ISO jump starts company

Lorne Scharnberg enjoys talking about his company, Katecho, Inc., a firm located on the south side of Des Moines. Katecho employs about 245 people and makes disposable electrodes for heart defibrillators, muscle stimulation equipment, and other medical uses. Scharnberg is president and CEO of Katecho. His wife, Kathi, is vice president and CFO.

It is an unusual story. Since its startup in 1984, the company has capitalized on: 1) a highly defined niche market; 2) a diverse, non-traditional workforce; and 3) an investment in better practices as well as improved technology, materials, and equipment. One of the more recent opportunities for improvement, becoming ISO certified, has reaped big rewards for the company, according to Lorne Scharnberg.

Making the commitment to ISO certification and making it felt throughout the company were large tasks, according to Scharnberg. It started with a customer suggesting certification for Katecho. The arguments made by the customer were powerful, but Scharnberg was skeptical. For the most part, he said he avoids using consultants. However, he sent some of his staff to seminars to explore the idea. They returned unable to explain what would be included – or why – in the ISO 9000 process.

"I was only interested in the secret to getting this accomplished," said Scharnberg. He then sent manufacturing managers to a session that included presentations by Don Brown of CIRAS. "When they walked away, they had a real good knowledge of ISO and what it would take to implement it," said the CEO.

"CIRAS became the launching pad for our ISO initiative," said Scharnberg. Brown staged an introductory training course at the plant and has worked with Katecho at various stages of the process, which took nearly 18 months to complete. Three years ago, the company became certified; a re-certification audit took place in July.

Scharnberg credits Brown with conveying ideas that began to make sense. "He said to get ISO implemented, you need to put together an internal audit team; preferably, one from each of the departments, then give them authority. He explained why ISO certified companies would dominate the markets. He got away from the (talk) of consultants." Scharnberg also used a set of books that used a straightforward manner to guide the team through the process.

Empowering the ISO team, comprised of workers from a variety of departments, was vital to the success of the ISO mission, according to Scharnberg. "The team has to have the ultimate, final say in what they do," making decisions that outrank even his own.

The ISO differences

What difference has the certification made to Katecho? First of all, according to Scharnberg, it fulfilled a requirement of a contract with his largest client. Without it, he would have lost nearly 50 percent of his product business.

"Secondly, it provided a structure within our company that permitted us to grow 40 percent one year and 60 percent another year – and be able to handle it," he said. "If you have the systems in place, you can handle that kind of growth."
CIRAS Mission Statement

CIRAS mission is to assist Iowa manufacturing to improve its operational performance. CIRAS will collaborate with the Iowa Manufacturing Extension Partnership program and its partners in fulfilling its mission. CIRAS will employ delivery methods consistent with Iowa State University’s outreach efforts. It will engage in education and training programs for its clients to assure that managers and staff of clients are aware of current technical and managerial practices. It wishes to be recognized as the preferred source of unbiased information for the industry.

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The CEO said he personally uses the ISO structure as an organizational tool, while “our people use it as quality control.”

The move to ISO also has created a system of checks and balances, procedures, checkpoints, and quarterly management reviews. It also has created more teamwork, he said.

“One of the things that has happened in the aftermath of the decision to adopt ISO standards,” said Scharnberg, “is that companies in medical fields (such as his) are now required to be ISO certified. By 2000, major Katecho vendors also will have to be ISO certified. It has been a European Common Market push that has driven the ISO movement. If you want to be a large company, you have to market in Europe,” added Scharnberg.

Improved marketing is frequently a reason companies move to ISO implementation. The nature of the niche market for Katecho products, however, defines its marketing. Being ISO certified “gives us our maximum marketing advantage,” said Scharnberg.

Katecho products
Heart defibrillator machines once used paddles to transfer electric impulses from machine to patient. In the mid-80s, the move was made to disposable pliable patches with lead wires attached. The technology of the machines has remained relatively the same over the years, but their size and convenience attributes as well, as the disposable electrodes, have altered dramatically to fit the uses, according to Kathi Scharnberg.

“The machines are more sophisticated now,” she explained, with portability being stressed. Some even use voice activation. They are found on airplanes, in personal vehicles, with sports groups. Hospitals and emergency medical workers are still the primary users.

Katecho sells directly to the manufacturers of the instrumentation, making about 600 different products for customers around the world, meeting a wide range of specialized specifications for materials and size, and supplying about 60 percent of the world’s demand. It is the longest standing producer of the devices.

Meeting individual customer requirements has meant being flexible. Metals and adhesives are shipped in from several corners of the world. Fasteners on the devices vary for different clients. One customer asked for packaging labels to be printed in six languages.

“We make pads – that’s our niche,” stressed Kathi Scharnberg. And in order to meet the demand and the variety of demand, she said, the company has to rely on a great amount of hand labor. “We take automation and marry it with hand labor.”

Two shifts of workers fill the plant to capacity. People sit at workstations and move around in well-lighted, air-conditioned, clean work environments. Thus far, Katecho has been able to entice non-traditional workers. About 60 percent of its workforce are senior citizens (the oldest worker is 82), 10 percent are disabled, and 20 percent are prisoners.

Machinery has allowed higher levels of production to meet a growing demand for product. But, said the CFO, hand labor is the only good way to put the wire together with the pads.

CIRAS offers a variety of programs, seminars and services, listed below, to assist manufacturers with their ISO endeavors. For further information, contact Don Brown at (319) 398-1272; or call the CIRAS Central Office in Ames at (515) 294-3420.

• Introduction to ISO 9000
• All About ISO 9000 Training
• ISO Gap/Readiness Audit
• Implementation Planning
• Documentation Training
• Documentation Writing
• Documentation Review
• Internal Auditor Training
• Selection of ISO 9000 Registrar
• Employee Training
• ISO Pre-Assessment Certification Audit
The ISO 9000 quality assurance system is not just for the manufacturing sector anymore. That is what Verl Anders, Operations Manager, and Merle Pochop, Field Specialist for CIRAS discovered on a recent visit to Europe. They were part of a team of ISU livestock specialists and Iowa producers who toured livestock production and processing facilities in four countries. Denmark, Belgium, the Netherlands, and England currently use some facets of ISO 9000 in the livestock business – from production through processing to the final sale by the supermarket.

In the United States, ISO 9000 standards currently are used primarily for manufacturing systems. In Europe, the agriculture and livestock sectors realize the importance of ISO for the increased value it contributes to the quality assurance process. Other reasons for adopting these standards are government regulations, consumer preference, and safety issues.

Importance of ISO certification

“There is an increasing awareness in Iowa among livestock producers with regard to some form of a quality system,” according to Anders. A number of Iowa cattle producers are participating in programs that use various components of the ISO system. Anders explains, “Livestock producers in Iowa could implement ISO 9000. What we find when we do a gap audit with a manufacturer is that there are many specific practices in place that correspond to specific requirements of ISO 9000. I think we will find the same thing true for the well-managed livestock operation.”

Quality systems are becoming increasingly important in the value added agriculture sector, and there is interest from a variety of groups in what the Europeans are doing. “Some of our competition in the world marketplace - such as in Argentina and Australia - are already selling meat overseas from ISO certified companies,” according to Mary Holz-Clause, value added agriculture specialist.

Anders says, “The future is positive for incorporating ISO 9000 into the agriculture sector. I am hoping to get support from a value added agriculture grant that will allow CIRAS to become more active in that field. We are currently involved with an Iowa meat processing company and a grain coop in the state that wish to become ISO certified because they want to export grain to Europe. So I think we can move into the livestock or other aspects of the agriculture.”

Verl Anders inspects a Danish cattle operation. Each animal has a national identification ear tag as part of the quality assurance program. When the animal transfers from one production site to another it accompanied with a passport which documents what health and management practices it has received.
When manufacturing firms find themselves in the enviable position of scrambling to keep pace with rising demands, they are faced with the following questions:
1. How can we increase throughput using our existing facility and resources?
2. How can we increase throughput by adding resources to our existing facility?
3. How can we increase throughput by adding to our facility or relocating to a larger facility?

One of the many answers to each of the above questions is by improving plant layout. According to D. R. Sule in his book (1994) *Manufacturing Facilities*, plant layout is important for two reasons: 1) material handling costs comprise 30-75% of total manufacturing costs and 2) modifications or rearrangements are usually costly in terms of both time AND money.

While you may not be able to “optimize” your facility in the mathematical sense of the term, you should be able to make improvements in areas such as:
- time spent handling materials
- cost of material handling
- distance traveled by materials and personnel
- number of moves made by materials and personnel
- congestion
- process flow

How does one go about improving plant layout? If you have done it before you know it is not an easy task! You must take into account every phase of plant operations plus diverse considerations such as order taking, employee break room, utilities, special ventilation requirements as well as all processes and activities. In other words, many factors must be considered. Since it is difficult to take that many different factors into account in any one problem, a systematic approach is needed in order to arrive at the “best” layout for you. One approach is documented in Richard Muther’s *Simplified Systematic Layout Planning* (1994). This method is broken down into six basic steps. The steps and a brief description of each are shown below.

1. Chart the relationships.
This begins by identifying departments, activities, or work centers to be included in the project. It’s best to keep the number in the range of 10-15 different work centers with a maximum of 20. More than that and the number of possible arrangements inhibits arriving at an agreed upon solution. A Relationship Chart is then created using a spreadsheet format or a mileage-type chart. A sample of a mileage-type chart is shown in Figure 1.

![Fig. 1](image)

The Relationship Chart is used to document the desired “closeness” between a work center relative to all the other work centers. As a mnemonic device, the vowels and “X” are used to indicate the relationships between each pair of activities. The desired closeness of each relationship value is defined in Table 1. If you find that the relationships for a certain work center or activity are similar to that of another work center, take a look at consolidating or combining the work centers into a common area.

Each relationship is also documented with a reason or reasons for the desired closeness. A number code represents each “reason” and is defined on the Relationship Chart for future reference. A “U” relationship needs no reason since it is by definition unimportant. Documenting the reason(s) for

<table>
<thead>
<tr>
<th>VALUE</th>
<th>CLOSENESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Absolutely Necessary</td>
</tr>
<tr>
<td>E</td>
<td>Especially Important</td>
</tr>
<tr>
<td>I</td>
<td>Important</td>
</tr>
<tr>
<td>O</td>
<td>Ordinary - Closeness OK</td>
</tr>
<tr>
<td>U</td>
<td>Unimportant</td>
</tr>
<tr>
<td>X</td>
<td>Not Desirable</td>
</tr>
</tbody>
</table>

Table 1
a relationship is very important when past or future changes are considered. It provides historical documentation on why a particular closeness was desirable or undesirable. Some examples of reasons for a specific relationship value are:

- Shared equipment
- Shared personnel
- Movement of material
- Movement of personnel
- Shared utilities
- Noise
- Cost of material handling
- Dirt
- Contamination
- Fumes
- Shared dock
- Supervision
- Steam
- Compressed air
- Foundations or pits
- Fire or explosion hazard
- Ventilation
- Electrical

This is by no means a complete list but it should give you an idea of what is meant by the reason for a closeness value or relationship.

2. Establish space requirements.
   The next step in Muther's method is to prepare an "Activities Area & Feature Sheet." At this point you will need to determine the area required for each activity, work center, or department. The information needed is overall square footage as well as length and width dimensions. You should also document other physical features that may be required, such as:

- Overhead clearance
- Maximum overhead supported load
- Maximum floor loading
- Minimum column spacing
- Water and drains
- Steam
- Compressed air
- Foundations or pits
- Fire or explosion hazard
- Ventilation
- Electrical

The above features are included on the form but should not be considered all-inclusive. Each manufacturing facility will have its own unique considerations and the form should be amended to include any necessary features. A sample of a completed Activities Area & Features Sheet is shown in Figure 2.

3. Diagram activity relationships.
   In this step, a node diagram is constructed, showing a graphical representation of the activities and their closeness relationships. Each node represents an activity. Starting with the "A" relationships, draw in nodes for the activities that share an "A" relationship. Then, connect the nodes with four parallel lines. These four lines represent an "A" relationship. Once the "A" related activities have all been placed and the relationship lines drawn, rearrange and redraw as necessary to achieve the best arrangement.

   Follow this procedure through the rest of the relationships and activities using three lines for an "E," two lines for an "I," and one line for an "O" relationship. No lines are used for a "U" and a zigzag or wiggly line represents an "X" relationship. Again, after adding each set of relationships and the necessary activities, rearrange or redraw as necessary to achieve the best arrangement. It is helpful to think of each line as a rubber band that you are stretching across the space between each pair of related work centers. The object is to minimize the tension present in a given arrangement. This analogy will facilitate creating an arrangement that will keep the A relationships closest, then E's, then I's and so on. Think of the wiggly line for an X relationship as a spring in compression that is trying to push the related work centers apart. Once a final diagram is created, add the square footage requirements next to each activity node for future reference. A sample of a completed diagram is shown in Figure 3.

4. Draw space relationship layouts.
   The next step is to combine the relationships diagram with the space requirements for each activity. When doing this by hand, it's best to use paper with a grid and to set a scale such that the entire drawing will fit on one sheet. Draw in each activity on the grid according to its square footage requirements. Adjustments should be made in order to fit realistic exterior wall configurations. Make sure to show any dominant physical features such as columns, access doors, walls, etc.

   If the building or addition already exists, overlay your layouts on the building outline. In the case of an existing building, depict permanent physical features like load-bearing walls, docks, windows and doors, etc. Replicate this activity for all the various layout options being considered. The more options you consider, the more confidence you can have in the final layout. A sample space relationship layout is shown in Figure 4.
5. Evaluate alternative arrangements.

The first step in evaluating different arrangements is to decide on the criteria by which each layout will be evaluated. These criteria may include such things as ease of supervision, flexibility in expansion, cost, material flow, etc. These criteria or factors must then be prioritized and assigned a weight value with the highest priority factor being a 10, the second a lower weight, the third lower, etc.

Then, evaluate and rate each alternative layout by these factors using the same A,E,I,O,U ratings as used previously. After rating each alternative, convert the letters to numbers (A=4, E=3, I=2, O=1, U=0) and multiply by the respective weight values. Total the weighted rate values for each layout. The layout with the highest total score should be the best alternative. A sample of a completed evaluation is shown in Figure 5.

6. Detail the selected layout plan.

Up to this point, the layout consists of blocks or various shapes for departments and areas. In this step you will be developing the final plan that will be used as a guide to show precisely where everything goes when you install the plan. Reproduce the selected layout plan, preferably to a scale of 1/8- or 1/4-inch equals a foot. Identify and draw in the activities and major features, major equipment, and primary services not already included. Then begin to draw in the details of individual equipment, machinery, utilities, or auxiliary services, and label them.

As you begin to do this, you will find yourself re-evaluating the fit of these details and making minor adjustments for such things as free door swings, adequate aisle space, space for maintenance or service, etc. Make sure that the arrangement is functionally sound. One of the best ways of accomplishing this is to involve employees from the individual areas in this step.

Finally, indicate the type of scale used. Add the compass points (or at least “north” to orient users), mark any key dimensions, and add the title block. You are then prepared to install the plan. A sample of a detailed area is shown in Figure 6.

Summary

Using this six-step, systematic approach will take much of the guesswork out of developing a new layout, resulting in increased confidence in your final plan. As suggested earlier, this system works best when employee teams are utilized for each step. Indeed, Muther designed his method to be used by self-directed work teams to arrange their own work areas. By using teams, not only will you find that you will come out with a better layout, but you will have less resistance in installing the plan because employees will take ownership of a plan they helped develop.
Simplified Systematic Layout Planning is especially useful in job shops or process layouts, where there are many different products that are produced in limited quantities. Where there is no consistent process flow, the development of a relationship chart may be the best data you have to determine relative placement of separate work areas. The value of a relationship chart should not be ignored in product-oriented layouts or production lines. The six-step process will aid you in locating all the necessary support functions.

Muther does caution that this simplified method should be limited to layout projects that include individual office areas up to 3000 square feet, individual shop areas no larger then 5000 square feet, and individual storage areas up to 10,000 square feet. When proceeding with the method manually, increasing the size and number of work centers drastically increases the difficulty in creating alternatives and evaluating them. (See Software & The Six-Step Method.)

**Software & The Six-Step method**

While Muther's Six-Step Simplified Systematic Layout Planning is a manual method, there are software packages that guide you through the same process. The use of software for this type of project effectively increases the number and size of work areas that can be considered. Engineering Animation, Inc. (EAI), an Ames, IA company, has one such software in its Factory Group of products. FactoryPLAN®, one component of EAI's VisFactory™, was developed by David Sly, an Iowa State industrial engineering graduate. FactoryPLAN® runs in tandem with AutoCAD and helps manage the process of rearranging areas into alternative layouts and evaluating them.

With FactoryPLAN®, the user inputs: 1) the work centers, activities, or departments; 2) square footage and length and width of each department; and 3) the relationships and reasons. The software then guides the user through a process that approximates steps 3 and 4 and shows a visual representation of the relationships for each alternative layout created. The software then performs the calculation for the evaluation in step 5 and presents a score for each alternative block layout.

With software like FactoryPLAN®, it is possible to effectively use the six-step method on much larger layout projects. Larger projects are extremely difficult, if not impossible, to evaluate using the manual method. Like the manual six-step method, FactoryPLAN® helps promote a team approach that offers participants ownership of the new layout and makes the most of minimal data.

**Case Study**

An eastern Iowa company, having experienced astounding growth, planned to build a new facility that would triple the size of their current building. A CIRAS specialist worked with a team of 10 persons representing departments throughout the plant. The group received training in Muther's six-step process, gathered data, and estimated square footage requirements and relationships between work centers. During this process, the team considered environmental and safety concerns, material flow, constraints, and monetary factors. The data was then input into EAI's FactoryPLAN® software. Several alternative layouts were developed by the team and scored using FactoryPLAN®. Finally, the team chose the best of the alternative arrangements and after a series of revisions and re-scorings, arrived at a final layout.

According to the company project leader, the process was invaluable in prompting the team to think through relationships between areas that wouldn’t have been considered otherwise. There was also a great benefit in bringing the team together so that individuals could see the “big picture” instead of only looking at how each area related to their area of expertise.

**References**


For more information about how CIRAS can assist your company with plant layout, contact the CIRAS Simulation Team: phone 515-294-3420; FAX 515-294-4925; e-mail x1jmohr@exnet.iastate.edu
Manage risk of LPG-powered forklifts

By Tom Greiner, Associate Professor, Ag and Biosystems Engineering

Editor’s Note: This is the first part of a two-part series. A second article will appear in the January issue of CIRAS News.

Liquids propane gas-powered forklifts are often used to reduce worker exposure to carbon monoxide. But contrary to popular opinion, LPG engines produce carbon monoxide (CO). Unless an LPG engine is well tuned and equipped with a catalytic converter, the concentrations of carbon monoxide in the tailpipe can be dangerously high.

Last year in Iowa, more than two dozen workers experienced flu-like symptoms after exposure to high levels of CO, primarily emitted by LPG-powered forklifts. Forklift operators, supervisors, and mechanics in the plants where the workers had become ill had mistakenly assumed that it was safe to use the forkift indoors because the equipment burned LPG. They were surprised when subsequent tests revealed high levels of carbon monoxide.

Carbon monoxide is a toxic gas that is odorless, tasteless, and non-irritating. It robs the body of oxygen when it is breathed in. The brain and the heart, which require a constant supply of oxygen, are quickly affected. Reduced oxygen flow to the brain leads to “carbon monoxide intoxication” and can cause persons to appear “goofy” or disoriented. Persons exposed to carbon monoxide often do not realize they are being poisoned. In mild poisoning, symptoms resemble winter flu (e.g. nausea, lethargy, headaches). Common complaints associated with chronic, low-level CO exposure include chest pains, palpitations, visual disturbances, and difficulty concentrating. In acute poisoning, the symptoms worsen with frontal headaches followed by convulsions, coma and, in severe cases, death.

According to the National Centers for Disease Control, an estimated 10,000 American workers annually miss one or more days of work because of exposure to CO, commonly misdiagnosed as flu. The Journal of American Psychiatry reports that as many as 15-40 percent of victims of serious, nonfatal carbon monoxide poisoning develop neuropsychiatric symptoms (personality changes, memory impairment) that can appear after apparent recovery.

To eliminate - or at least reduce - symptoms of CO, exposure to it must be reduced. This can be accomplished by reducing the amount of carbon monoxide produced, diluting the concentrations of carbon monoxide, and reducing workers’ exposure time.

Allowable concentrations of carbon monoxide (CO)

The U.S. Occupational Safety and Health Administration (OSHA) limits the maximum amount of CO in the workplace to 50 parts per million (ppm) averaged over an 8-hour time period. Brief exposures higher than 50 ppm are typically allowed by OSHA as long as the worker spends sufficient time in fresh air and does not exceed the 50 ppm level over an 8-hour average. Even at 50 PPM, however, some people will experience headaches, nausea, and a decreased ability to perform heavy work. For persons with even mild coronary ischemia, the risk of a heart attack increases. For these reasons, the American Conference of Governmental Industrial Hygienists (ACGIH) recommends an action level for CO of 13 parts per million.

Keys to reducing exposure to carbon monoxide

To reduce worker exposure, several safety groups like the American Society of Safety Engineers and the National Propane Gas Association recommend these precautions:

- tune engines and use catalytic converters to decrease the amount of CO emitted
- use plant ventilation to dilute and remove CO
- reduce worker exposure time
- use CO detectors to monitor carbon monoxide levels
- eliminate sources of CO

Tuning engines: Carburetor settings are critical in reducing the amount of carbon monoxide produced by LPG engines. Less than one turn of the jet adjusting screw can change CO emissions from 50,000 ppm to 500 ppm without a noticeable change in engine operation, exhaust color, or exhaust odor. Engines adjusted by sound and performance, without measuring tailpipe emissions, can be expected to produce high levels of carbon monoxide.

There are no Iowa or U.S. regulations limiting CO emissions from LPG forklifts. Most LPG or gasoline-powered forklifts have not been equipped with emission control equipment. The ACGIH recommends that LPG forklifts, when properly tuned, should produce 10,000 ppm or less.

In the Iowa cases, it was discovered that several LPG forklifts produced more than 30,000 ppm even after tuning (without a CO meter) by a forklift distributor. To reduce carbon monoxide emissions, manufacturers’ specifications for engine tuning must be followed carefully, using a CO instrument to measure emissions.

Catalytic converters: Catalytic converters can be retrofitted to older LPG forklifts, and will typically reduce engine emissions of CO to 1,000 ppm or less. Emissions from a rich-running engine producing high CO concentrations will quickly destroy a catalytic converter. Oxygen sensors and better fuel-system

Several precautions can be taken to minimize CO exposure from LPG-powered forklifts.
Clancy has retired

Jon Clancy, CIRAS field specialist for Fort Dodge, retired on August 15, 1999. He came to CIRAS in 1994 after 20 years of management work for various manufacturing operations in Iowa. Clancy's expertise enabled him to build strong relationships for CIRAS with many companies in the north central and central Iowa areas. He also was responsible for showcasing the ABC computer throughout the state.

Jon was also a tireless contributor to the publications team for the CIRAS News. We will miss his wit, charm, and most of all his writing skills.

His plans for retirement will include travel with his wife Stella. We wish him much happiness!

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Rudolph Pruszko is new CIRAS field specialist

Rudy Pruszko has joined CIRAS as a field specialist for the Dubuque and Delaware County area. His office is located in Peosta. He received his undergraduate degree in chemical engineering from Penn State and an MBA from the University of Dubuque.

Rudy has over 20 years of experience in a variety of management and engineering positions in the chemical and equipment manufacturing industry. His prior positions include project/plant manager and marketing and engineering manager for Wold Trona Company, chemical facility supervisor for FMC Corporation, president and chief operating officer of Wilderness Outfitters, Ltd., and chemical metallurgical engineer for John Deere. His experience includes the design, construction, startup and operation of five manufacturing plants; new technology development and patents; feasibility and financial analysis and strategic business and marketing planning.

Rudy and his wife Rose have three children - two in college and a sixth grader. His hobbies include whitewater canoeing, hiking, biking, woodworking, and geology.

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controls increase fuel economy, reduce emissions, and increase converter life.

Reducing worker exposure time: Carbon monoxide is a cumulative poison. Concentrations in the body rise when carbon monoxide is breathed in — and then require several hours of fresh air to drop to normal. Reducing exposure time can increase comfort, health, and productivity.

Ventilating to remove and dilute carbon monoxide: Fresh, outside air is needed to remove and dilute CO. Circulating fans are not sufficient. ACGIH recommends a ventilation rate of 5,000 cubic feet per minute (cfm) per LPG forklift, if the forklift is well-tuned. A ventilation rate of 15,000 cfm is recommended for a poorly tuned engine. The recommendations assume that the forklift is operated less than 50 percent of the time, that the volume of the space is 150,000 cubic feet per forklift, that the forklift is 60 horsepower or less, and that there is reasonably good distribution of air flow. If several poorly tuned forklifts are operating continuously in a small space, the ventilation requirements increase, requiring large expenditures for heating, cooling, electricity, and fans. Reducing CO emissions becomes essential.

Carbon monoxide detectors: Accurate, durable electronic instruments that measure carbon monoxide concentrations can be purchased for under $400. Residential alarms, designed to warn of acute, high concentrations of carbon monoxide, are not suitable for industrial use. Most residential alarms are not designed to operate in a harsh industrial setting, are not sufficiently sensitive, and do not respond quickly enough. They may give a false alarm in response to exposure to other gases and pollutants found in manufacturing.

Remove carbon monoxide sources: Electric forklifts do not produce carbon monoxide, making them well-suited for drive-in coolers, loading semi-trailers, or other poorly ventilated locations. One plant switched to electric forklifts after two LPG forklifts caused carbon monoxide problems. Since the plant was air conditioned, they decided electric forklifts would work better for them than reducing CO emissions and providing adequate ventilation for their LPG forklifts.

For more information on CO, LPG forklift emission controls, and CO monitoring equipment, please contact Tom Greiner, (515) 294-0464 or x1grein@exnet.iastate.edu; or Dorothy Luecke, x1dlueck@exnet.iastate.edu; or visit the CIRAS website at: www.ciras.iastate.edu/.
November 11, 1999:
Seminar featuring ISU Center for Non-Destructive Evaluation, sponsored by CIRAS and Siouxland ASQ.  8:30-11:30 a.m.
Western Iowa Tech in Sioux City.  Contact Merle Pochop 712-274-0048

November 11, 1999
Manufacturing and Industrial Ergonomics,

November 12, 1999
Office Ergonomics.

December 9, 1999
Greater Quad Cities Minority Women and Small Business Owners Breakfast, 7:30-8:30 a.m., Lady Luck Casino Banquet Facility (Adjacent to the Hotel), Bettendorf, Iowa.
Cost $8.00. Register with Kathy Bryan, 1-800-458-4465 or 515-242-4949, e-mail: kathy.bryan@ided.state.ia.us.

February 9, 2000:
One-day workshop “What is the Goal? An Introduction to TOC” Location TBA in Waterloo.
Cost $199 for first person, $125 for each additional person from the same company. Register with Sarah Terrones 1-515-294-5008. For more information contact Tim Sullivan 515-965-9355.

Tuesdays from 6:00-8:00 p.m.:
Smart Start: Business Planning Workshop. ISU Research Park Conference Room.
Cost $10.00 per person. For information contact the ISU Business Development Center at 296-7828.

CIRAS is moving:
Our new location is:
2272 Howe Hall, Suite 2620
Iowa State University
Ames, IA  50011
515-294-3420

All phone numbers, fax numbers, and e-mail addresses will remain the same.
November 4, 1999:
*Siouxland ASQ Members Meeting, 6:00-8:00 p.m.*
Featured speaker Ray Martin, Gateway Computers “Managing Supplier Quality”. This meeting will be over the ICN. The origin site will be Sioux City. Members from the surrounding area will go to the site closest, or most convenient to them in Storm Lake, Ida Gove, and Sioux Center. For more information contact Merle Pochop, 712-274-0048.

November 8, 1999:
*ISO Quality Orientation Seminar 8:30 a.m.*

November 9, 1999:
*ISO Documentation Development, Quality Manual and Procedures, 8:30 a.m.*

November 10-12, 1999:
*ISO Quality System Internal Auditor Training.* Sessions begin at 8:30 a.m. Indian Hills Ottumwa Campus. For more information contact Dan Meyer, DIT, 515-682-8324. For registration contact Sarah Terrones 515-294-5008.

November 9-11, 1999:
*InfoIowa, Polk County Conference Center, Des Moines.* For information contact the Small Business Development Center at 515-292-6351.

November 11, 1999:
*Central Iowa Minority, Women and Small Business Owners Breakfast, 7:30-8:30 a.m.*
Holiday Inn 6th Avenue, Des Moines. Cost $8.00.
Register with Kathy Bryan, 1-800-458-4465 or 515-242-4949, e-mail: kathy.bryan@ided.state.ia.us.