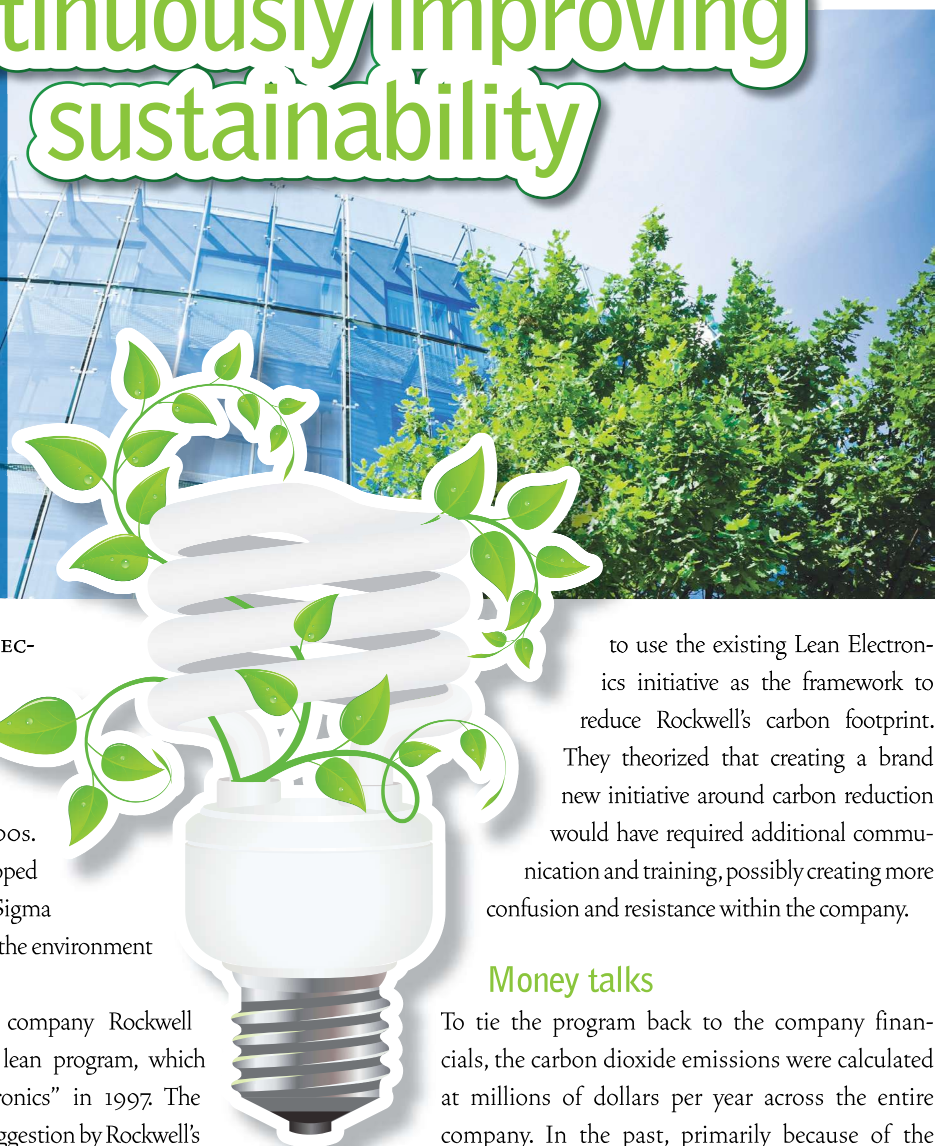
Continuously improving sustainability



Lean, Six Sigma save energy and big bucks at Rockwell Collins

BY BRION HURLEY, CAROLYN McARTOR AND CAL VAN'T LAND

THE ENVIRONMENTAL PROTECTION Agency noticed a strong connection between environmental stewardship and process improvement methodology back in the early 2000s. Numerous toolkits were developed to help explain how lean and Six Sigma techniques could be used to help the environment and reduce company expenses.

The aerospace and defense company Rockwell Collins began implementing a lean program, which it trademarked as "Lean Electronics" in 1997. The program's genesis came from a suggestion by Rockwell's largest customer, Boeing. Years later, Boeing approached Rockwell Collins with another suggestion: Start reporting your carbon footprint to the Carbon Disclosure Project (CDP). CDP is an organization that encourages companies and cities around the world to begin measuring and managing their carbon footprint and environmental impact, with the goal of eventually reducing those measurements. CDP houses the largest global collection of self-reported climate change, water and forest-risk data, information that can catalyze business and government action.

With the success of the lean initiative behind them, officials at Rockwell Collins agreed to follow their customer's suggestion once more. After two years of reporting, CDP expressed concern that Rockwell Collins was not making enough progress, and the company needed to improve its carbon reduction efforts.

In early 2009, a team of employees organized to come up with a plan. Using the EPA toolkits and employee expertise, they decided to use the existing Lean Electronics initiative as the framework to reduce Rockwell's carbon footprint. They theorized that creating a brand new initiative around carbon reduction would have required additional communication and training, possibly creating more confusion and resistance within the company.

Money talks

To tie the program back to the company financials, the carbon dioxide emissions were calculated at millions of dollars per year across the entire company. In the past, primarily because of the manual effort it would have required, such costs were isolated to each facility instead of rolled up at the corporate level.

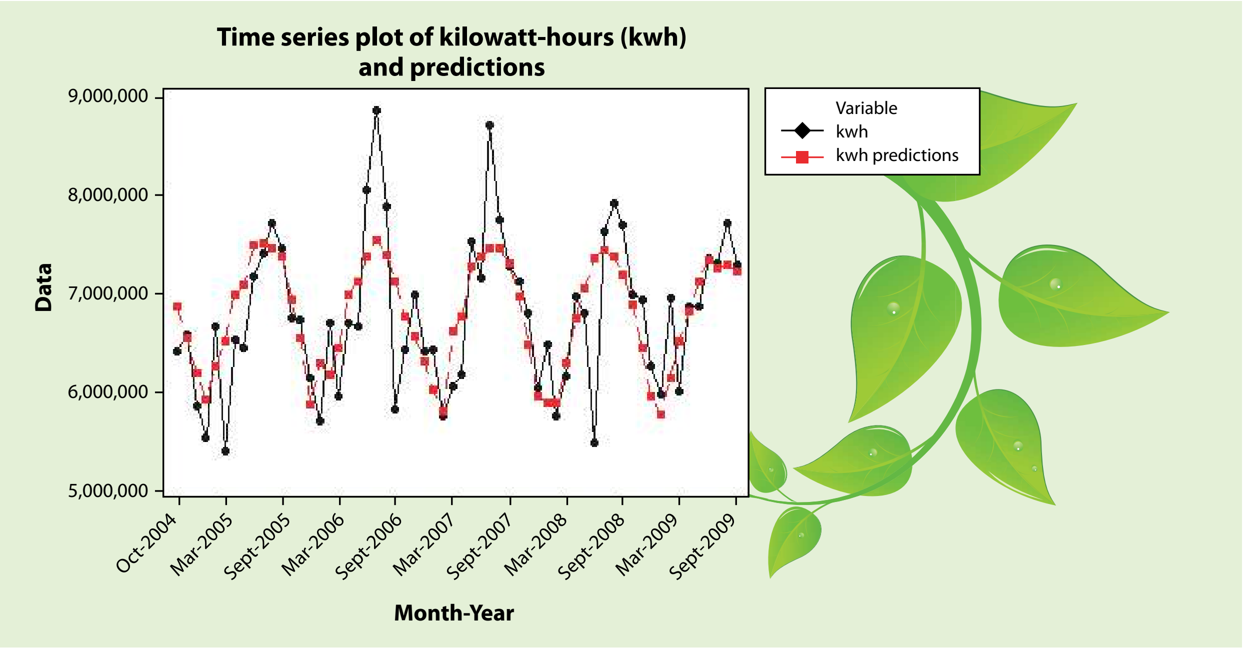
Once the financial impact was presented, it was easy to sell leadership on the idea that there were numerous opportunities to save money and help the environment.

Through benchmarking efforts and leadership discussions, the team came up with a goal to reduce carbon emissions by 15 percent by 2014. The team finalized an approach and rollout process to achieve the goal using the same Lean Electronics terminology and event formats already familiar to leaders and employees.

One of the first efforts launched was to get all the carbon dioxide emission data into a common database so the data could be reported on easily, validated and analyzed for opportunities. The database provided the team with a breakdown of

APPROXIMATING REALITY

Figure 1. Electricity usage (black line) versus regression model (red line) based on outside temperature only. The red line of the regression model showed how well outside temperatures predicted electricity usage, filling in data gaps that were holding back sustainability improvements.



energy by facility and energy type by month. It was determined that nearly 80 percent of the carbon emissions (and cost) was coming from electricity.

The team decided on a two-pronged approach to reduce electricity use. The top-down approach would analyze electricity data using the Six Sigma DMAIC project format. The bottom-up approach would engage employees in behavior changes through lean "go and see" events.

Six Sigma sustainability

The Six Sigma project started off quickly, identifying the facility with the largest electricity usage and a business case of $200,000 worth of savings in six months. That figure made it easy to get leadership support. It was no surprise that the biggest electricity consumer was the facility at headquarters, the largest one in the company at 1.5 million square feet.

However, as with prior efforts at electricity reduction, the project struggled in the measure phase because detailed electricity data was not available to identify the biggest department users within such a large facility. Without good data, most teams would be forced to brainstorm solutions without analysis and hope they could achieve the desired benefits.

Initially, a quote was put together to put power meters on each electrical substation to gather real-time data to point the team in the right direction. However, the time to implement such an endeavor, not to mention the cost involved, would have pushed the project out numerous months. To overcome the lack of actual data, the project team came up with four different approaches to determine how to proceed on the project:

1. **Employee inputs from maintenance personnel.** Their experience and knowledge of the building identified numerous project ideas, one of which the team picked to pursue (setback program for air handlers). The other ideas were added to the list of potential projects.
2. **Statistical modeling of the facility.** Using regression analysis, the team was able to correlate some key facility metrics with electricity usage to help support which project idea to pursue. Figure 1 shows how closely the regression model, using only the average monthly outside temperature, was able to predict electricity usage each month. This proved to the team that the systems that are affected by outside temperature (heating and cooling) need to be investigated to ensure that they are working as efficiently as possible.
3. **Trend analysis of the five-minute increment data from the utility company.** Looking at the usage at night and over the weekend differed from what most people assumed was happening, which highlighted potential opportunities. Figure 2 shows how the electricity usage is high even during the evenings and weekends, which are outside of normal production hours. A

list of electronics and machines that typically were left on overnight was generated for the team to review. This included the air conditioning.

4. **Manual data collection of the more than 50 electrical substations within the facility.** A smaller team uncovered all the substations within the facility, a task that was not as easy as it may seem, and took random samples of kilowatt-hours (kwh) data. The data was collected at various times of the day and days of the week during a two-week period. The results were used to estimate a pie chart of electricity usage by the department that primarily uses each substation. This exercise identified sections of the facility that were large electricity consumers. The data pointed to the chiller room, which provides cooling for the building.

All four approaches pointed to the same opportunity: the heating, ventilation and air conditioning (HVAC) system was running all night and all weekend when hardly any employees were working. The multiple approaches that resulted in similar findings gave project sponsors the confidence they needed to allow the team to dig deeper into the HVAC system.

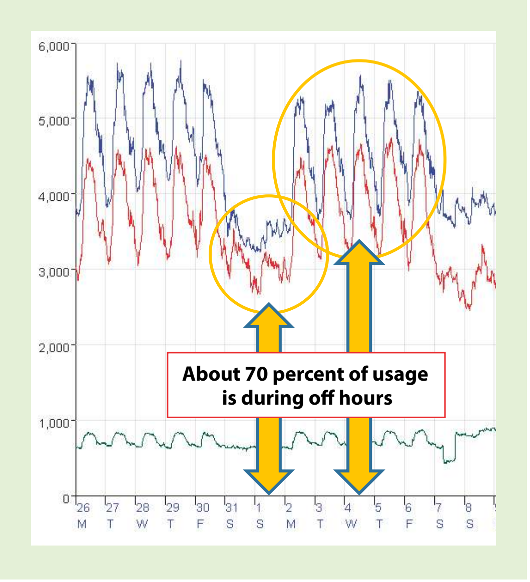
Team members unanimously determined that the best solution would be a setback program, where the HVAC system would automatically turn down the air conditioning at a specific time at night to save electricity. Before employees returned to the building, the air conditioning would be turned back on at a set time, so most would not even realize the setback program was in place. Such a program had been attempted years ago, but the lack of three key items – leadership support, change management considerations and known savings – caused the program to fail.

To avoid repeating the same mistakes, a pilot study was conducted in one section to understand employee concerns, working hours and potential technical issues with an HVAC overnight and weekend setback program. The facility includes engineering labs, cafeterias, production and test area, computer servers, offices, restrooms, conference rooms, storage space and a water treatment facility. Each area might have legitimate situations where the setback program might not work. Those sections would be exempt from the setback program.

The survey also was a communication tool to make employees aware of the program and determine when most employees left each day. That information helped determine the correct setback and startup times. The team asked employees in the pilot area to provide their usual start and stop time by day of the week. To validate the survey results, employee badge swipes, which are required for all employees entering the building, were extracted from security.

OFF-HOUR WASTE

Figure 2. Electricity usage (kwh) in five-minute increments at the largest facility within Rockwell Collins showed that a lot of energy was consumed outside of working hours.



The results were consistent, but the team decided to be conservative, adding an extra hour on both ends of the setback and startup times to reduce the number of potential complaints. The team still calculated that the estimated savings would achieve the project goal.

To encourage even more acceptance, a temperature override button was installed in the pilot area. The button helped alleviate concerns among employees who might have to work on weekends or other special situations outside normal working hours. The pilot project was successful, and a project plan was developed to roll out the program to the rest of the facility. The rollout included the override buttons and employee surveys by area.

To help ensure success, an energy manager was hired within the facilities organization to complete the improve phase of the Six Sigma project across the entire facility. In addition, the manager was provided with a $500,000 annual budget for other energy projects that had been identified in the past. Many facilities had received energy audits over the years, but without an energy reduction goal and project management resources, few improvements had been implemented.

It took almost one year to complete the rollout across the large facility, but the results yielded more than $300,000 in electricity savings, with an implementation cost of approximately $50,000 for labor and materials.

Lean, go and see

As a result of benchmarking other companies and reviewing the EPA toolkits, a modified lean event format was developed. This

Pam Ehlen, a Rockwell Collins environment safety and health engineer, evaluates why a computer is on during a weekend go-and-see session in October 2011. The observation was noted and discussed with the operations team during the second session.

aligned closely with Rockwell Collins' existing lean structure, which made adoption much easier.

Departments were selected based on leadership support, total electricity usage and ability to obtain actual electricity data for their department or work area. An event preparation worksheet was created for each department conducting an event.

Portable meters were hooked up to the substations connected to the work area to establish a baseline of electricity performance at least one week prior to the event. This allowed the teams to see their actual usage of electricity, not the amount allocated to their budget based on floor space or employee count. The pattern of electricity usage by hour and day of week helped the teams brainstorm the equipment or building inefficiencies that could be the largest drivers of electricity usage.

Each team received training prior to the start of the event. The training covered the carbon footprint reduction goal at Rockwell Collins, electricity basics (kwh, peak demand, utility rates), carbon footprint calculations, the go-and-see event format, roles and responsibilities in the event, and how to fill out the forms. There are six different observation periods within the go-and-see event: weekend, startup, working time, breaks, changeover and shutdown.

The event training takes place on Friday afternoon, with the events officially starting the next morning with a walk through the work area during nonworking hours. The event teams split up into smaller groups (at least one person from the work area and the rest from outside the area). Each group takes notes and makes detailed observations about what could be wasting electricity using a template with pre-defined items by type of work space. This session lasts about two hours.

The teams return early on Monday morning before work begins in the area to see if anything has changed. Team members arrive early to observe the startup process when employees come in. They look to see whether equipment and lights are turned on right away to allow for setup time or turned on only when needed.

They also use that time to interview the employees about observations from the weekend and observe how equipment is used during the shift. The team also makes observations during the breaks to see if equipment is shut off or left on. Finally, the team observes what happens when the shift ends.

If there is more than one shift, team members observe what happens when the shifts change over. This can take place over a two- to three-day period depending on work and participant schedules.

The go-and-see events result in several common observations:

- Ovens were left on.
- Lights were left on.
- Personal fans were left on.
- Test equipment/computer monitors were left on.
- Compressed air leaks were observed.

After the observations, the teams reconvene and list their observations. Teams identify the best opportunities to pursue based on ease of implementation and total electricity reduction. They identify the top actions and establish a regular review to follow up with the actions so the improvements, if deemed feasible, can be implemented.

Larger actions would be assigned back to the energy manager for prioritization within the annual budget. Some of the actions were quick and easy to implement and were given priority over more impactful actions that would take a long time to complete.

Based on the observations, some common solutions appeared at each event:

- Training on how to report air leaks
- Oven shutoff timer installations
- Visuals on how the lights align within the control panel
- Equipment shut off decision stickers

Getting results

Over a two-year period, six events were completed in four different facilities. Additional facilities were added beyond headquarters to expand the knowledge of the employees and ensure that the approach could be replicated. The events identified over $200,000 in opportunities, and more than 50 employees were trained.

As with many lean events, the real value was educating employees and making them able to see the electricity waste in their own area, along with making them aware of the company's goals and financial cost of electricity.

Rockwell Collins is on track to achieve its goal of reducing carbon dioxide emissions by 15 percent. In fact, the company expects its reduction of carbon dioxide emissions to exceed 18 percent by the end of this year.

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Photo courtesy Ford Motor Co.

Ford's 10.4-acre living roof sits on top of the company's Dearborn Truck Plant.

LIVING ENVIRONMENTALISM

For more than a decade, the living roof sitting atop Ford's Dearborn Truck Plant has been a symbol of corporate environmental sustainability.

Roger Gaudette, Ford Motor Land's director of planning, estimating and engineering, recently told the Dearborn, Michigan, *Press & Guide* that the 10.4-acre garden absorbs storm water and collects and filters rainwater with vegetated swales, natural treatment wetlands and porous pavement with underground storage basins.

It naturally insulates the truck plant, reducing heating and cooling costs. The roof is filled with sedum, a stonecrop and perennial flower that resists drought. It's a natural habitat for birds, butterflies and insects, Gaudette said. Since the living roof protects the actual roof from ultraviolet radiation, it reduces expansion and contraction from hot days and cold nights. This helps the living roof last twice as long as one made from tar.

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