extensive line of high-quality, custom cabinetry, and offers more than 4,500 different combinations of door styles and finishes. Canyon Creek's typical market is mid-range to high-end customers, and the facility sells primarily to designers and builders, a select dealer network, and regional Canyon Creek sales representatives. The company has grown from \$1 million in sales in 1981 to \$85 million in sales in 2005, and has averaged about 20 percent growth per year in the last several years. Canyon Creek employs about 670 staff, including facility staff, sales staff, and dealers.

Prior to this project, Canyon Creek implemented several lean changes with the help of a consultant. The facility was interested in furthering its lean efforts with this project, while simultaneously integrating environmental improvements. Canyon Creek has been incorporating aspects of lean and pollution prevention into manufacturing for several years. The company began working formally on lean with a consultant in 2005, and the consultant continues to spend a few days per month with Canyon Creek management and staff to address manufacturing inefficiencies with lean tools. The company also promotes environmental improvement in its company culture, and its mission statement requires environmental considerations in major business decisions. The facility is ISO 9001 certified and has an Environmental Management System (EMS).

Canyon Creek is a large quantity generator (LQG) of hazardous wastes in Washington State and is permitted as a synthetic minor facility for VOC emissions. Reducing hazardous wastes and emissions is a high priority for environmental and regulatory reasons and enables the facility to remain a synthetic minor facility and avoid the need for a Title V permit.

Overview of Lean and Environment Activities at Canyon Creek

Project Scope

Canyon Creek pilot project participants identified the finishing department and the Millennia production line as the target areas for lean and environment pilot project activities. The Millennia production line (addressed by the "Woodchuckers Team") was chosen because of the material costs and solid waste reduction opportunities and the finishing department (addressed by the "Toxics Team") was selected based on significant air emissions and hazardous waste generation.

The pilot project included a week-long value stream mapping (VSM) workshop and three week-long kaizen events involving both teams. All events were conducted between May and August 2006. WMS facilitated and managed on-site activities during the VSM and kaizen events. Ecology staff were on-site during the lean events, and at least one Ecology staff participated on each team at all times. Canyon Creek staff led the teams and participated as team members.

Value Stream Mapping Workshop Structure

The VSM workshop at Canyon Creek was conducted over five days and included four components: (1) training, (2) analyzing and mapping the "current state" of the Millennia production line and the finishing department, (3) developing "future state" value stream maps and implementation plans, and (4) preparing report-out presentations and holding a debrief meeting. The workshop was extended by two days (VSM workshops are generally three days) to support additional process mapping and

environmental waste and cost analyses. About thirty staff attended the training and eight or nine staff participated in each of the two teams during the rest of the week.

The training sessions on the first day included a standard lean training on the VSM method, along with a separate presentation by Ecology on environmental issues. During the VSM workshop, the two teams used several lean and environmental tools and methods to identify additional sources of waste and process improvement opportunities. These tools included: (1) detailed process mapping of environmental waste streams, (2) “fishbone diagrams” to identify root causes of problems, and (3) Pareto diagrams to examine the largest sources of environmental costs.

Kaizen Event Structure

The kaizen events occurred over three weeks, with several weeks between each event. The first kaizen event began with a day of training on lean methods. From there, teams brainstormed, planned, and prioritized actionable items for each week, and proceeded to implement the changes using a set of lean and environmental tools.

Lean and Environment Integration Strategy

Canyon Creek, Ecology, and WMS staff integrated environmental considerations into lean implementation in the following ways:

- Selecting projects based on their potential to reduce environmental wastes, pollution, and exposure.
- Adding a separate environmental training presentation to the training day of the VSM workshop.
- Prioritizing and sequencing future implementation projects during the VSM workshop based on their potential to reduce environmental wastes and costs.
- Identifying large sources of environmental wastes on current and future state value stream maps using starbursts and other icons.
- Involving Ecology staff in teams to help identify and analyze sources of environmental wastes as well as to anticipate any potential compliance issues associated with improvements identified and/or implemented during the events.
- Conducting additional process mapping and analysis of environmental waste streams and costs during the VSM workshop and kaizen events.

Lean and Environment Events and Projects

This section describes the activities and results of the “Woodchuckers” and the “Toxics” Team’s lean and environment implementation efforts at Canyon Creek.

Woodchuckers Team (Millennia Line and Plant-Wide Milling)

The Woodchuckers Team examined the overall flow of the frameless “Millennia” cabinet production line, from the raw materials receiving area in the warehouse, through several cutting, machining, and doweling steps, and lastly to the final assembly, packaging, and shipping. The team examined the production processes as well as the associated information flows. In the third and final kaizen event, the Team also examined milling operations for all cabinet lines.

Woodchuckers Team Value Stream Mapping Activities

In the VSM workshop, the Woodchuckers Team measured the following metrics: (1) cycle time and changeover time for each process, (2) number of days of inventory located between processes, (3) distance the product traveled, (4) amount of floor space occupied by work-in-process, and (5) total dollars lost to solid waste. The team found large amounts of production waste—including non-value added time spent looking for parts, wood wastes from scrap and defects, unnecessary movement of workers and products, and rework. The team developed detailed process maps and fishbone diagrams of the doweling process and the rip and cross cut saw process and quantified the costs for materials, labor, and disposal of the solid wastes. These activities went beyond the typical analytic focus of VSM workshops because the team looked explicitly at the amounts, sources, and costs of environmental wastes.

With an improved understanding of the Millennia production process, the Woodchuckers Team brainstormed process changes that would (1) improve the flow of the process, (2) decrease total lead time, and (3) reduce the amount and cost of solid wastes. The future state map included fewer process steps, a couple of “supermarket” systems for controlling levels of inventory between processes, and a series of kaizen “starbursts” denoting specific improvement actions (e.g., improve parts storage, revise scheduling, etc.). The Woodchuckers Team grouped the changes into three “loops” representing sections of the overall value stream—machining, cutting, and assembly—and assigned each loop to one of the planned kaizen event, and developed a schedule of tasks and due dates.

Woodchuckers Team Kaizen Events

The kaizen events for the Woodchuckers Team focused on improving overall productivity and, cabinet assembly, and reducing solid wood waste associated with milling and cutting stock. Some of the major problems in milling and Millennia assembly operations were losses due to misplaced pieces for an order, inefficient cutting patterns, storage of “fall-off” (remaining sheet stock after a cut), inefficient equipment layout, and a few bottlenecks in the milling area.

Lean methods used in the kaizen events included 5S, standard work, layout changes to improve flow, pull systems using kanban (signals) for inventory control of screws and fasteners, real-time inventory (for ripped and cross-cut pieces), waste identification, set-up reduction, work-load leveling, and root cause analysis. Environmental methods complemented the lean methods, especially environmental cost accounting, which helped quantify wastes and its associated costs.

Table 1 lists the team’s kaizen event activities as well as the benefits stemming from these activities. Many of the results included in Table 1 were achieved without capital expenditure.

Table 1 - Process Changes and Results for the Woodchuckers Team

Activity	Results
Rearranged Millennia assembly area, including a major equipment (doweler) move, to improve flow and reduce travel of parts and staff.	<ul style="list-style-type: none"> • Work in process (WIP) reduced by 50 percent. • Saved 10 lineal feet of floor space. • Reduced operator travel by 649 miles per year. • Reduced lead time by 36 percent for Millennia box parts from milling to completion.
Created shadowboards for tools.	<ul style="list-style-type: none"> • Reduced operator travel.
Optimized kanban systems for storing hardware inventory for jobs.	<ul style="list-style-type: none"> • Reduced time to access inventory.
Implemented triggering systems for Millennia door assembly and machining.	<ul style="list-style-type: none"> • Matched box parts with doors (a quality improvement).

Table 1 continued on next page

Table 1 - Process Changes and Results for the Woodchuckers Team, continued

Activity	Results
Optimized cutting patterns and combined the Finish to Match Interior (FMI) & Miscellaneous departments because they have similar equipment and operations.	<ul style="list-style-type: none"> Increased yield from 52 percent to 55 percent, and reduced use of raw material by 7 wood sheets per day, for a savings of \$110,000 per year in raw materials.
Improved the fall-off rack layout where leftover/miscellaneous cut sheet pieces are stored.	<ul style="list-style-type: none"> Reduced floor space needed for fall-off by 50 percent (440 square feet).
Prepared standard work protocols for several areas.	<ul style="list-style-type: none"> Improved production consistency.
Actions Pending Implementation (As of November 2007)	
Designed the layout for Cornerstone Assembly, and justified a “rip market” station for real-time cutting, including three new crosscut saws.	<p>The new process is expected to:</p> <ul style="list-style-type: none"> Reduce cutting time from 12 hours 15 minutes to 1 hour 17 minutes (over 2600 hours per year), transferring these staff hours elsewhere. Reduce material use from 368 wood sheets per day to 219 sheets per day, for a cost savings of \$194,000. Increase yield from 76 to 88 percent. Reduce solid waste by 580,000 lbs per year (\$58,000 per year). Eliminate WIP stored on pallets in this area (and associated damage of WIP on pallets). Reduce Cornerstone box parts from mill by 75 percent.

Toxics Team

The Toxics Team examined the sequence of activities in the finishing department from kitting to assembly. The finishing system, located near the center of the Canyon Creek plant, is a process step for multiple product lines where workers apply one of several stains to the cabinet components, seal the stain, add a top coat, and inspect the components before unloading them from the line. Before each coating step, the cabinet components are cleaned and prepped, and after each coating, the components are dried in convection and/or infrared ovens. Before the pilot project, the finishing system involved four coating steps—the stain, two seals, and the top coat. Environmental wastes from the process included solvent, stains (aqueous and solvent-based), expired catalytic wastes, and VOC emissions.

Toxics Team Value Stream Mapping Activities

During the VSM workshop, the Toxics Team examined the causes and costs of the wastes associated with the stain booth, the first seal step, and the top coat booth using detailed process maps, fishbone diagrams, and Pareto charts. The environmental waste costs, such as improper spraying and color changeovers were the greatest for the top coat process step, the stain booth, and the first seal.

In developing the future state map and implementation plan, the Toxics Team selected projects that would achieve multiple objectives, including: (1) improving the flow of products through the finishing department by reducing changeover time; (2) simplifying the process by consolidating process steps; (3) reducing large sources of environmental wastes, risk, and the associated costs; and (4) improving quality by reducing the potential for errors and defects. The implementation plan from the VSM workshop involved investments in technology and equipment to be installed during kaizen events, as well as a series of smaller action items that could be implemented immediately.

Toxics Team Kaizen Events

The Toxics Team kaizen events addressed issues in the aqueous and solvent-based stain booths and application methods, pre-stain quality inspection and repair stations, and the current sealant and top-coat products. Some of the major issues identified for the coatings areas were the hazardous waste streams from purging the spray lines and the defective boards that passed unnoticed throughout the finishing department due to an inadequate inspection work station.

Lean methods included 5S, standard work, layout changes to improve product flow, waste identification, triggering, set-up reduction, root cause analysis, process mapping, Pareto charts, and fishbone diagrams. Environmental tools included environmental waste identification, total cost analysis, and material substitution.

Table 2 lists the kaizen event improvement activities and results. Collectively, these changes helped eliminate a third shift, and employees were reassigned to the first and second shifts. This was possible because 39,000 to 52,000 finishing labor hours per year were eliminated due to the reduced downtime for color changeovers and other improvement activities.

Table 2 - Process Changes and Results for the Toxics Team

Activity	Results
Aqueous Stain Booth: Redesigned the aqueous stain carts with a mistake-proof system to purge lines for each color change. Each color change now generates only half a quart of rinse water, which is pH tested, neutralized if necessary, before entering the sewer.	<ul style="list-style-type: none"> • Eliminated 1.3 quarts of hazardous waste per line purge. • Reduced downtime for changeover.
Solvent-Stain Booth: Justified the capital expenditure for, and designed, installed, and tested a recirculating pump system with dedicated reels, pumps, and guns for each solvent-based stain color.	<ul style="list-style-type: none"> • Reduced downtime costs by at least \$19,500. • Decreased operator travel and movement. • Increased VOC emissions due to higher throughput. (These were offset by VOC reductions from the unicoat system described below). • Reduced purchase of stains and solvents, by 68,723 pounds for a cost savings of \$128,454.
<i>Cumulative hazardous waste savings for stain booth changes listed above:</i>	<ul style="list-style-type: none"> • Reduced hazardous waste generation by 47,705 pounds, for a savings of \$20,493.
Developed flagging and triggering systems to indicate product line changes and to identify materials in offline inventory storage.	<ul style="list-style-type: none"> • Reduced material loss because parts are better able to be matched with orders.
Implemented a spray-gun tip cleaning process.	<ul style="list-style-type: none"> • Eliminated downtime due to clogged tips. • Extra tips are now stored at each booth. • Reduced purchases because tips last longer.
Moved the inspection station for unstained panels, to the hang-line in front of the stain booth and installed high-quality lighting. Inspectors now stand up to inspect the hanging piece, rather than bending over the piece lying on a horizontal surface.	<ul style="list-style-type: none"> • Reduced inspection time. • Improved ergonomics and lighting. • Increased defect detection, resulting in much lower rework or scrap of stained pieces, saving \$208,000 per year. • Reduced operator and piece travel.
Redesigned the repair cart and moved the cart in-line.	<ul style="list-style-type: none"> • Improved repair efficiency. • Cleared 100 square feet of factory floor space.

Table 2 continued on next page

Table 2 - Process Changes and Results for the Toxics Team, continued

Activity	Results
<p>Conducted a cost-benefit analysis and vendor testing for a new unicoat product to replace the existing sealant and topcoat. The new product contains about one-third of the VOC content as the previous product.</p>	<p>The material substitution:</p> <ul style="list-style-type: none"> • Reduced worker exposure to VOCs. • Extended the pot life of the new product, eliminating 38,684 pounds of hazardous waste per year. • Eliminated 114,535 pounds of VOCs per year from material substitutions resulting in net VOC reduction of 55,130 pounds for the finishing department as a whole. • Eliminated two infrared (IR) ovens, which cost \$24,000 per year to operate with natural gas¹. • Freed almost one full FTE to monitor systems.

¹ Initially, Canyon Creek took six IR ovens out of service because they were no longer needed with the new coating system. However, subsequent changes sped up the line, requiring four ovens to be put back into service to decrease curing times and maintain production levels.

Post-Pilot Project Improvement Activities

Canyon Creek management and staff have embraced and supported lean and environmental continuous improvement activities. One year after completion, Canyon Creek has sustained the improvements implemented during the project, and continues to implement lean improvement activities, several of which are connected to opportunities identified during the pilot project.

Examples of Canyon Creek’s ongoing lean and environmental improvement efforts include:

- Completed and filed a "Lean and Environment Pollution Prevention Plan" and Annual Report with Ecology, as part of a P2 Planning Options pilot project, to satisfy the State of Washington's annual P2 planning and reporting requirement.
- Reconfigured the off line paint booth area and layout to improve production flow. The facility is in the process of making the layout changes and installing new and improved equipment.
- Installed a new finishing line area to enable spraying of miscellaneous parts and items as a kit without affecting the flow and speed of the main production lines. These changes improved the quality and uniformity of the finish and will reduce hazardous substance and energy use.
- Tested a plural gun system for mixing top coat and unicoat products. This will reduce hazardous wastes due to the short pot life of pre-mixed products.
- Eliminated an alcohol and water waste stream by implementing the unicoat product. The switch to the unicoat product eliminated the need to flush lines containing an aqueous based seal coat.
- Replaced eight blow-down stations for dust removal between coats by manually removing dust with a tack cloth. This will save approximate 40 horsepower of compressed air stream, on the order of 120,000 kWh annually.

Canyon Creek’s collective post-pilot project improvement efforts have increased the product line speed and uptime. Two major contributors to reduced downtime is less frequent stopping for color changes, and increased capacity from less rework.

Summary of Pilot Project Results

The lean and environmental efforts at Canyon Creek resulted in impressive improvements in productivity, material savings, environmental performance, as well as other benefits for the company and employees.

Cost and Environmental Savings

Canyon Creek's lean and environment efforts resulted in \$1.19 million of annual savings. Table 3 summarizes the quantifiable cost time, material, and environmental savings from implemented actions.

Table 3 –Annual Cost, Time, Material, and Environmental Savings

Reductions	Woodchuckers Team		Toxics Team	
	Annual Cost Savings	Time, Material, & Environmental Savings	Annual Cost Savings	Time, Material, & Environmental Savings
Raw Material	\$110,000 ¹	~1,820 wood sheets		
Hazardous Substance Use			\$128,450	68,720 pounds
Air Emissions				55,130 pounds (net reduction in VOCs)
Hazardous Waste			\$37,100 ¹	84,400 pounds
Energy			\$24,000 ¹	
Solid Waste	\$58,000 ¹	508,000 pounds		20,680 therms
Rejects			\$208,000 ¹	10,400 parts
Labor			\$624,000 ²	39,000 hours ²
<i>Cost Savings Sub-Total</i>	<i>\$168,000</i>		<i>\$1,021,550</i>	
Total Cost Savings:	\$1,189,550 per year			

¹ These savings were achieved without a capital expenditure request.

² This is a conservative estimate. The additional labor hours were used to fill open positions.

Canyon Creek expects to save an additional \$194,000 in raw material and waste reductions and 2,600 labor hours from the pending investment of three cross-cut saws. The saws are expected to increase the efficiency of wood ripping and reduce the equivalent of up to 37,000 wood sheets per year.

The pilot project resulted in numerous other benefits, including qualitative and quantitative improvements in worker productivity, product quality, worker health and safety, morale, and reduced environmental regulatory burden. All pilot project benefits were achieved within six months and have been sustained one year later. Examples of these benefits are listed below.

Productivity Improvements

- Increased production from about 900 cabinets per day on average to about 1,000 cabinets per day.
- Noted an initial upward trend in productivity in “cabinets built per finishing man-hour” from about 1.05 in June 2006 to 1.3 in August 2006.
- Freed staff time to assist with other tasks such as continuous improvement and equipment audits.
- Reduced cabinet lead time in the Millennia product line by 24 percent.
- Reduced WIP floor space in the Millennia line by 590 square feet.

Quality Improvements

- Increased the first-pass yield rate in finishing from 92 percent to about 94.5 percent from July to August 2006.
- Reduced the number of daily defects from an average of about 260 per day in early July, to 214 per day in August 2006, for all cabinet lines.
- Significantly reduced the number of defective doors that must be completely scrapped and sent for hog fuel. *Subsequent to this project, Canyon Creek outsourced cabinet door manufacturing, and nearly eliminated this waste stream altogether.*

Environmental Health and Safety Improvements

- Reduced VOC emissions, which will allow up to 70 percent increase in production capacity before reaching the Clean Air Act Title V permit threshold for VOC emissions and will reduce worker exposure.
- Improved ergonomics.
- Reduced operator travel and movement.
- Positive staff involvement, acceptance, pride in accomplishments, and higher morale due to more efficient and ergonomic operations.

Project Costs

The total direct project costs to Canyon Creek are shown in Table 4.

Table 4 - Direct Project Costs to Canyon Creek (Excludes Grant Contributions and Administration Costs)

	General	Toxics	Woodchuckers
Labor: Value Stream Map		\$3,680	\$4,800
Labor: Kaizen 1		\$3,040	\$4,800
Labor: Kaizen 2		\$1,760	\$5,440
Labor: Kaizen 3		\$2,400	\$4,160
Labor: Between Kaizen Events		\$6,080	
Lean Consultant	\$6,000		
Capital Expenditure		\$131,360	\$84,580 ¹
Sub-Totals	\$6,000	\$148,320	\$103,780
		Total	\$258,100

¹This expenditure remains pending, but is allocated for three cross-cut saws for real-time cutting.

Lean and Environment Case Study

Canyon Creek Cabinet Company

Grant Contributions to Conduct the Pilot Project at Canyon Creek

Table 5 shows pilot project costs that were covered by project grant funding, including a portion of WMS facilitation, Ecology staff participation, and outside assistance documenting project activities and results.

Table 5 – Other Project Costs Not Incurred by Canyon Creek

Costs	
Labor: Ecology Staff Training ¹	\$ 7,900
Labor: Assistance to Business ¹	\$13,800
Labor: Overhead ²	\$12,300
WMS	<u>\$24,000</u>
Total³	\$58,000

Funding	
Ecology	\$21,700
Pollution Prevention Grant (A 50/50 split of U.S. Environmental Protection Agency [EPA] and Ecology funding)	\$31,600
U.S. EPA National Center for Environmental Innovation funding	<u>\$ 4,700</u>
Total	\$58,000

¹ This pilot project served as an opportunity to train Ecology staff. In the future, it is likely that fewer Ecology staff would attend training at a facility, and only those needed to provide environmental expertise during planning and implementation events would participate.

² Overhead costs do not include overall project start-up costs, such as time spent on marketing. Overhead costs cover pilot support and management activities, including conducting initial research, attending event report-out sessions, conducting interviews of various participants, and documenting project activities and results.

³ Total cost does not include administrative costs to update the report one year following the initial pilot project activities.

Challenges, Successes, and Conclusions

To help others interested in using this model of combining of lean and pollution prevention technical assistance delivery, several challenges, successes, and conclusions from the pilot project are listed below.

Challenges

Despite the impressive collection of performance improvements that resulted from the Canyon Creek pilot project, the project teams faced several challenges during the course of the project, as follows.

- **Staffing Challenges:** There were significant changes in senior management at Canyon Creek during the course of the project, as well as some variability in the availability of team members for kaizen events. This required pilot project teams to adapt their plans for individual events. For example, Canyon Creek canceled the second week of kaizen events entirely, at the request of new Canyon Creek leadership, but then reinstated the original plans the week before the event.

Also, having two teams working simultaneously allowed for significant strides in lean and environmental improvements in two areas of the facility. In retrospect, however, if only one team had participated, they may have been able to learn and apply lean and environmental strategies at a much deeper level in one area of the plant.

- **Communications and Coordination:** Although communication and coordination throughout the project were very good, there were a few initial challenges. WMS and Ecology had not worked together before, so this required some initial acclimation and resolution of communication issues. For example, Ecology staff was sometimes not able to communicate directly with the lean service provider, a subcontractor to WMS. In addition, there were some missed opportunities for greater integration of environmental considerations into the lean events, particularly during training sessions. Another short-lived obstacle occurred when a Canyon Creek team leader had not been made aware that he was able to authorize a major capital equipment purchase for the Toxics Team's work.
- **Schedule Limitations:** Some of the kaizen events planned at Canyon Creek required investments in new technology, new raw materials, or other equipment. Some new acquisitions required several weeks of lead time to purchase, conduct competitive bids, and/or fully evaluate prior to purchasing. The ambitious schedule, with only three weeks between each kaizen event, made it challenging to gather the necessary information, and to complete the details to acquire equipment and materials in time for the project completion. Conversely, the tight schedule contributed to the project's momentum and cohesiveness.

These challenges were not insurmountable; in fact, many of the solutions to these challenges are considered project successes. Project participants adjusted their plans as circumstances changed during the project, to make the most of the lean and environmental improvement opportunities.

Successes and Key Elements of Project Design and Implementation

There are several key aspects of pilot project that helped make it successful.

- **Top Management Support:** The management at Canyon Creek was behind this project from the onset. Their physical presence at various points during events and at report-out sessions was motivational to the participants.
- **Strong Performance Measurement System:** Canyon Creek already had a rigorous system of metrics in place for evaluating most aspects of its environmental and operational performance, so this provided a solid foundation for the measurement and evaluation component of this project. One data area recommended for improvement was idle time or downtime during production.
- **Team Participation:** The cross-functional composition of the teams, in which Canyon Creek and Ecology staff worked side by side, helped to ensure that process changes met operational as well as environmental objectives. Some of the more innovative and environmentally beneficial solutions, such as the color-changing system for the stain booth, were identified by line operators. Canyon Creek appreciated the attendance and support of the State pollution prevention experts and other project partners throughout the project because they helped keep the momentum going, offered pollution prevention assistance, and provided an outside perspective with new ideas and suggestions.
- **Flexibility/Adaptability:** Adjusting to changes in the scope and structure of events was necessary due to unforeseen occurrences such as changes in management, vendor/equipment lead times or delays, and additional time needed to collect data in preparation for kaizen events.
- **Follow-Up Between Events:** Follow through on action items identified during lean events was essential to ensuring that progress was sustained, and that future events would be successful. In particular, Ecology worked with Canyon Creek to ensure that necessary equipment purchases were made and other preparations were in place for upcoming kaizen events.

Conclusions

The opportunity for Canyon Creek to participate in this project, including the financial assistance, brought lean and environmental improvement efforts to a higher level of awareness and attention company-wide. This also created an opportunity for continued improvements that benefit Canyon Creek, its customers, and the environment.

All of the organizations participating in the pilot project—including Ecology, WMS, and Canyon Creek—felt that the environmental component of the project added value to lean implementation efforts and contributed to the project’s overall success. Because environmental considerations were integrated throughout the pilot, it is difficult to isolate the impact that the environmental component of the project had on the overall results of lean implementation. However, several outcomes were observed. Lean teams would not have likely focused on identifying the root causes of hazardous wastes and excess use of raw materials, including wood. Canyon Creek also may not have chosen the finishing department as a priority for lean improvement activities; however, focusing on this area resulted in significantly lower VOC emissions, hazardous waste generation, and labor cost savings.

A few overarching conclusions stand out from this pilot project:

- **Examining environmental wastes and costs during lean implementation helped project teams identify new process improvement opportunities and cost savings.** Without explicitly addressing these considerations, lean implementation teams may have missed important opportunities to reduce wastes, improve quality, and increase customer responsiveness.
- **WMS and Ecology worked effectively together in helping Canyon Creek improve its operational and environmental performance.** WMS and Ecology’s services complemented each other’s and enhanced their overall effectiveness. Ecology P2 staff, for example, commented that “this is the way P2 is supposed to work.”
- **Linking lean and environmental improvement methods yielded powerful result for Canyon Creek’s bottom line, its environmental performance, and the health and safety of its workers.** With the results from this project, Canyon Creek was able to avoid new regulatory requirements, as well as chart a new course for future lean and environmental improvement efforts.

Lean and Environment Case Study Canyon Creek Cabinet Company

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